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Contents

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Congenital Heart Defects and Non-Cardiac Malformations in Patients with Normal Karyotype

Preetha Tilak[1], Sonia Dhawan[2], Sayee Rajangam[3]

Abstract

Context: Present study is based on the available data on patients with heart defects. *Aim:* The presence of non-cardiac malformations in patients with heart defects and normal karyotype is reported. *Settings and Design:* Division of Human Genetics, St John's Medical College, Bangalore is a referral centre for genetic counseling. *Methods and Material:* Information was gathered from 10 male and 8 female patients. Their age ranged from neonates to 16 years. *Statistical analysis:* Percentage analysis is calculated. *Results:* A total of 26 CHDs were noted and 38 NCMs were observed in 5 systems (skeletal, central nervous, digestive, urogenital, respiratory system). Malformations noted in male were 22 (58%) and in female 16 (42%). Heart defects observed in male were 16 (61.5%) and in female 10 (38.5%). Malformations in 2 systems have occurred 9 times (50%); in which skeletal anomalies were 15 (39.5%). Single heart defects have occurred 12 times and in that ventricular septal defects were 7 times (27%). In male patients, skeletal anomalies (9), ventricular septal defects (4) and malformations in 2 systems (5) were prevalent. The association between the types of heart defects versus malformations showed that in male atrial septal defects were associated to 5 system anomalies and in female dextrocardia to 4 system anomalies. *Conclusions:* The study has reported the presence of 38 malformations in 18 patients with 26 heart defects and normal karyotype. Two system anomalies; defects in skeletal system and associations of malformations to ventricular septal defects were found to be frequent. Patients and families were counseled and were recommended for medical and surgical management of malformations and heart defects.

Keywords: Non-Cardiac Malformations; Congenital Heart Defects; Normal Karyotype; Genetic Counseling.

Introduction

The incidence of the congenital abnormalities in the newborns is reported to be around 2 to 3%. The reported overall prevalence of congenital heart defects (CHDs) is around 8 to 10 in 1000 births (Turnpenny and Ellard 2012). CHDs account for around 1/3rd of all congenital anomalies and are considered to be the major causal factor to infant mortality attributed to birth defects (Reller et al 2008).

Based on the method of ascertainment, the reported overall frequency of non-cardiac malformations (NCMs) among the individuals with CHDs is from 9 to 42% (Belisario et al 1981). For birth defects, such as CHDs and or NCMs, genetic etiology (chromosomal abnormalities or single gene disorder-Mendelian inheritance) and multifactorial mode of inheritance (genetic and or environmental factors) are the contributing factors (Rajangam et al 2015).

The present study is designed to include only those CHD patients with normal genetic profile. CHD patients in whom genetic causes have been identified as chromosomal abnormality and syndromes with Mendelian or sporadic occurrence are excluded.

It is Aimed to Assess

i. The presence of NCMs in CHD patients with normal karyotype;
ii. The occurrence of NCMs as per the systems of the body;
iii. The association between the types of NCMs and the types of CHDs.

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Material and Method

Eighteen patients with CHDs out of 65, referred consecutively for genetic analysis and genetic counseling to Division of Human Genetics, St.John's Medical College, Bangalore were selected for the study. They had CHDs, NCMs and normal karyotype. There were 10 male and 8 female patients and their age ranged from neo-nates to 16 years. From the available records, retrospectively, information on the presence of the types of CHDs and NCMs were gathered. Percentage analysis is calculated.

Results

The observed features in the patients were grouped under 5 major systems (central nervous/ skeletal/digestive/uro-genital/respiratory) of the body (developmental delay, poor weight gain, tired, mental retardation, hypotonia, spasticity, not attained head control, open mouth, high arched palate, large tongue, poor feeding, low set ears, clinodactyly, syndactyly, polydactyly, club foot, barrel chest, conical fingers, breathlessness, pulmonary hypopalsia, vesico-urethral reflex, hypoplastic genitalia).The findings from the 18 patients are tabulated.

Table 1: A total of 26 CHDs were noted in these patients. 38 NCMs were observed in 5 systems (SS-skeletal system, CNS-central nervous system, DS-digestive system, UGS: urogenital system, RS-Respiratory system). 22 NCMs (22/38, 58%) were noted in male and 16 (16/38, 42%) in female patients. 16 (16/26, 61.5%) CHDs were noted in male and 10 (10/26, 38.5%) in female patients.

Table 2: The affected systems in NCMs in male patients were 5 (SS, CNS, DS, UGS, RS) and in females were 4 (SS, CNS, DS, UGS). Likewise, the observed CHDs in male patients were 8 (VSD, ASD, PFO, PAH, murmur, double outlet right ventricle, PDA, pulmonary valve stenosis) and in female were 6 (murmur, VSD, ASD, dextrocardia, PAH, mitral valve stenosis). It is seen, that CHDs such as VSD, ASD, PAH and murmur were present in both sexes.

The distribution of NCMs were: skeletal system-SS:15 (15/38, 39.5%) (male 9; female 6); central nervous system-CNS:10 (10/38, 26.3%) (male 4; female 6); urogenital system-UGS:6 (6/38,15.8%) (male and female 3 each); digestive system-DS:6 (6/38, 15.8%) (male 5; female 1); respiratory system-RS:1 (1/38,2.6%) (male 1). In males, SS defects were found 9 times (9/22, 41%); whereas in females SS and CNS defects have occurred in equal numbers (6/16, 37.5%). In total SS anomalies have occurred 15 times (15/38, 39.5%).

Types of CHDs and their occurrence: VSDs: 7 times (7/26, 27%); murmur 4 times (4/26, 15.4%); ASD (3 times (3/26, 11.5%); PDA/dextroxardia/ mitral valve prolapsed/pulmonary valve stenosis/

Table 1: CHDs, NCMs, Normal karyotype

Serial No.	Male: CHDs	Karyotype/ NCMs
1	Ventricular septal defects (VSD)	46,XY,CNS/ SS
2	Atrial septal defects(ASD), patent foramen ovale (PFO)	46,XY,CNS/SS/DS
3	Murmur	46,XY,CNS/SS
4	ASD	46,XY,SS/RS/DS/UGS
5	Murmur	46,XY,SS/DS/UGS
6	Murmur	46,XY,SS/UGS
7	Double outlet right ventricle, VSD, pulmonary artery hypoplasia (PAH)	46,XY,SS/DS
8	Pulmonary valve stenosis, VSD	46,XY,CNS
9	PDA	46,XY,SS
10	Pulmonary tricuspid stenosis, VSD, PDA	46,XY,SS/ DS
Total	16 (61.5%)	22 (58%)
Serial No.	**Female: CHDs**	**Karyotype**
1	Murmur	46,XX,CNS/SS/UGS
2	Dextrocardia	46,XX,CNS/SS/DS
3	VSD	46,XX,CNS
4	VSD,ASD	46,XX,CNS/SS
5	Dextrocardia	46,XX,SS/UGS
6	VSD, PAH	46,XX,SS/UGS
7	Mitral valve prolapse	46,XX,CNS/SS
8	Mitral valve prolapse	46,XX,CNS
Total	10 (36.5%)	16 (42%)
Grand Total	26	38

Table 2: Systemic NCMs and CHDs in male and female

Systems	Male (n)	Female (n)	Total (n & %)
SS	9	6	15, 39.5
CNS	4	6	10, 26.3
DS	5	1	6, 15.8
RS	1	-	1, 2.6
UGS	3	3	6, 15.8
Total (n & %)	22 (58%)	16 (42%)	38
CHDs	Male (n)	Female (n)	Total (n & %)
VSD	4	3	7, 27
ASD	2	1	3, 11.5
PFO	1	-	1, 3.8
Murmur	3	1	4, 15.4
Double outlet right ventricle	1	-	1, 3.8
PAH	1	1	2, 7.7
Pulmonary valve stenosis	2	-	2, 7.7
PDA	2	-	2, 7.7
Dextrocardia	-	2	2, 7.7
Mitral valve prolapse	-	2	2, 7.7
Total (n & %)	16 (61.5)	10 (38.5)	26

pulmonary artery hyperplasia: 2 times each (2/26, 7.7%) and PFO/ double outlet right ventricle: one time each (1/26, 3.8%). It is VSD which has occurred 7 times (27%).

Table 3:It is seen, that NCMs in 2 systems have occurred 9 times (9/18, 50%) and in male 5 times (5/10, 50%) times.

It is single CHDs which have occurred 12 times (12/18, 66.7%).

Number of CHDs to Number of systems in Male and Female patients: In 5 patients one CHD each has affected 2 systems (3 males: VSD:CNS/SS, Murmur: CNS/SS; Murmur: SS/UGS); (2 females: dextrocardia: (SS/ UGS, mitral valve prolapse: CNS/SS). It is also seen in a male patient that one CHD has affected 4 systems (ASD-SS/RS/DS/ UGS).

Table 3: Association:CHDs and NCMs

Number and names of CHDs	Number of affected systems	Number of male patients	Number of female patients
One CHD: One system: One male/ 2 females: 3			
PDA	SS	1	-
VSD	CNS	-	1
Mitral valve prolapsed	CNS	-	1
One CHD: 2 systems : 3 males/ 2 females: 5			
VSD	CNS/ SS	1	-
Murmur	CNS/SS	1	-
Murmur	SS/UGS	1	-
Dextrocardia	SS/UGS	-	1
Mitral valve prolapse	CNS/SS	-	1
One CHD: 3 systems: 1 male/ 2 females: 3			
Murmur	SS/DS/UGS	1	-
Murmur	CNS/SS/UGS	-	1
Dextrocardia	CNS/SS/DS	-	1
One CHD: 4 systems: 1 male: 1			
ASD	SS/RS/DS/UGS	1	
2 CHDs: One system: 1 male: 1			
Pulmonary valve stenosis, VSD	CNS	1	-
2 CHDs: 2 systems: 2 females: 2			
VSD,ASD	CNS/SS	-	1
VSD, PAH	SS/UGS	-	1
2 CHDs: 3 systems: 1 male: 1			
ASD,PFO	CNS/SS/DS	1	-
3 CHDs: 2 systems: 2 males: 2			
Double outlet right ventricle, VSD, PAH	SS/DS	1	-
Pulmonary tricuspid stenosis, VSD, PDA	SS/ DS	1	-
26	38	10	8

Table 4: Association: Systems and types of CHDs

Systems versus number of CHDs	Types of CHDs	
	Male patients	Female patients
SS: 14 + 8= 22	VSD-3,ASD-2, PDA-2, Murmur-3, PFO, double outlet right	Murmur,Dextrocardia- 2, VSD-2
8+6=14	ventricle, PAH, Pulmonary tricuspid stenosis,	,ASD, Mitral valve prolapse,PAH
CNS: 6 + 7= 13	VSD-2 ,ASD, PFO, Murmur, Pulmonary valve stenosis	Murmur,Dextrocardia, VSD- 2,ASD,
5+5=10		Mitral valve prolapse-2
DS: 8 +1= 9	ASD- 2, PFO, VSD-2, Murmur,double outlet right ventricle, PAH, Pulmonary tricuspid stenosis, PDA	Dextrocardia
RS: 1	ASD	-
UGS: 3+ 4= 7	ASD,Murmur-2	Murmur,Dextrocardia,
2+4=6		VSD,PAH
34+20= 54	34	20
24+16=40	24	16

Table 4: Defects in SS were associated to 14 types of CHDs; defects in CNS were associated to 10 types of CHDs; defects in DS were associated to 9 types of CHDs; defects in UGS were associated to 6 types of CHDs and defect in RS to one type of CHD. SS (5 times) and CNS (4 times) were associated to VSDs (9 times).

The association between the types of CHDs versus NCMs showed that in male ASD was associated to 5 system anomalies and in female dextrocardia to 4 system anomalies.

Discussion

Review of literature showed that studies on non-cardiac or extra-cardiac malformations and CHDs have been carried out on live births or still births and as necropsy and autopsy studies.

Cardoso et al (2013) reviewed the association between CHDs and extracardiac malformations.

Scientific articles were searched in the Medline, Lilacs, and SciELO databases and all case series that specifically explored the association between CHDs and extracardiac malformations were included. CHDs were found to be responsible for about 40% of birth defects, being one of the most common and severe malformations. Extracardiac malformations were observed in 7 to 50% of the patients with CHDS, bringing a greater risk of co-morbidity and mortality and increasing the risks related to heart surgery. Different studies have attempted to assess the presence of extracardiac abnormalities in patients with CHDs and among the changes described, those of the urinary tract were more often reported.

In India, Karande et al (2014) have assessed the proportion and pattern of extracardiac birth defects in children with CHDs. They have found that out of 560 with CHDs, 98 (17.5%) had extracardiac birth defects. Fifty-six had multiple congenital defects; 36 were syndromic cases and 6 had laterality defects. A total of 386 extracardiac birth defects (103 major and 283 minor) were documented, with craniofacial and skeletal birth defects being the commonest.

From literature, it is seen that exactly matching the observations of the present study, articles could not be traced. The present study differs, because it is an attempt on NCMs in patients with CHDS without any genetic profile; such as chromosomal abnormalities or single gene disorders. Moreover, in spite of the sample size, the present study has tried to associate the types of NCMs with the types of CHDs. Of course, the high percentage of NCMs in skeletal system was similar to the reports by Greenwood et al (1975) and Karande et al (2014). Any differences may be attributed to the sample size and the method of assessment. With each discovery, knowledge on genes is becoming explosive. Nowadays, genes involved during development are also investigated. Some of them are segment polarity genes, homeo-box containing genes and paired-box containing genes. Examples are: Transcription factor β super family, Sonic hedgehog-Gli pathway, T-box genes, Zinc finger genes, SOX genes). They act as transcription factors in regulating sequentially the developmental processes and in cell signaling. Mutations in these genes resulting in malformations of the various systems of the body are also reported.(Turnpenny and Ellard 2012)

Genetic counseling (GC): During GC, diagnosis/ incidence/ risk assessment/ medical and surgical options/ support are communicated. In general, one in 20 (5%) or less is considered to be a low risk; whereas one in 10 (10%) or high is high risk. In case a definite genetic etiology could not be detected (chromosomal abnormalities, single gene disorders) then multifactorial inheritance could account for most of the congenital abnormalities. Based on

family and population studies for malformations, the observed or empirical risks are derived. For example: CHD: incidence is 8 in 1000 births; male to female sex ratio is 1: 1; parents unaffected; then the risk is around 1 to 4% for a second child to be affected; father is affected then it is 2%; mother is affected then it is 6%. (Turnpenny and Ellard 2012).

Conclusion

The primary outcome of the study is reporting the presence of 38 non-cardiac malformations and 26 CHDs in 18 patients with normal karyotype. 22 malformations were seen in 10 male and 16 in 8 female patients. The secondary outcomes are the frequent occurrence of the: 2 system anomalies (9 times); skeletal system defects (15 times) and associations of malformations to ventricular septal defects (9 times). Genetic counseling was provided to patients and families and they were recommended for medical and surgical management of CHDs and non-cardiac malformations.

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Original Article

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A Morphometric Study of Nutrient foramen of Tibia in East Godavari Region

Khalkho Anupam[1], Arjilli Vamsy[2]

Abstract

To have a better outcome for the surgical intervention of leg, taking consideration of the details of the nutrient foramen is of prime importance.The nutrient foramen is a canal with proximal groove which allows the nutrient artery to go through the bone and supply the medullary cavity and inner cortex of the bone, here it is the posterior tibial artery. The study was undertaken on 116 dried tibia from G.S.L Medical College Rajahamundry. The detail study of the nutrient foramen of tibia was done accounting its number, size, direction, foramina index and position of foramen with respect to soleal line. In 69 right sided tibia 84% of the cases have the nutrient foramen in the upper third and rest 16% were present in the miidle third of the bone, all directed downwards with 95% of cases directed lateral to soleal line whereas in 47 left sided tibia 85% of the cases it is placed in the upper third keeping rest 15% in the middle third of the tibia all directed downward with 93% of cases directed lateral to soleal line leaving 7% to be upon the soleal line. The present study was found to be in accordance to the previous studies done by various researches and agreed to the the same results as of this one. The knowledge of morphology of Nutrient foramen is applied by orthopaedic surgeons to perform various surgical intervention like fracture repair, bone grafting and bone transplantation.

Keywords: Foramina Index; Nutrient Foramen; Nutrient Artery; Bone Grafting; Bone Transplantation.

Introduction

Nutrient foramen is the foramen which is present on the shaft of long bone responsible for providing nutrition to the bones through the nutrient artery [14]. Nutrient foramen of long bones is observed by their elevated margins & the presence of groove proximal to it [5].

One or two diaphysial nutrient arteries enter the shaft obliquely through the nutrient foramina which lead into nutrient canals.Their sites of entry and angulation are almost constant and characteristically directed away from the dominant growing epiphysis.Nutrient arteries do not branch in their canals but divide into ascending and descending branches in the medullary cavity, these approaches the epiphysis dividing repeatedly into smaller helical branches close to the endosteal surface. The endosteal vessels are vulnerable during surgical operation such as intramedullary nailing, which involve passing metal implants into the medullary canal.

In tibia nutrient foramen lies near the soleal line transmitting the branch of the posterior tibial artery [14,15].

The study of the nutrient foramen holds an utmost importance in various clinical entities as it carry artery which is responsible for the supply of the bone [13].

Henceforth data pertaining to location of the nutrient foramen of the long bones is an essential prerequisite for the surgeons to perform various surgical procedures which will have a commendable outcome [2,3].

Also studying the morphometric measurements of the bone and nutrient foramen is useful for determining the whole length of a bone adding importance in some medicolegal aspects [4].

Preservation of the nutrient blood supply is considered as one of the most important aspects in promoting repair in vascular bone grafting [1,7].

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Several studies were performed determining the details of the nutrient foramen of the long bones.The present study has been undertaken to determine the morphology of the nutrient foramen of tibia in the body & comparing with the findings of the studies done previously.

Material and Methods

The study of 116 washed and dried tibia was done in G.S.L Medical College Rajahmundry. Deformed bones were excluded from the study. Age and gender of bone were not taken into account and to determine the sides of the bone universally accepted rules were followed. In the present study all the measurements were taken using sliding Vernier calliper and hypodermic needle of 24 gauge.

The following Observations were Taken

1.Number of nutrient foramen.

2.Type as Dominant or Secondary foramen.

3.Location as in upper 1/3rd, middle 1/3rd or lower 1/3rd - It was determine by the help of Foramina index (FI) using the formula:

FI = DNF/TL X 100

DNF – the distance from the proximal end of the bone to the nutrient foramen.

TL – total length of the bone.

Fig. 1: A photograph showing measurement of total length of the Right tibia measured by Vernier sliding calliper

Fig. 2: A photograpgh showing the measurement of DNF (distance from the proximal end of the bone to nutrient foramina using Vernier sliding calliper

The position of the Nutrient foramen was grouped into three types according to FI as follows [12]:

Type 1 – FI from 01 to 33.33

Nutrient foramen is in the proximal third of the bone

Type 2 – FI from 33.34 to 66.66

Nutrient foramen in the middle third of the bone

Type 3 – FI above 66.67

Nutrient foramen in the distal third of the bone

4. Location with respect to soleal line (medial, lateral or upon soleal line) was observed [8,14].
5. Size of the nutrient foramen – Nutrient foramen equal or larger than the size of 24 gauge hypodermic needle having the diameter of 0.56 mm were considered as Dominant nutrient foramen and less than this as the Secondary nutrient foramen [5].
6. Direction of the nutrient foramen – fine wire used to observe the direction & obliquity of the foramen [5].

Results

This study was undertaken on 116 dried tibia among which 69 were of right side & 47 left sided.

In right sided tibia 69 nutrient foramens were observed all directed downwards, of which 60 were the Dominant nutrient foramen & rest 9 were Secondary. By using foramina index it was stated that 58 of the Nutrient foramen were located in the upper third of the bone & remaining 11 were present in the middle third of the bone.With respect to soleal line 66 nutrient foramen were lateral to the soleal line & 3 were present upon it (Table 1,2 & 3).

Table 1: Type of Nutrient foramen and direction of foramen

Type of foramen	Right sided tibia direction	Left sided tibia direction
Dominant foramen	60, downward	38, downward
Secondary foramen	9, downward	9, downward
Dominant + Secondary Foramen	0	0

In left sided tibia 47 nutrient foramen were observed, all directed downward, 38 of them were considered as the Dominant nutrient foramen leaving other 9 as the Secondary one.Coming to the location using foramina index, 40 of the nutrient foramen were found to be in the upper third of the bone & rest 7 were in the middle third of the bone.With respect to soleal line, only 3 nutrient foramen were present on the soleal line, rest were found to be lateral to the soleal line (Table 1,2 & 3).

Fig. 2: A photograph showing the location of nutrient foramen in Right tibia in the upper third lateral to soleal line and directed downward sized .56mm

Table 2: Location of the Nutrient foramen

Sample side & Number	Upper 1/3rd	Middle 1/3rd	Lower 1/rd
Right (69)	58	11	0
Left (47)	40	7	0

Fig. 3: A photograph showing the location of the nutrient foramen upon the soleal line in the upper third of the three Right tibia (directed downwards)

Table 3: Nutrient foramen with respect to soleal line

Sample size and Side	Lateral to sole al line	Medial to sole al line	On sole al line
Right (69)	66	0	3
Left (47)	44	0	3

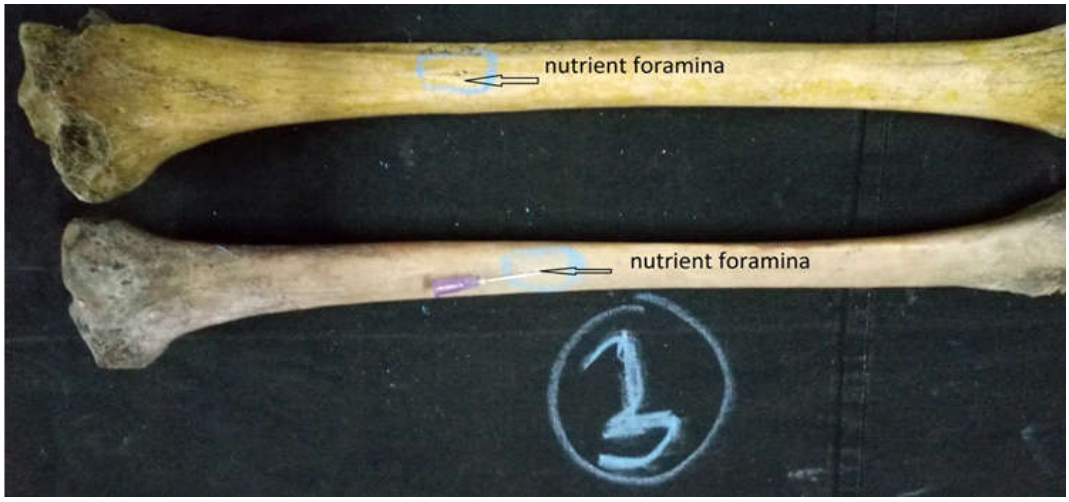

Fig. 4: A photograph showing the location of the nutrient foramen (lateral) in two of the tibia (directed downwards)

Table 4: Calculation of the Foramina index of the Right tibia

S. No of Right tibia	T.L	DNF	Type of Foramen	Direction	Foramina Index(FI) FI= DNF/TL X 100	Location	Sole al line
1.	35	19.6	D	downward	56	M1/3rd	L
2.	35.5	10.2	**S**	downward	28.7	U 1/3rd	L
3.	37	11.2	D	downward	30.27	U 1/3rd	L
4.	36	12.9	D	downward	35.8	M 1/3rd	L
5.	36.2	8.7	D	Downward	24	U 1/3rd	L
6.	34.5	10.6	D	Downward	30.7	U1/3rd	L
7.	36.3	12.1	D	Downward	33.33	M1/3rd	L
8.	35.5	11.6	D	Downward	32.6	U1/ 3rd	L
9.	38.2	13.2	D	Downward	34.5	M1/3rd	L
10.	35.4	9.2	D	Downward	25.9	U1/3rd	On sole al line
11.	38.1	12.4	D	Downward	32.5	U1/3rd	L
12.	35.8	11.3	D	Downward	31.5	U1/3rd	L
13.	33.9	11.7	D	Downward	34.5	M1/3rd	L
14.	36.1	10.1	**S**	Downward	27.9	U1/3rd	L
15.	41.4	13.2	D	Downward	31.8	U1/3rd	L
16.	38.5	10.2	D	Downward	26.4	U1/3rd	L
17.	34.9	8.2	D	Downward	23.4	U1/3rd	L
18.	34	10.6	**S**	Downward	31.1	U1/3rd	L
19.	35.6	10.2	D	Downward	28.6	U1/3rd	L
20.	36.5	11.6	D	Downward	31.7	U1/3rd	L
21.	36.6	9.3	D	Downward	25.4	U1/3rd	L
22.	36.8	11.8	D	Downward	32	U1/3rd	L
23.	38.9	9.8	D	Downward	25.1	U1/3rd	L
24.	35.8	10.2	D	Downward	28.4	U1/3rd	L
25.	38.2	11.1	D	Downward	29	U1/3rd	L
26.	39	14.9	D	Downward	38.2	U1/3rd	L
27.	35.7	10.4	D	Downward	29.1	U1/3rd	L
28.	34	8.3	D	Downward	24.4	U1/3rd	L
29.	33.3	11.4	D	Downward	34.2	M1/3rd	L
30.	39.5	11.6	D	Downward	29.3	U1/3rd	L
31.	35.4	7.4	**S**	Downward	20.9	U1/3rd	L
32.	37.4	10.4	D	Downward	27.8	U1/3rd	L
33.	38	11.9	D	Downward	31.3	U1/3rd	L
34.	36.6	11.8	D	Downward	32.2	U1/3rd	L
35.	36.6	9.4	D	Downward	25.6	U1/3rd	L
36.	37	14.5	D	Downward	39.1	M1/3rd	L
37.	37.7	10.4	D	Downward	27.5	U1/3rd	L
38.	32.2	10.2	D	Downward	31.6	U1/3rd	L
39.	40.1	12.1	D	Downward	30.1	U1/3rd	L
40.	39.4	14	D	Downward	35.5	M1/3rd	L

41.	37.5	13.4	D	Downward	35.7	M1/3rd	L
42.	38.7	10.4	D	Downward	26.8	U1/3rd	L
43.	35.4	10.5	D	Downward	29.6	U1/3rd	L
44.	34.8	11.8	D	Downward	33.9	M1/3rd	L
45.	38.5	12.6	D	Downward	32.7	U1/3rd	L
46.	36.3	10.3	D	Downward	28.3	U1/3rd	L
47.	31.8	9.3	**S**	Downward	29.2	U1/3rd	L
48.	33.6	11.4	D	Downward	33.9	U1/3rd	L
49.	36.8	10.4	D	Downward	28.2	U1/3rd	L
50.	31.3	8.6	**S**	Downward	27.4	U1/3rd	L
51.	31.7	9.4	D	Downward	29.6	U1/3rd	L
52.	27.4	7.5	D	Downward	27.3	U1/3rd	L
53.	38.8	10.2	D	Downward	26.2	U1/3rd	L
54.	29.5	10.1	D	Downward	34.2	M1/3rd	L
55.	34.8	11.4	D	Downward	32.7	U1/3rd	L
56.	36	11.3	D	Downward	31.3	U1/3rd	L
57.	32.6	9.8	D	Downward	30	U1/3rd	L
58.	35.4	10.9	D	Downward	30.7	U1/3rd	On sole al line
59.	37.2	13	D	Downward	34.9	M1/3rd	L
60.	36.8	9.8	D	Downward	26.6	U1/3rd	L
61.	35.2	11.3	D	Downward	32.1	U1/3rd	L
62.	36.9	11.4	D	Downward	30.8	U1/3rd	L
63.	36.7	11.4	D	Downward	31	U1/3rd	L
64.	37.2	11.5	D	Downward	30.6	U1/3rd	L
65.	37.8	12	**S**	Downward	31.7	U1/3rd	L
66.	39.4	10.4	D	Downward	26.3	U1/3rd	L
67.	32.6	9.8	**S**	Downward	30	U1/3rd	L
68.	33.8	11	**S**	Downward	32.5	U1/3rd	L
69.	32.6	9.8	D	Downward	30	U1/3rd	L

S. No of Left tibia	T.L	DNF	Type of foramen	Direction	Foramina Index(FI) FI=DNF/TL X100	Location	Sole al line
1.	33	13.2	D	Downward	40	M1/3rd	L
2.	36.2	11.4	D	Downward	31.4	U1/3rd	L
3.	38.2	11.8	D	Downward	30.8	U1/3rd	L
4.	34.8	9.4	D	Downward	27	U1/3rd	L
5.	37.4	10.5	D	Downward	28	U1/3rd	L
6.	37.5	15.3	**S**	Downward	40.8	M1/3rd	L
7.	38.6	11.4	D	Downward	29.5	U1/3rd	L
8.	34.2	11.2	D	Downward	32.7	U1/3rd	L
9.	37.2	11.1	D	Downward	29.8	U1/3rd	On soleal line
10.	35.3	12.8	D	Downward	36.2	M1/3rd	L
11.	40.1	11.8	D	Downward	29.4	U1/3rd	L
12.	35.6	10.9	D	Downward	30.6	U1/3rd	L
13.	38.5	11.8	D	Downward	30.6	U1/3rd	L
14.	40	10.4	D	Downward	26	U1/3rd	L
15.	38.5	11.6	D	Downward	30.1	U1/3rd	L
16.	39	9.4	D	Downward	24.1	U1/3rd	L
17.	34.4	10.6	D	Downward	30.8	U1/3rd	L
18.	35.9	10.3	D	Downward	28.6	U1/3rd	L
19.	40	12.6	D	Downward	31.5	U1/3rd	L
20.	37.5	10.2	D	Downward	27.2	U1/3rd	L
21.	36	9.8	D	Downward	27.2	U1/3rd	L
22.	38.7	11.2	D	Downward	31.3	U1/3rd	L
23.	38.1	10.6	D	Downward	27.8	U1/3rd	L
24.	28.6	7.4	**S**	Downward	20.9	U1/3rd	L
25.	39.3	9.8	D	Downward	24.9	U1/3rd	L
26.	36.8	12.6	D	Downward	34.4	M1/3rd	L
27.	35.8	10	D	Downward	27.9	U1/3rd	L
28.	33.4	11.1	D	Downward	33.2	U1/3rd	L
29.	35.3	10.8	**S**	Downward	30.5	U1/3rd	L
30.	36.3	11.3	D	Downward	31.1	U1/3rd	L
31.	33.2	9.5	D	Downward	28.6	U1/3rd	L

32.	32.6	10.4	**S**	Downward	31.9	U1/3rd	L
33.	35.7	10.8	**S**	Downward	30.2	U1/3rd	L
34.	37.8	10.1	D	Downward	26.7	U1/3rd	On sole al line
35.	35.6	13.1	D	Downward	36.7	M1/3rd	L
36.	38.3	11.4	D	Downward	29.7	U1/3rd	L
37.	32.7	10.1	**S**	Downward	30.8	U1/3rd	L
38.	31.5	9.7	D	Downward	30.7	U1/3rd	L
39.	33.8	11.4	D	Downward	34.5	M1/3rd	L
40.	36.8	23.4	D	Downward	63.5	M1/3rd	L
41.	38.5	11	D	Downward	28.5	U1/3rd	L
42.	34.8	9.4	**S**	Downward	27	U1/3rd	L
43.	36.6	10.2	D	Downward	27.8	U1/3rd	L
44.	36.6	10.9	D	Downward	29.7	U1/3rd	L
45.	39.6	12.4	**S**	Downward	31.3	U1/3rd	L
46.	38.1	12.2	D	Downward	32	U1/3rd	L
47.	36.7	11.4	**S**	Downward	31	U1/3rd	L

Discussion

In present study of 116 dried tibia 84% of the Nutrient foramen of the right side was located in the upper third of the bone & 85% were present in the upper third of the bone in the left sided tibia. Only 16% & 15% Nutrient foramen of the right & left sided respectively were found to be in the middle third of the bone. Distal third of the bone was devoid of Nutrient foramen suggesting that any injury leading to fracture will take more time in healing and repair or at times may go in phase of malunion [5,10].

This study of location of the Nutrient foramen was in accordance with the previous studies. Longia (1980) showed the location of the Nutrient foramen to be in the upper third of the bone in 91.0% of the cases whereas Krischner (1998) came up with the conclusion that Nutrient foramen was present in the upper third in 93.50% of the cases. Also Tejwasi H.L (2014) got the Nutrient foramen in the upper third in 94.90% of the cases [6,15].

In the present study all the Nutrient foramen were seen to be positioned on the posterior surface of the tibia directed downward and lying lateral to the soleal line.

In 95% cases of the right side it was lateral to soleal line whereas on the left side it was found to be in 93% of the cases.Similar findings were reported by Collipal (2007). He reported the Nutrient foramen to be lateral to soleal line in 94.33% of cases [3]. On the other hand Tejaswi H.L (2014) it was in 95.7% of cases [15].

Conclusion

The present study was in accordance and is confirmatory with the data given by the previous studies done by various researches. It provides useful information pertaining to the Nutrient foramen of the tibia and will surely help the surgeons to salvage the Nutrient artery while performing important surgical intervention like bone grafting and fracture repair.

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Dimension of Trachea on Various Parameters in Male and Female Cadavers from Western Maharashtra, India

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Abstract

Aim: To study the dimension of trachea on various parameters in male and female cadavers from Karad, Maharashtra, India. *Objectives*: The present article is based on the study of the shape of tracheal opening, an anatomical measurement of length, diameters and the angle of bifurcation of the adult trachea in cadavers from western India and their sexual dimorphism. *Materials and Method*: The cadaveric specimens of adult trachea comprising of 20 males and 20 females were studied. The length of the trachea, the internal and external transverse diameter at upper and lower end and the angle of bifurcation was measured. The shapes of the tracheal opening were noted by making the cross section of trachea at the inferior border of cricoid cartilage. Mean and standard deviation were calculated for all parameters. Sexual differences between the mean of measurements were calculated by applying unpaired student't' test. *Results:* Significant difference was seen in the length and the transverse diameter of the trachea between the male and female. There was no significant difference seen in the thickness of the posterior membrane as well as the angle of bifurcation of trachea. *Conclusion:* It may have their clinical implication in the maintenance of airways in anesthesiology and emergency medicine.

Keywords: Trachea; Airways; Oropharynx; Sub Carinal Angle.

Introduction

The trachea an unpaired organ, located in the midline and functions to conduct air from the oropharynx to the lungs. The position in the neck is superficial and follows an oblique course and is well protected in middle of the mediastinum [1]. It is important to realize that the human trachea is a dynamic distensible organ of continuously varying size, shape and tone. Tracheal shape and circumference also alter with posture particularly with position of head in relation to the rest of the body, coughing, inspiration, expiration and during mechanical ventilation [2].

Since it has become very essential to obtain the dimension of trachea in order to prevent the complication of commonly used technique of endotracheal intubation in anesthesiology and other medical emergencies. Information's are available regarding the dimensions of human trachea and tracheobronchial angle in the Caucasians for western countries as well as of a few regions of India. Therefore, the present study has been carried out to observe the dimensions of various parameters and shape of adult trachea in the cadavers of eastern India.

Material and Method

Present Study was performed at Department of Anatomy, Krishna Institute of Medical Science Karad, Maharashtra, India. Ethical clearance was taken from the institutional ethics board. For the purpose of study 40 adult tracheas comprising of 20 males and 20 females were collected from the cadavers used for the dissection by the undergraduate students in the department of anatomy.

During the process of routine dissection in the neck and superior mediastinum the relation of important structures around the trachea were identified. In the thorax heart was removed from

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the middle mediastinum and also both the lungs were separated from the principal bronchi close to the surface of the lung. The trachea was completely exposed by removing thyroid gland from its position and by cutting the major blood vessels in the thorax. At the upper region trachea was cut along with the cricoid cartilage and was taken out and cleaned the connective tissue from its surface. The trachea was cut along the inferior margin of cricoid cartilage and the shape of the upper end was recorded.

Placing the trachea straight on a graph sheet on a smooth wooden surface the length of the trachea was measured in centimeter by taking two points between upper ends of trachea from the inferior border of cricoid cartilage to the inferior margin of the bifurcation of the trachea. Using a digital Vernier calipers with an accuracy of 1mm the outer and inner transverse diameter of the upper end was recorded in millimeter, and the similar measurement was taken for the lower end by cutting the cross section just proximal to the tracheal bifurcation. For subcarinal angle the trachea was placed straight on the graph sheet. A median line was drawn in the midline of the tracheal length, which was extended caudally.

In relation with median line a straight point was taken on the medial margin of the right bronchus and similar point were taken on the medial margin of the left bronchus. Two points on each margin were joined together by a line AA′ for right and BB′ for left and were extended upwards until the two lines were intersected and formed an angle facing downward which was taken as the total sub carinal angle.

The angle between the median line and the medial margin of right bronchus was taken as right bronchial angle (RBA) and the angle between the median line and the medial margin of left bronchus was taken as left bronchial angle (LBA). Mean and standard deviation were calculated for all parameters.

Statistical Analysis

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 15 (SPSS Inc. Chicago, IL, USA) Windows software program. Descriptive statistics included computation of percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively. Sexual differences between the mean of measurements were calculated by applying unpaired student't' test.

Results

In the present study the total length of trachea in case of male was ranged from 10cm to 12.30cm (mean 11.13±0.713) and in female it was ranged from 8.30cm to 11cm (mean 9.58±0.752) (Table 1). Significant difference was seen between the tracheal length in male and female. The outer transverse diameter at the upper end in case of male was ranged from 19mm to 26.50mm (mean 22.80±2.14) and in female it was ranged from 13mm to 19mm (mean 15.07±1.69). The inner transverse diameter of male at the upper end was ranged from 11mm to 21mm(16.95±2.62) and in female it was ranged from 8.90mm to 13.7mm (11.03±1.59). In the lower region just proximal to the tracheal bifurcation the outer transverse diameter in case of male was ranged from 21.10mm to 29.80mm (mean 25.13±2.039) and in case of female it was ranged from 18.10mm to 32.80mm (mean 20.72±3.063).

The inner transverse diameter in the lower end in case of male was ranged from 17.20 mm to 24mm (mean 20.10±1.88) and in case of female it was ranged from 14.10mm to 17.10mm (mean 15.85 ±1.051). Highly significant difference was seen in outer and inner transverse diameter at both upper and lower end of the trachea between male and female (Table 1).

Thickness of the posterior membrane at the upper end in case of male was ranged between 1.90mm to 4.5mm (mean 3.115±0.716) and in case of female it was ranged between 1.80mm to 4.10mm (mean 2.96±0.710). There was no significant difference seen in the thickness of the posterior membrane between male and female. The subcarinal angle in case of male was ranged between 45^{o} to 96^{o} (mean 72.15±1.38) and in case of female it was ranged between 58^{o} to 70^{o} (mean 70.60±7.75). The RBA in case of male was ranged between 14^{o} to 45^{o} (mean 29.95±8.80) and in the female it was ranged between 21^{o} to 40^{o} (mean 28.05±4.89). On the other hand, the LBA in the male was ranged between 28^{o} to 51^{o} (mean 42.70±7.76) and in female it was ranged between 28^{o} to 52^{o} (mean 42.55±5.808). No significant difference was seen in tracheobronchial angles between male and female.

Based on the study done by Mehta and Myat[2] the cross sectional shape of 20 male tracheal openings were found to be D shaped in 11, E shape in 5, U shaped in 3 and C shaped in 1 cases. Whereas in case of female out of 20 specimens 10 were D shaped, 6 were U shaped, 3 were E shaped and 1 was C shaped.

Table 1: OTDU-Upper outer transverse diameter, ITDU-Upper inner transverse diameter, OTDL-Lower outer transverse diameter, ITDL-Lower inner transverse diameter, SCA-Subcarinal angle, RBA-Right bronchial angle, LBA-Left bronchial angle, TPM-Thickness of posterior membrane, M-Mean, STD-Standard deviation

No	Male	Female	P value
Total M	11.13	9.58	0.001*
Length N	20	20	
STD	±0.713	±0.75	
OTDU M	22.80	15.07	0.003*
N	20	20	
STD	±2.14	±1.69	
ITDU M	16.95	11.03	0.01*
N	20	20	
STD	±2.82	±1.59	
OTDL M	25.13	20.72	0.001*
N	20	20	
STD	±2.04	±3.06	
ITDL M	20.10	15.85	0.05*
N	20	20	
STD	±1.88	±1.05	
SCA M	72.15	70.60	1.23
N	20	20	
STD	±1.39	±7.75	
RBA M	29.95	28.05	0.45
N	20	20	
STD	±8.80	±4.89	
LBA M	42.70	42.55	0.87
N	20	20	
STD	±7.62	±5.80	
TPM M	3.12	2.96	0.90
N	20	20	
STD	±0.72	±0.71	

* indicates statistically significance at $p \leq 0.05$

Discussion

Engel in 1962 reported that the length of the trachea in adults is 9 to 15cm [3]. William et al has reported that the length of the adult trachea is 9 to 11cm [4]. Series of the data regarding the length of trachea has been reported by Harjeet and Inderjeet ranging from mean of 82.43±5.79 to 91.85±6.55 in the various age groups of northwest Indian population [5]. In the present study the mean tracheal length in case of male was 11.17±0.69cm and in case of female it was 10.1±0. 98cm. There was significant difference seen between the male and female tracheal length (p=0.03, <0.05). The length of the trachea in this study is found to be in a higher range than those of previous study, this could be due to the difference in the methodology as the tracheal length in this case was taken from inferior border of cricoid cartilage to the inferior margin of carina. Various authors have studied the tracheal diameters. In a cadaveric study done by Jesseph and Merindino in an age group of 13 to 86 years the mean tracheal diameter was found to be 22.0±2.6 in male and 17.0±2.2 in female [6]. Fraser RG has reported mean value of tracheal diameter of 19.5 in male and 15.5 in female. In a radiological study done by Breatnach et al. they have recorded a mean value of 19.58±2.25 in male and 16.57±2 in female [7]. In the present study the upper outer and upper inner transverse diameter in male were 22.80±2.14 and 16.95±2.82 and in female 15.07±2.039 and 11.03±1.59 respectively. The lower outer and lower inner transverse diameter in male were 25.13±1.78 and 20.10±1.88 and in female 20.72±3.063 and 15.85±1.051 respectively. Significant difference in the transverse diameter seen at both the level between male and female.

The thickness of posterior membrane at the upper end in case of male was 3.09±0.187 and in female 2.85±0.79 and there was no significant difference seen between the two sexes. This finding resembles with the finding of Harjeet and Inderjeet who has reported that the thickness of posterior membrane was almost similar in both the sexes after 46 years of age [5].

Radiological study by Haskin and Goodman have reported the subcarinal angle in degree of 62.0±11.97 in male and 60.9±10.99 in female [8]. Kher and

Makhani have reported that the average angle of bifurcation in case of adult ranges from 30-105 degrees [9]. Harjeet and Inderjeet have recorded the value of subcarinal angle in degree ranging from 43.50±10.12 to 57.21±12.97 in a various age group of adult male and 50±15.44 to 69.29±5.18 in different age group of adult female. In the present study the subcarinal angle in male was 73.39±13.96 and 70.14±9.75. RBA in male was 30.65±8.68 and in female 28.57±3.15 and LBA in male was 43.73±7.72 and in female 40.14±7.08. The data of the present finding seems to be little higher than the one recorded by previous authors and also the result did not show any significant difference between male and female.

Campbell and Liddellow [10], Mehta and Myat [2] have described the incidence of various shapes of the trachea in cross sections. But there is no unanimity in the classification of the various shapes. In this study 55% of adult male had D shaped tracheal opening followed by E shaped in 25% and in female it was 50% D shaped and 30% U shaped respectively. Whereas Harjeet and Inderjeet did not find 'U' shaped trachea in female.

Conclusion

Besides some parameters in adult trachea, the other dimensions are significantly larger in male than in female possibly a result of the difference in its growth rate. This could probably be helpful in anesthesiology for selecting the appropriate size of endotracheal tube and to minimize the hazard out of it. The limitation of the present study would be the cadavers utilized in the material were embalmed for variable period which could affect the results in the tracheal morphometry. Hence it is highly suggested to carry out the similar study in tracheal sample obtained from fresh cadavers with proper ethical clearance.

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Original Article

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Role of Anatomy Dissection in This Digital Era: A Cross Sectional Study on Medical Students Perceptions

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Abstract

Introduction: Human cadaveric dissection is most routinely practiced method of learning anatomy for medical students since many years. With the use of technological advancements in teaching and learning methods, there has a high risk of reduction in human cadaveric dissection as a method of learning in this modern digital era. *Aims & Objectives:* The present study was done to analyse the medical student's preferences regarding the teaching and learning methods of human anatomy and to analyze the perceptions regarding anatomy dissection. *Material and Methods:* The sample constituted 346 randomly selected medical students from the medical institute of Navi Mumbai, Maharashtra. The present cross sectional study was conducted using a simple random sampling. *Result:* Total 346 students were participated in the present study. The mean age of the participants was 19.54 (±1.24) years. Males & females constituted 45.7% & 54.3% respectively of total study population. Dissection was ranked as the most preferred method by 246 (71.1%) by the students, followed by lectures 44 (12.7%) and textbooks 30 (8.7%) over the least preferred methods such as demonstrations 20 (5.8%) and computer assisted learning 6 (1.7%). Strong positive agreement was displayed by the students for items describing that dissection still the best method of learning anatomy 334 (96.5%) and dissection helps in feeling more comfortable with patients subsequently 332 (96%). Strong negative agreement was displayed by the students for items describing that dissection is boring and less informative method 282 (81.5%) and there are other better methods as dissection is outdated 268 (77.5%). *Conclusion:* This study has revealed that medical students still rated anatomy dissection as a most preferred method of learning anatomy, despite technological advancements.

Keywords: Anatomy Dissection; Medical Students; Perceptions; Questionnaire.

Introduction

The word anatomy is derived from the Greek word 'anatome' means cutting up. Anatomy, the study of the structures of the human body is one of the first, most basic and important subjects studied by medical students when they begin their medical education career [1]. Anatomical knowledge is of critical necessity in clinical examination of patients, diagnosis of diseases and consultation with other medical personnel [2]. Anatomy has been taught by using different learning methods such as didactic lectures, demonstrations, cadaveric dissection and living anatomy, as well as newer methods such as problem-based learning, computer based learning, 3D models, plastinated models, body painting, holograms.

The Anatomy dissection has remained an important part of medical curricula across all over the world. All professional anatomical associations and societies clearly mention that human cadaveric dissection is a backbone of medical knowledge for medical students. The practice of cadaveric dissection allows students grasp the three dimensional anatomy and concept of biological variability [3]. In addition it also plays important role in shaping the medical students attitudes to life and death [4].

Anatomy teaching in medical colleges has been traditionally based on the use of human complete cadaveric dissection or as prosected specimens [5]. There is little debate on the best mode of teaching and learning method in anatomy, some authors states that prosected specimens can impart similar knowledge as traditional dissection [6], while others

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state that traditional dissection has great advantage [7]. Moreover, the cadaveric dissection has been identified by some scholars as expensive, time consuming and potentially hazardous [8].

Unfortunately, with reduced time available for anatomy teaching and advancements of newer technologies in teaching & learning methods, there has been significant reduction in cadaveric dissection as a method of anatomical learning. There is no much data from India on perceptions of anatomy dissection from the student's perspective. The present study is aimed to assess the student preferences regarding the learning methods of human anatomy and to analyze the perceptions of the medical students on human anatomy dissection

Materials and Methods

Study Design

The study was a cross sectional study.

Study Site

The study was conducted in the medical institute of Navi Mumbai, Maharashtra, India.

Study Population

The population of this study consisted of first year completed medical students who were selected by random sampling method.

Sample Size

Total 346 medical students selected from the medical institute were included in the study.

Study Tools

This study was conducted by using predesigned valid questionnaire. The questionnaire was based on review of literature and similar studies conducted elsewhere. The predesigned questionnaire included three broad categories with six items evaluating positive perception, six items evaluating negative perception and a question comparing dissection with other modes of teaching. The purpose of the study was explained and consent was obtained from the students.

Ethical Approval

Considering the observational nature of the study and no likelihood of any potential harm to the subjects, no formal ethical approval was taken from institutional ethics committee. Informed written consent was obtained from all the participants. Confidentiality of the study participants was maintained throughout the study.

Statistical Analysis

The IBM SPSS statistics version 21 was used for analysis of data. Socio-demographic parameters of the students such as male-female ratio, internet usage pattern, medium of education etc. were considered as primary explanatory variables. The perceptions regarding teaching and learning methods of human anatomy were taken as primary explanatory variables. Categorical variables were presented as frequencies and percentages. Quantitative variables were presented as mean and standard deviation.

Result

A five-level Likert scale was used to collect data from participants. Positive-key items are items that are phrased such that an agreement with the item represents a relatively high level of the measured attribute. Each item was rated on a five-level scale (SA=5, A=4, NAND=3, D=4 and SD=5).

Negative-key items are also phrased items so that an agreement with the item represents a relatively low level of the measured attribute. Reverse scoring was applied to the negative items. For positive perceptions, strongly agree and agree levels were taken as correct responses while for negative perceptions, strongly disagree and disagree were taken as correct responses by medical students.

A total of 346 medical students were included in the present study. The mean age of the participants was 19.54 (±1.24) years. Males constituted 45.7% of the study population while females constituted 54.3% of study population. The medium of education was English in majority (97.1%) of the study population, with only 10 (2.9%) of the subjects were from local language i.e. Marathi.

Majority 212 (61.3%) of the participants, reported to be moderate user of internet, another 108 (31.2%) of participants reported high use. Only 26 (7.5%) participants reported occasional low use. The proportion of students, included from second year, third first year and third second year were 34.7%, 32.4% and 32.9% respectively in study population (Table 1).

Dissection was ranked as the most preferred method by 246 (71.1%) of the students, followed by lectures 44 (12.7%) and text books 30 (8.7%). Demonstrations and computer assisted learning were ranked as the preferred methods by very few students 20 (5.8%) and 6 (1.7%) respectively (Table 2).

Strong positive agreement was displayed by the students for items describing that dissection still the best method of learning anatomy 334 (96.5%) and dissection helps in feeling more comfortable with patients subsequently 332 (96%). The agreement was moderate for items describing dissection gives overall perspective of human anatomy 318 (91.9%) and dissection is exciting and interesting method 306 (88.4%). The agreement was poor for items describing dissection feels different from other non medical peers 290 (83.8%) and it provides more opportunities to develop professional skill 288 (83.2%) (Table 3).

Table 1: Socio-demographic parameters of study population (N=346)

Parameters	Frequency and percentage
Mean Age (mean ± SD	19.54 ± 1.24
Gender	
Male	158 (45.7%)
Female	188 (54.3%)
Medium of Education	
Marathi	10 (2.9%)
English	336 (97.1%)
Self-reported internet use	
Low users	26 (7.5%)
Moderate users	212 (61.3%)
High users	108 (31.2%)
Year of Study	
Second year	120 (34.7%)
Third I year	112 (32.4%)
Third II year	114 (32.9%)

Table 2: Most preferred learning method of human anatomy (N=346)

Learning Method	Frequency	Percentage
Dissection	246	71.1
Lectures	44	12.7
Demonstrations	20	5.8
Text books	30	8.7
Computer assisted learning	6	1.7

Table 3: Positive perceptions of medical students regarding human dissection

	Parameters	SA	A	NAND	D	SD	Overall correct perception	Overall wrong perception
	Positive Perceptions							
1.	Dissection still best method of learning anatomy	242 (69.9%)	92 (26.6%)	4 (1.2%)	8 (2.3%)	0 (0.0%)	334 (96.5%)	12 (3.5%)
2.	It is exciting and interesting method	200 (57.8%)	106 (30.6%)	24 (6.9%)	10 (2.9%)	6 (1.7%)	306 (88.4%)	40 (11.6%)
3.	It helps in feeling more comfortable with patients subsequently	214 (61.8%)	118 (34.1%)	12 (3.5%)	2 (0.6%)	0 (0.0%)	332 (96.0%)	14 (4.0%)
4.	It provides more opportunities to develop professional skills.	182 (52.6%)	106 (30.6%)	48 (13.9%)	8 (2.3%)	2 (0.6%)	288 (83.2%)	58 (16.8%)
5.	It gives overall perspective of human anatomy	202 (58.4%)	116 (33.5%)	26 (7.5%)	2 (0.6%)	0 (0.0%)	318 (91.9%)	28 (8.1%)
6.	It feels me different from other non medical peers	168 (48.6%)	122 (35.3%)	40 (11.6%)	12 (3.5%)	4 (1.2%)	290 (83.8%)	56 (16.2%)

Table 4: Negative perceptions of medical students regarding human dissection

	Parameters	SA	A	NAND	D	SD	Overall correct perception	Overall wrong perception
	Negative Perceptions							
1.	There are other better methods as dissection is outdated	0 (0.0%)	30 (8.7%)	48 (13.9%)	116 (33.5%)	152 (43.9%)	268 (77.5%)	78 (22.5%)
2.	Dissection is boring and less informative method	2 (0.6%)	26 (7.5%)	36 (10.4%)	136 (39.3%)	146 (42.2%)	282 (81.5%)	64 (18.5%)
3.	It does not give overall perspective of human anatomy	26 (7.5%)	118 (34.1%)	76 (22.0%)	84 (24.3%)	42 (12.1%)	126 (36.4%)	220 (63.6%)
4.	It is nauseating and anxiety provoking method	14 (4.0%)	80 (23.1%)	100 (28.9%)	82 (23.7%)	70 (20.2%)	152 (43.9%)	194 (56.1%)
5.	Tissue demarcation is very poor	8 (2.3%)	30 (8.7%)	42 (12.1%)	144 (41.6%)	122 (35.3%)	266 (76.9%)	80 (23.1%)
6.	It does not help how to deal with patients	8 (2.3%)	28 (8.1%)	64 (18.5%)	118 (34.1%)	128 (37%)	246 (71.1%)	100 (28.9%)

As far as the negative attitude towards dissection is concerned, Strong negative agreement was displayed by the students for items describing that dissection is boring and less informative method 282 (81.5%) and there are other better methods as dissection is outdated 268(77.5%). The disagreement was moderate for items describing tissue demarcation is very poor in dissection 266 (76.9%) and it does not help how to deal with patients 246 (71.1%). The disagreement was poor for items describing dissection is nauseating and anxiety provoking method 152 (43.9%) and it does not give overall perspective of human anatomy 126 (36.4%) (Table 4).

The average of correct responses for positive and negative perceptions was 90% and 64.5% respectively (Figure 1).

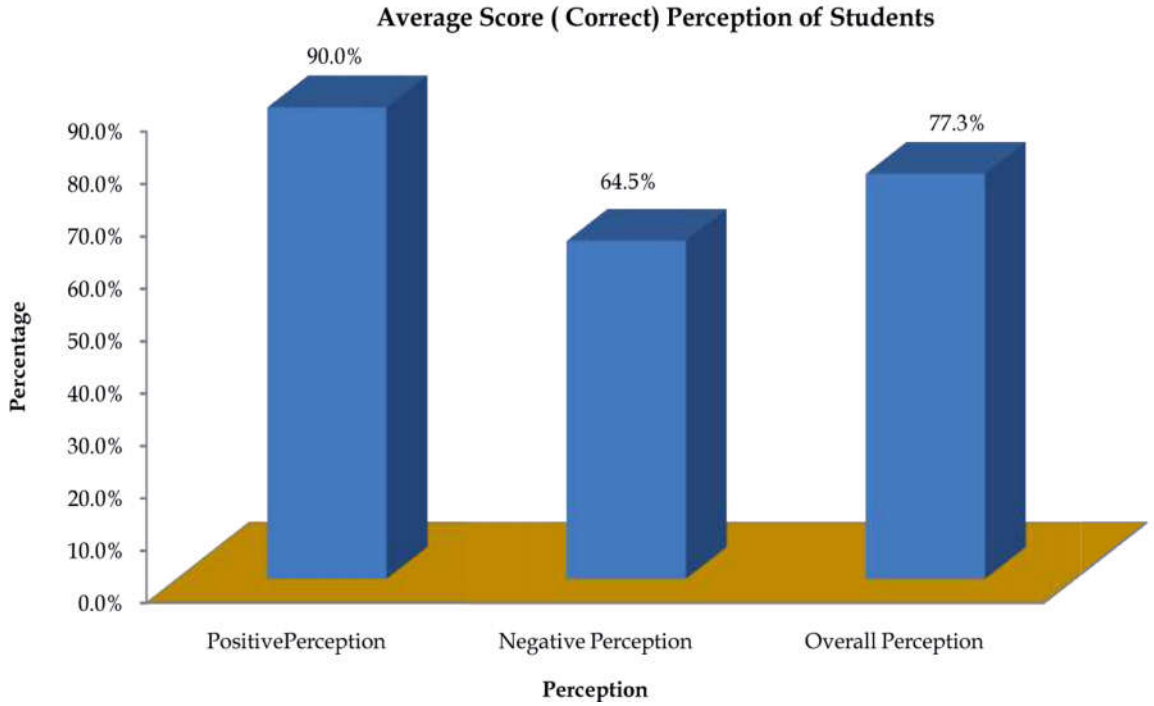

Fig. 1: Graph showing average score of correct perceptions of students

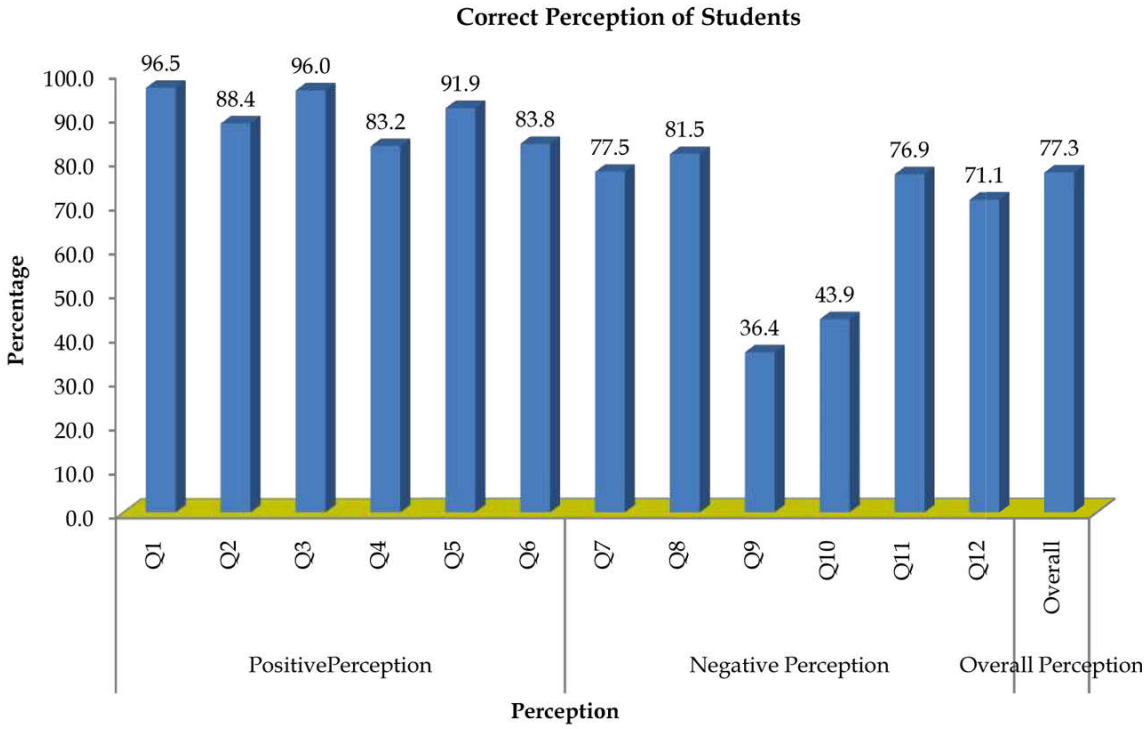

Figure 2: Graph showing question wise correct perception of students

Disscusion

The present study revealed a favourable outlook for traditional human cadaveric dissection and its further usefulness in the development of medical professionalism. The present study showed that a vast majority of the students identify dissection (71.1%) as a preferred method of learning anatomy followed by lectures (12.7%) and textbooks (8.7%). Demonstrations (5.8%) and computer assisted learning (1.7%) were least preferred methods by medical students. The similar higher percentage of students (52.7%) chose that dissection as a most preferred method of learning anatomy while 14% of them preferred computer assisted learning (14%) over lectures (3.2%) by Anandhi P G, et al [9]. The another similar study by Azer, et al [10] showed that dissection as a most preferred method (44%) over textbooks (23%) and computer assisted learning (10%). Similar other studies also showed that dissection of human cadaver is still preferred method of learning anatomy [11-13].

In present study 96.5% of the students agreed that dissection is the best method for learning anatomy. The similar study by Bhaskar Patel et al showed that 80% of the students also agreed for the dissection as the best method of learning anatomy [14]. This finding is also consistent with previous studies by Izunya A M and Rajkumari [15,16]. While the study by RE Elizondo-Omana et al showed that average final grade was more in students (58) using traditional learning methods supported by computer assisted learning than in students (68) using only traditional learning methods [17].

In present study 22.5% of the students viewed that dissection is outdated and there are other better methods to learn anatomy. The previous similar studies also agreed that there is need to modify traditional cadaveric human dissection into other teaching modalities [18-21]. Hence the debate on whether to continue with traditional dissection method in learning anatomy or to replace it with other methods in this modern digital era has been going on.

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Study of Correlation of Foot Length and Foot Breadth with Stature in Humans

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Abstract

Anthropometry helps in reconstruction of biological profile of the deceased such as age, sex, ethnicity and stature. *Aim:* The aim of the present study is to study the correlation of foot length and breadth with stature. Material and Methods: Sample size of the present study consisted of 200 students (males = 84 and females = 116) between 17–24 years of age from Government Medical College. Their stature and foot length and breadth were recorded. *Observations:* It was observed that males had higher mean, standard deviation and range for each of the parameter considered than those of females. Significant correlation was observed between height and foot length and breadth. From the regression equations derived, one can calculate height from any known parameter and vice versa. *Conclusion:* Foot length and foot breadth showed statistically significant correlation with height in total cases and also when male and female cases were evaluated separately. Foot length and foot breadth show significant positive correlation with each other. When one has to calculate height using one parameter, we recommend the use of foot length for the same as it showed highest correlation with height. This study will be useful for stature estimation from available skeleton material or parts of the deceased body that are available.

Keywords: Correlation; Stature; Foot Length; Foot Breadth.

Introduction

Stature is the height of a person in upright position [1]. Anthropometry helps in reconstruction of biological profile of the deceased such as age, sex, ethnicity and stature [2,3,4].

Rutishauser [5] estimated height from foot length in African children aged below six years with as much success as found by Trotter and Glesser [6,7] in adult American Negroes and Whites. So far few studies have been done to estimate height of an individual from measurement of foot length and foot breadth together. Also no information regarding correlation among these parameters is available.

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Aim

To study the correlation of foot parameters with stature.

Material and Methods

Sample size consists of 200 students (males = 84 and females = 116) from our College. Subjects known to have any significant disease, orthopaedic deformity, metabolic or developmental disorders which could have affected the general or bony growth were not included in this study. Samples were drawn randomly across the student population, after taking written valid informed consent from each of the participants. The age of the sample group ranged between 17–24 years. Stature i.e. height, foot length and foot breadth were studied in each subject. The material used for the present study is standiometer (height measuring instrument), measuring scale, paper and pencil.

All the above mentioned parameters were measured under the same conditions using the same measuring instruments in a well illuminated room at a fixed time. Before taking measurements, it was

checked that nails were trimmed. Measurements were taken on both sides in each subject by using standard anthropometric instruments in centimetre.

Height of the individual was measured as vertical distance from the vertex to the floor by using an anthropometer. Measurement was taken by making the subject stand erect on a horizontal resisting plane bare footed. The movable rod of an anthropometer is brought in contact with vertex in the mid-saggital plane [8]. No pressure was exerted since this is a contact measurement [2].

Foot Measurements

For recording foot measurements, the participant was made to stand so that both feet were slightly apart with equal pressure on both arches [2]. The outline was marked as it is done for shoe print [3]. Both feet were measured for foot length and breadth as follows (Figure 1).

Fig. 1: Showing foot tracing done

The length of the foot was measured as direct distance from most prominent point of the back of the heel to the tip of the hallux, or to the tip of second toe, when the second toe was larger than the hallux [4]. Distance between posterior most point of the heel and anterior most point of the foot was measured as the foot length [1,9] (Figure 2).

The breadth of the foot was measured as the direct distance between medial metatarsal point (metatarsaletibiale i.e. most prominent part of the head of the 1st metatarsal bone) and lateral metatarsal point (metatarsalefibulare i.e. most prominent point of the head of the 5th metatarsal bone) (Figure 2).

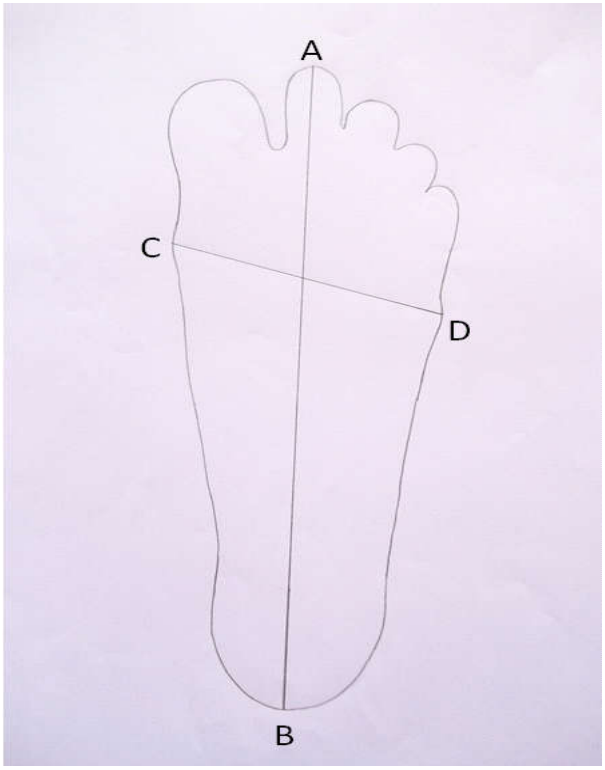


Fig. 2: Landmarks for foot measurements:
Distance between A and B = Foot length
Distance between C and D = Foot Breadth

Results

The data was analysed using SPSS software version 20.

The data was analysed for pooled sample as well as for males and females separately.

As there was no significant difference between the measurements of right and left sides, we have taken the average of the right and left sides of each parameter into consideration for further study.

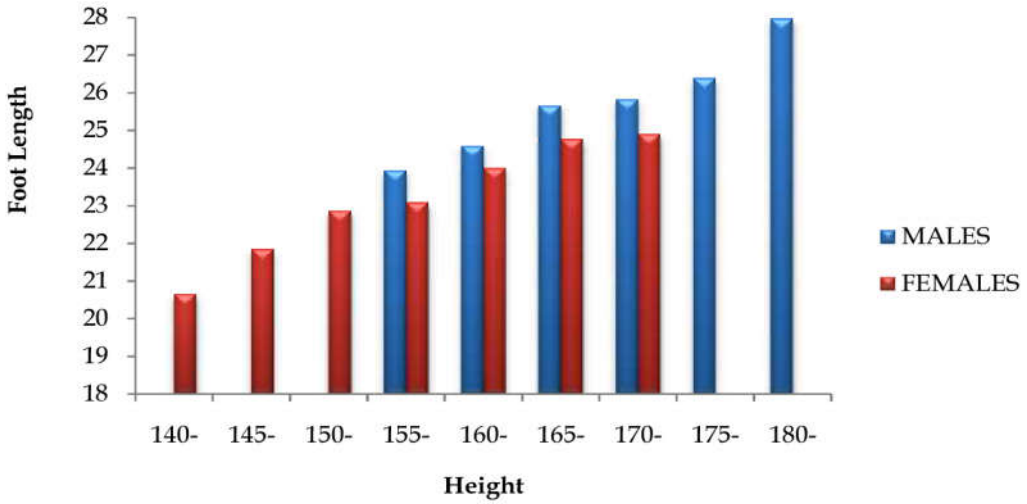
From the Table 1, we observe that the mean value for each parameter is higher for the male population than total cases, which is still higher than the female population. By using Student's t-test of significance, this difference among the male and female parameters is found to be highly significant. $P < 0.01$ indicates that the probability of difference being due to chance is less than 1% [12].

In graph 1 and 2, we arranged the observations of foot lengths and foot breadths of male and female population separately for a defined height range.

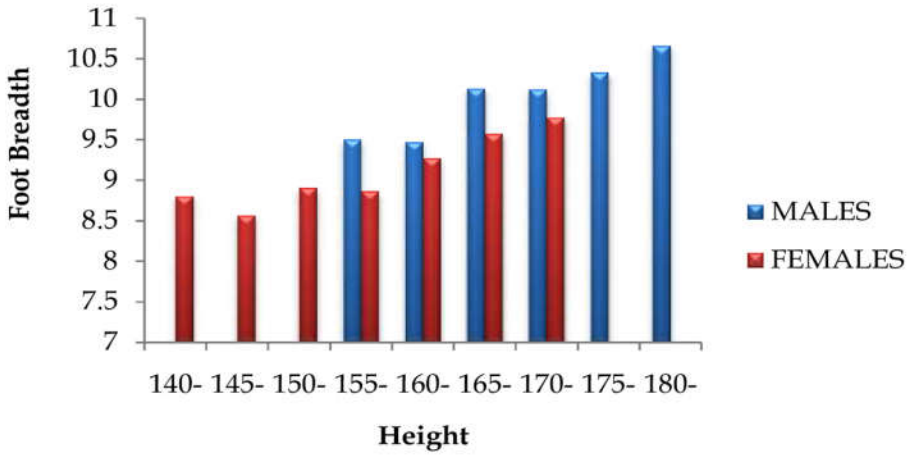
Table 1: Distribution of various parameters in study population with 't' values indicating the difference in male and female parameters

Sr. No.	Parameter		Total Cases	Males	Females	t	P Value
1	Height	Mean ± SD	163.08 ± 8.36	169.76 ± 6.42	158.23 ± 5.90	13.149**	
		Range	142-185	155-185	142-171		0.001
2	Average Foot Length	Mean ± SD	24.45 ± 1.62	25.76 ± 1.23	23.51 ± 1.15	13.268**	
		Range	20.45 - 29.3	23.4 - 29.3	20.45 - 26.4		0.001
3	Average Foot Breadth	Mean ± SD	9.51 ± 0.79	10.09 ± 0.68	9.10 ± 0.57	11.255**	
		Range	7.75 -12.1	8.8 - 12.1	7.75 - 10.5		0.001

If P ≤ 0.01 or 0.001 Highly Significant
** - Highly Significant



Graph 1: Showing mean foot length for various height groups in males and females



Graph 2: Showing mean foot breadth for various height groups in males and females

Comparing this data, we observed that for a specific height, foot length and breadth in males is always higher than the foot length and breadth in females and the difference is statistically highly significant (t = 13.268; P = 0.001 and t = 11.255; P = 0.001 for foot length and foot breadth respectively) (Table 1).

For finding out the strength of correlation, we calculated the Pearson's correlation coefficient (r). Pearson's correlation coefficient (r) for height and foot length is 0.841, 0.655 and 0.730 for total cases, males and females respectively. Pearson's correlation coefficient (r) for height and foot breadth is 0.675, 0.388 and 0.482 for total cases, males and females respectively. Pearson's correlation coefficient (r) for foot length and foot breadth is 0.801, 0.679 and 0.634 for total cases, males and females respectively. All values are significant at 0.01 level (P = 0.001).

The correlation of height with foot length and foot breadth is highly significant; foot length showing stronger correlation than foot breadth. Also foot length and foot breadth show highly significant correlation among them.

Linear regression equations are used to calculate an unknown variable from known variable. Linear regression model is given by: $y = a + bx$

where y = dependent variable (which is height in our case)

x = independent variable (FL/FB)

b = regression coefficient

a =intercept (a constant)

The linear equations for calculating height from foot length are:

For total cases: Height = 57.283 + 4.326 FL

R^2= 0.707 and f value = 477.16, P = 0.001

For males: Height = 80.49 + 3.466 FL

R^2= 0.442 and f value = 64.96, P = 0.001

For females: Height = 70.169 + 3.746 FL

R^2= 0.533 and f value = 130.19, P = 0.001

The linear equations for calculating height from foot breadth are:

For total cases: Height = 94.993 + 7.156 FB

R^2= 0.456 and f value = 166.03, P = 0.001

For males: Height = 133 + 3.682 FB

R^2= 0.15 and f value = 14.51, P = 0.001

For females: Height = 70.169 + 3.746 FL

R^2= 0.232 and f value = 34.48, P = 0.001

The high 'F' value with low 'P' value indicates significant functional relationship between dependent variable and independent variable. R square is the square of the correlation coefficient. In equation of deriving height from foot length in total cases, it is 0.707 which indicates that 70.7% of variation in height is due to variation in foot length. Foot length shows stronger correlation with height, hence predicting height better.

Multiple regression equations calculate unknown parameter using multiple known variables. Multiple regression model is given by: $y = \beta_0 + \beta_1(FL) + \beta_2(FB)$

where y = dependant variable (height in our case)

β_0= regression coefficient

β_1 = regression coefficient for FL

β_2 = regression coefficient for FB

For total cases: Height = 57.28 + 4.30FL+ 0.068FB

R= 0.84 R^2= 0.71 and f value = 237.39, P = 0.000

For males: Height = 81.03 + 3.89FL- 1.13FB

R= 0.67 R^2= 0.45 and f value = 33.08, P = 0.000

For females: Height = 69.62 + 3.64FL+ 0.33FB

R= 0.73 R^2= 0.53 and f value = 64.68, P = 0.000

In the multiple regression equations, the dependant variable is height and explanatory variables are foot length and foot breadth. The multiple correlation coefficient (R) is highly significant at P = 0.001.

For total cases, R^2 is 0.71 indicating that 71% of the prediction of height is attributed to the parameters considered. Thus, height can be calculated from all the parameters with good accuracy by using multiple regression equation.

Multiple regression model fits well to the observed data than the linear regression model as the values of multiple correlation coefficient are higher than the Pearson's correlation coefficient.

Discussion

Establishing the identity of an individual from mutilated, decomposed, & amputated body fragments is an important necessity. It is important both for legal & humanitarian reasons [13]. Estimating the stature, age, sex and ancestry facilitate narrowing down of the pool of possible victim matches in the forensic investigation process and help in establishing identification of an individual [14].

When male and female population was considered separately, the mean values of all parameters including height were higher in males than those of females. This difference was statistically significant. These differences in measurements between males and females can be attributed to the fact that fusion of epiphyses of bones occurs earlier in girls in comparison to boys. Boys have about two more years of bony growth than girls [15].

We have compared the mean values of all the parameters under study with the studies conducted earlier. We observed that mean value of height in our study matches with the findings of Khanapurkar S [16] (2012) and Patel PN [17] (2012) but is lower than the findings of Sanli SG [18] (2005), Chikhalkar BG [19] (2009) and Jakhar JK [20] (2010). But height of the present study is on a lower side as compared

to the height observed by Jakhar JK [20] (2010). Jakhar JK [20] studied the Haryanvi population whereas Sanli SG [18] (2005) studied the population of Turkey. Haryanvi and Turks are known to have larger stature than the Western Indian population. Our study provides the same finding. Mean foot length and mean foot breadth are comparable with the findings of other studies.

The difference in the findings of the present study from those of the other studies may be attributed to the geographical as well as racial factors that may influence growth and stature of an individual. Hawes et al [21] (1994) studied ethnic differences in foot shape and found that besides differences between genders, ethnic origin can influence foot shape.

In the present study, we observed highly significant differences in all dimensions of males and females. Baba K [22] (1975), Anil A [23] (1997), Ashizawa [24] (1997), Jakhar JK [20](2010), Danborno B and Elukpo A [25] (2008) reported similar significant differences in males and females. Hishama S [26] (2012) estimated stature from foot anthropometry in Malaysian Chinese and found no sex difference in foot dimensions. Our findings do not match with these findings of Hishama S [26] (2012).

We observed significant moderate positive correlation of height with foot length. These findings match with those of Janardana T [27] (1963), Chikhalkar BG [19] (2009), Jakhar JK [20] (2010), Khanapurkar S [16] (2012) and Patel PN [17] (2012).

Significant moderate positive correlation was observed between stature and foot breadth in present study as well as by Chikhalkar BG [19] (2009) and Patel PN [17] (2012).

Patel SM et al [28] (2011) studied foot parameters and stature. In his study, moderate positive significant correlation between foot length and foot breadth was reported on both right and left sides. In the present study, we found similar correlation among foot length and foot breadth.

Various authors have derived the linear regression equations for deriving height from foot length as well as from foot breadth separately.

Khanapurkar S and Radke A [16] (2012) studied estimation of stature from the measurement of foot length, hand length and head length. They found that contribution of head length in estimating height was not significant. So they derived the equation taking hand length and foot length into consideration. The equation derived by them was Height = 59.451 + 2.552 FL+2.295 HL.

It must be noted that the equations are applicable to the population from which data has been collected because genetic, racial and environmental factors (climate, nutrition etc) may influence the parameters under consideration.

Summary and Conclusion

In many circumstances, stature of a deceased individual is calculated by using regression equation from available skeleton material or parts of the deceased body that are available. Present study was designed to estimate height from foot length and foot breadth. Correlation among these parameters was also studied. The difference in the measurements of males and females was found to be statistically highly significant for each parameter. Foot length and foot breadth showed statistically significant correlation with height; stronger association was shown by foot length. Foot length and foot breadth showed statistically significant correlation among them. Linear and multiple regression equations were formulated to calculate height. When one has to calculate height using one parameter, we recommend the use of foot length for the same. Multiple regression equation predicted height better than the linear regression equations.

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A Morphometric Study of Anterior Clinoid Process and its Surgical Importance

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Abstract

Background: Knowledge about the unusual ossification of the Carotico-Clinoid Foramen (CCF), would be essential for neurosurgeons and radiologists in day-to-day clinical practice as internal carotid artery, optic nerve may get compressed. *Aim:* To obtain knowledge about morphometry of Anterior Clinoid Process (ACP), Optic Strot (OS) and the type of ossification of Carotico-Clinoid Foramen which would be beneficial to guide surgeries related to the cavernous sinus and internal carotid artery. *Materials and Methods:* A total of 135 half skulls were studied for various parameters such as the length of ACP from its base to the tip, the width at its base and the distance between the tip of ACP to optic strut were measured and were expressed in millimeters using digital calipers. SPSS 17th version was used for the statistical analysis. Paired t-test was applied to compare between right and left sides. Presence of carotico-clinoid foramen was observed and was classified as incomplete, contact form or complete. *Results:* The average length of ACP in the male skulls was 8.8±1.3 (right) and 8.40 ±1.4 mm (left). Its width was 7.9±1.4 mm and 7.5±1.0 mm. On female skulls the average length of the process was 8.48 ±1.6 mm on the right and 8.0 ± 1.4 mm on left side, while the width measured 7.3±1.5 mm (right) and 7.6±1.6 mm (left), on the opposite side. In our sample, a complete caroticoclinoid foramen appeared in male and female skulls were 9 (6.0%) and 8 (6.6%), contact form in male and female skull 6 (4.0%) and 3 (2.5%). At last, an incomplete form of the foramen in male and female were 21 (14%) and 19 (15.8%). The anatomic variations of the investigated structures must be considered during the approaches to the cavernous sinus and neurovascular elements of the sellar region. *Conclusion:* Considering the immense anatomical surgical and radiological importance of morphology of ACP, OS and CCF, this study highlighted the detailed morphometry of these structures.

Keywords: Anterior Clinoid Process; Optic Strut; Caroticoclinoid Foramen; Caroticoclinoid Ligament.

Introduction

Anterior Clinoid Process (ACP) is located on the medial end of the lesser wing of the sphenoid bone. The Carotico-Clinoid Ligament (CCL) joins ACP to the middle clinoid process (MCP) which is sometimes ossified. A dural fold extending between the anterior and middle clinoid processes or ossification of the CCL may result in the formation of the Carotico Clinoid Foramen (CCF) [1,2]. Removal of the anterior clinoid process (anterior clinoidectomy) allows a full approach to the anterior portion of the cavernous sinus and to the vertical segment of the internal carotid artery. It's a significant problem in neurosurgical procedures to find a massive anterior clinoid process, which by removing can cause optic nerve and internal carotid artery injury [1]. The optic strut (OS) is a bony structure that is closely related to the significant structures such as the cavernous sinus, the internal carotid artery, the optic nerve and the pituitary gland [2]. In neurosurgical operations, the ACP is usually accessed to gain entry into the clinoid space. Intracranial course of internal carotid artery is related medially to the ACP. The presence of an ossified CCL may form a potential site for compression of the internal carotid artery, optic nerve and variations in the ACP may pose a risk while it is being removed in surgical procedures [3].

According to Williams [4] and Lang [5] this foramen is formed by the ossification of the carotico clinoid ligament in early childhood. The carotico clinoid foramen was first described by Henle [6].

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The presence of this foramen is of great importance to neurosurgeons and preoperative detection of CCF, by CT imaging, has a huge clinical significance during surgeries on tumors and aneurysms in the parasellar and suprasellar region, where anterior clinoid process and the optic strut must be moved from the lesser wing of sphenoid bone to provide a better approach to the operating field, primarily to the internal carotid artery and the optic nerve, and to minimize the need for brain retraction [7,8].

Materials and Methods

Samples

The present morphometry study was done in the Department of Anatomy, Kannur Medical College, Kannur,India. A total of 135 dried half skulls were studied for parameters such as length of ACP, measured from its base to the tip and the width at its base was noted and the distance between the tip of ACP to optic strut (OS) was also measured using manual caliper and expressed in millimeter. Presence of Carotico-Clinoid foramen was observed. If present, its type was classified as incomplete, contact form or complete according to the criteria given by Keyes, 1935 [9]. [Table and Figure 1,2]. Sexual dimorphism of the skulls was noted based on the criteria given by Walrath et al. [10]. The skulls with damaged ACPs were excluded from the study.

Statistical Analysis

Statistical analysis was performed using SPSS version 15th and data were expressed in Mean ± SD. The testing was performed by Student's t-test, and $p<0.05$ is considered statistically significant.

Results and Discussion

The optic strut is a bony formation located between upper side of the body and the lesser wing of sphenoid bone and separates optic canal from the medial portion of superior orbital fissure. Position of the optic strut was determined based on relation between the length of anterior clinoid process and the distance measuring from the optic strut to the top of the anterior clinoid process.

In skulls of both genders on examination it has been found that the optic strut was attached to the anterior fifth of anterior clinoid process in 10.6% cases on the right side, and in 12.5% on the left. Its attachment to the anterior two fifths of the process was registered in 42.0% on the right side and the 44.0% on the left side. The least seen positions of the attachment site are entirely to the front, by the base of anterior clinoid process – in 0.9% on the right side and 3.2% on the left side, as well as entirely to the back, by the top of the process in 2.0% on the right and 0.5% on the left side (Table 1).

On all the skulls we measured the width of anterior clinoid process in its base, and the length from the base's midline to the top as shown in (Figure 1). The anterior clinoid process in almost every observed male skull was triangular in shape, its base oriented to the front and top to the back and medially. In the total of 75 analyzed male skulls, the mean value of ACP width on the right side measured 7.9±1.4 mm. On the left side the ACP width is 7.5±1.0 mm, mean± SD. The length of the process in males measured 8.8±1.3 mm on the right, and 8.40±1.4 mm on the left (Table 3). On the skulls originated from females, the mean value of ACP width on the right side measured 7.6±1.5 mm, and 7.3±1.6mm on the left side. The process mean value of length in females on the right side was 8.5±1.6 mm, and 8.0 ± 1.4 mm on the left side (Table 2). There were statistically significant differences in mean width and in mean length of the anterior clinoid process between men and women on the both sides of the examined skulls ($p<0.05$).

The carotico clinoid foramen (CCF) is formed when tops of the anterior and middle clinoid processes merge on the upper side of sphenoid bone. The merge can appear to be complete and incomplete. Aside from these two forms of the foramen, we also analyzed the so called contact form when there is a suture between the two clinoid processes (Figure 2). The complete form of CCF on the total of 75 male skulls (150 sides) was found to be bilateral in three cases (2.0%) . Unilaterally, it appeared in six skulls (3.9%), in four cases on the right side, and in remaining two cases on the left.

An incomplete caroticoclinoid foramen was found in larger number of male skulls. It appeared bilaterally in 10 skulls – 6.6% cases. The contact form of the foramen was found bilaterally in two male skulls (1.3%). Based on the results, we can conclude that the caroticoclinoid foramen in all three forms appeared in 36 cases, which is 14% (Table 3,4).

While analyzing female skulls (60 skulls - 120 sides), we found complete CCF bilaterally in four skulls (3.2%) and presence of CCF unilaterally two on right and left side respectively. Out of 19 skulls registered in incomplete form, nine skull noted

having incomplete form out of which five on right side (4.1%) and four on left side (3.3%). Bilateral incomplete form was noted in 8 skulls (6.6%). Similar to male skulls, incomplete CCF was found in larger number of female skulls as well: in eight skulls bilaterally (6.6%) and nine skulls unilaterally (7.4%). We haven't found the contact form of carotico-clinoid foramen bilaterally in female skulls.

Any abnormality in the anatomical structure of ACP combined with a completely ossified CCF, may have high risk of injury to the ICA and complete or partial removal of the ACP is an important step to approach to the cavernous sinus, paraclinoid aneurysms and radical removal of tumors and Therefore, understanding the complex morphometric anatomy of ACP and knowledge of the type of ossifications of the carotico-clinoid ligament serves special purpose to increase the success of surgery [8,9].

A study by Kapur et al. [7], repored the average length of the ACP in males 9.9±1.6mm on right and 9.3±1.4mm on left. The length in females was 9.3±1.6mm right side and 8.9±2mm on left side. The present study reported mean value of ACP length in males on the right and left side as 8.8±1.3 and 8.8±1.3 mm and in female of length of ACP on right and left side were 8.5±1.6 and 8.0±1.4 respectively when compared to the values in the literature.

Gupta et al. [8], reported the basal width of ACP 9.62±2.36 and 9.66±1.27mm on right and left side respectively. In a Korean study by Lee et al. [13], the width of ACP was 9.97±1.58 and 9.29±1.39mm on right and left side respectively. The present study the width of ACP in males was 7.9±1.4 and 7.5±1.0 mm on right and left side and in females 7.6±1.5 and 7.3±1.6 mm respectively reported lower values when compared to the values in the literature.

The optic strut was most commonly attached to front two fifths on the lower side of anterior clinoid process (42% on the right side and 44% on the left). The data on size and dimensions of the optic strut should be kept in mind during surgical procedures on cavernous sinus and region of orbital apex. Knowing the precise location of the optic strut and its variations are very important while analyzing CT images, since it represents a valuable landmark in proper evaluation and differentiation of the optic canal, superior orbital fissure and anterior clinoid process on coronal and axial scans [8].

In our sample consisting of 75 male and 60 female skulls (270 sides) the complete form of CCF was discovered in 17 cases (15.2%). The contact form of the foramen was noticed in 9 cases, which is (12.9%) in a sample of 270 sides. The incomplete form was present in 40 cases (56.0%). On observing the results it shows that the complete, contact and in-complete forms of caroticoclinoid foramen were more often found in men, and were more often found on right side regardless of gender (Table 3,4).

Hochstetter [11] and Kier [12] postulated that an osseous CCF was a developmental anomaly and showed its existence in the fetal and infant skulls.

Table 1: Location of the optic strut in relation to the anterior clinoid process (ACP)

Attachment Site	Right Side	Left Side
By the base of the ACP	0.9%	3.2 %
Anterior fifth of the ACP	10.6%	12.5%
Anterior two fifths of the ACP	42.0%	44.0%
Anterior four fifths of the ACP	4.4%	5.0%
Posterior fifth of the ACP	2.0%	0.5%

Table 2: Incidence of complete, incomplete and contact form caroticoclinoid foramen (CCF) in male skulls (n=150)

Male skull		Complete form	Contact form	Incomplete form
Unilateral	Right	4 (2.6%)	1 (0.6%)	7 (4.6%)
	Left	2 (1.3%)	3(2.0%)	4 (2.6%)
Bilateral		3 (2.0%)	2(1.3%)	10 (6.6%)
Total		9 (6.0%)	6 (4.0%)	21 (14%)

Table 3: Incidence of complete, incomplete and contact form caroticoclinoid foramen (CCF) in female skulls (n=120)

Female skull		Complete form	Contact form	Incomplete form
Unilateral	Right	2 (1.6%)	1 (0.8%)	5 (4.1%)
	Left	2(1.6%)	2 (1.6%)	4 (3.3%)
Bilateral		4 (3.3%)	Nil	8 (6.6%)
Total		8 (6.6%)	3 (2.5%)	19 (15.8%)

Table 4: Dimensions of the ACP in millimeter including gender and side of the examined skulls

	Male		Female	
	Right	**Left**	**Right**	**Left**
Width	7.9±1.4	7.5±1.0	7.6±1.5	7.3±1.6
Length	8.8±1.3	8.40 ±1.4	8.5 ±1.6	8.0 ± 1.4

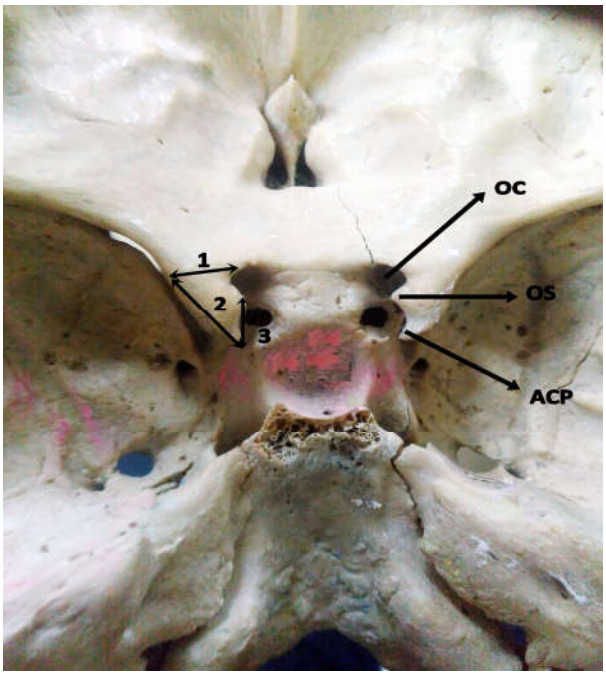

Fig. 1: The measured parameters on the anterior clinoid process. 1-width in the base, 2-length from base to the top, 3-length from the top to the posterior margin of the optic strut (ACP-anterior clinoid process, OP-optic strut, OC-Optic canal)

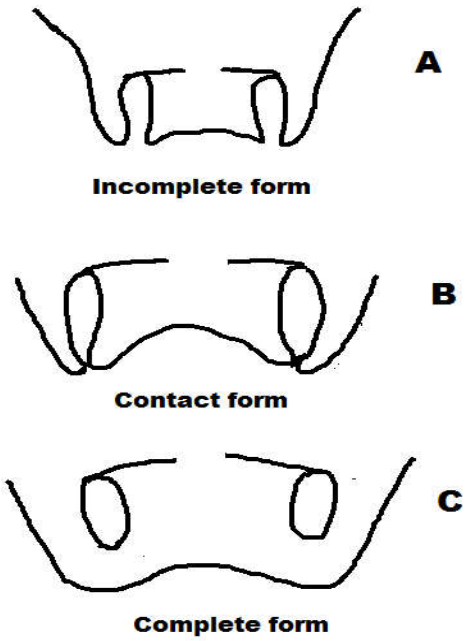

Fig. 2: Illustration of three forms of caroticoclinoid foramen. ACP-anterior clinoid process, MCP – Middle Clinoid process. A-incomplete form, B – contact form, C – complete form

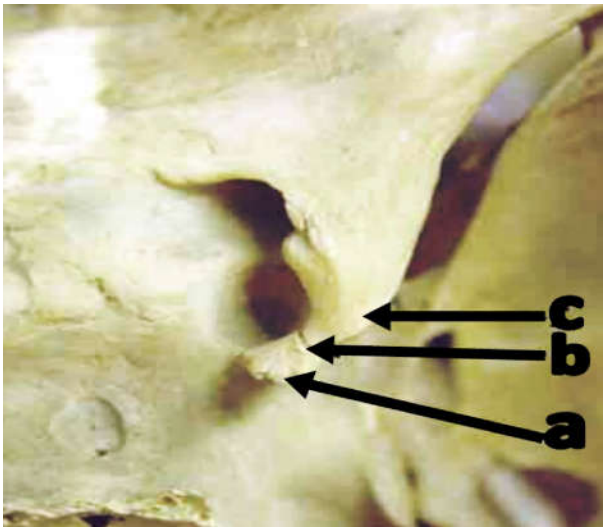

Fig. 3: Male skull (right side). Contact form of the caroticoclinoid foramen. a-middle clinoid process, b-carotido clinoid foramen, c-anterior clinoid process

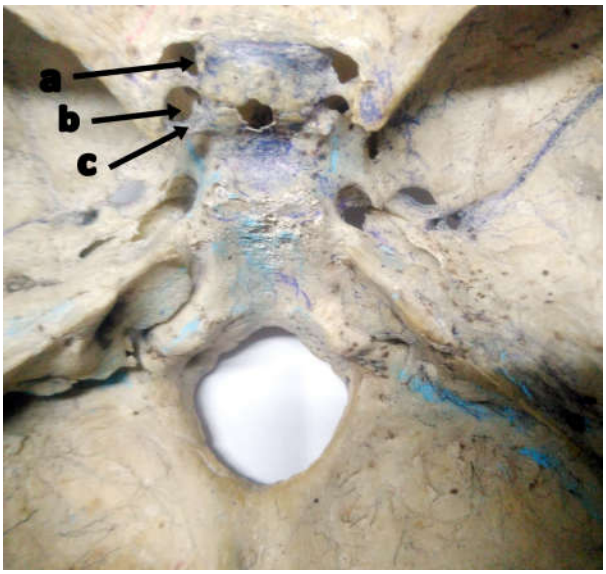

Fig. 4: Male skull (left side) Complete form of the caroticoclinoid foramen. a-optic canal, b-carotido clinoid foramen, c-middle clinoid process

In the study by Lee et al [13], the complete and incomplete forms of caroticoclinoid foramen were found in 17.0% cases, while Keyers [9] registered their appearance in 27.4% among American caucasions, predominantly on the left side. Azeredo et al. [14] registered caroticoclinoid foramen in the skulls of Portuguese population in 6.27%. Erturk [16] found the three forms of the foramen in 23.8% cases.

Most studies proclaim higher incidence on the right side, with an exception of studies performed in USA [5], that indicate higher incidence of caroticoclinoid foramen on the left side, as well as more significant number of complete or incomplete foramina bilaterally.

Conclusion

Considering the immense anatomical surgical and radiological importance of ACP, OS and CCF, this study highlighted the detailed morphometry of these structures and may be immensely contribute to surgeons during the surgical interventions on tumors and aneurysms in the sellar region, mobilization of the ACP and the OS and prevent inadvertent damage to internal carotid artery and the optic nerve. The study also has explained the sexual dimorphism in their morphology.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Metric Study of Mastoid Triangle for Sexual Dimorphism

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Abstract

Background & Aims: The mastoid region, a fragmentary piece of skull is ideal for sex determination as it is more robust and tough making it resistant to physical damage. The mastoid bone is most protected, due to its anatomical position at the baso-lateral region of the skull. In present study, mathematical dimensions of various parts of mastoid were used by craniometric techniques to identify the sex in fragmentary remains. *Material & Method:* The study was performed on 132 human skulls of known sex (80 Males & 52 Females) collected from Bone Bank of Department of Anatomy at Govt. Medical College, Aurangabad and various medical colleges of Marathwada region. The measurements were taken on mastoid region of skull by defining the three craniometrical points- Asterion, Porion and Mastoidale. Distance between these three craniometrical points were located and measured in mm to calculate the area in mm^2 by Heron's formula on both right and left side of skull. Unpaired't' test were used for data analysis. Total mastoid area was calculated by adding the right and left triangular areas. The total area being used as it would avoid asymmetry between the areas, so it can be used for sex determination. *Results:* The means of all mastoid measurements and total mastoid triangular area in males are significantly larger than those of the females ($p<0.001$). Result showed significant craniometric differences between male and female mastoid triangle on both right and left side of skull. *Conclusion:* The mastoid measurements and total mastoid triangular area provides an accurate method for sex determination in Marathwada population. Knowledge of above dimensions of mastoid process will be helpful to physical and forensic anthropologist for sexing of human skull from fragmentary skeletal remains.

Keywords: Craniometric Points; Mastoid Triangle; Sex Determination; Area.

Introduction

Mastoid process is a conical downward projection from the external surface of mastoid part of temporal bone. Mastoid process is absent at birth and appears during second year by the pull of sternocleidomastoid muscle when child moves his head [1]. It is more robust in males than in females and which is most likely due to the larger muscles that insert on the mastoid process in males. The visual assessment is commonly applied for sex estimation from mastoid region due to its relative ease of use, but it is critical as it reflects subjectivity in observation [2].

Sex determination of human skeletal remains is considered as a vital step in identification and is crucial for further analysis. In the skull, the temporal bone is highly resistant to physical damage, thus it is commonly found as a remainder in the skeletons that are very old age and of this the petrous portion has been described as important for sex determination [3].

The skull is the most dimorphic and easily sexed portion of skeleton after pelvis, providing up to 92% reliability. Both metrical and morphological characteristics may be helpful in fragmented skull bone to determine the sex [4].

Paiva and Segre (2003) [5] introduced an easy technique to determine the sex of skulls by indirect mastoid process measurements. They obtained the xerographic copy of each side of the skull. After that,

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three craniometric points like asterion, porion, and mastoidale were used for triangular area calculation by Heron's formula and made a summation of right and left triangle area to the total area value. The result showed significant differences between sexes in right and left triangle area and total area. This technique had a small observational error and high degree of predictability.

The validity of above sexual dimorphism in the mastoid triangle has been evaluated by Kemkes and Gobel [6] in German forensic and Portuguese cemetery sample by direct mastoid measurements on the skull with a sliding vernier caliper. However results of the study did not reveal the excellent results as like the previous study by Paiva [5].

Subsequently, Nagaoka T et al [7] measured height, width and length of the mastoid process in Japanese human skeletons to postulate the advantage of mastoid measurements as good sex determinators. The results revealed that the percentage accuracy of sex classification is more than 80% with one variable and increased to 82 to 92% with two variables. This indicated greater accuracy than previous studies.

According to method developed by De Paiva and Segre [5], different studies were done by different workers by using three reference points - porion, asterion and mastoidale, to calculate the area of mastoid triangle in Brazilian skulls [8], in Thais [9], in South Indian population [10], in Gujarat population [11].

Comparison of mastoid triangular area between CT scan and manual method in South Indian population were studied to evaluate the significance of measurements. But the results showed no significant difference between CT scan and manual method of area measurement of mastoid process [12].

The objective of the present study was to assess the sexual dimorphism in the dimensions and triangle area of the mastoid process in Marathwada region of Maharashtra, measured directly on the skull using three craniometric points of mastoid process.

Materials and Methods

The study sample was taken from the Bone Bank of Department of Anatomy, Government Medical College, Aurangabad and various medical colleges of Marathwada region. Total 132 dried adult human skulls (80 Males and 52 Females) were used to get craniometrical data of the mastoid process. Deformed and damaged skulls were excluded from the study. The present study was carried out using method applied by previous researchers [5], which was based on craniometric dimensions of mastoid part of the skull. The dimensions of the both sides of mastoid triangles were measured directly [6] on the skull by sliding vernier caliper, using the three craniometrical landmarks. [Figure 1].

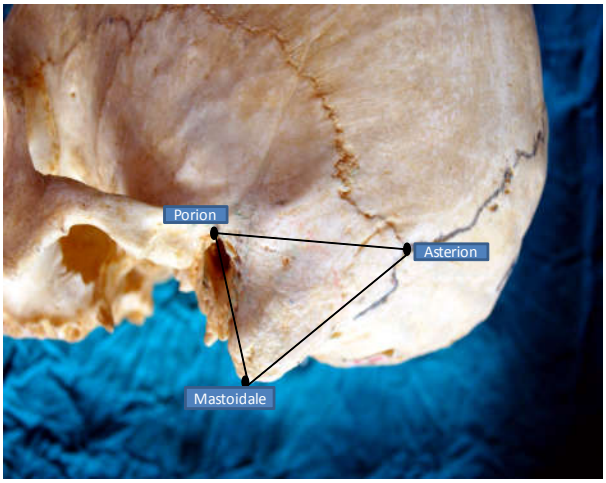

Fig. 1: Lateral view of the skull showing three craniometric landmarks: Porion (Po), Asterion (AST), Mastoidale (Ms) forming mastoid triangle

Porion (Po): Superior point of external acoustic meatus.

Mastoidale (Ms): is the tip of mastoid process.

Asterion (AST): is the meeting point of lambdoid, occipitomastoid and parietomastoid sutures.

The points were located and marked on both sides of the skull. Then the distance between the three landmarks were measured by a single investigator in order to eliminate interobserver error. The area of mastoid triangle was calculated in mm^2 by means of the Heron's formula. When one knew the lengths of sides, the area of triangle can be calculated by this formula.

$$= \sqrt{s(s \quad a)(s \quad b)(s \quad c)}$$

a, b, and c are the length of the sides.

$$s = (a + b + c) \div 2$$

After that, the descriptive statistics of all mastoid dimensions and mastoid triangle area were analyzed by using statistical package for social sciences (SPSS) computer software, assessing the correlation between the male and female. The mean, standard deviation and p value were calculated and

its significance was tested by students unpaired 't' test. "P"- Values of less than 0.05 were considered to be statistically significant difference between sexes.

According to the method described by De Paiva and Segre [5], the total area was calculated by adding the area obtained on both right and left side of skull.

Observation and Results

The study comprised of 132 adult dried Human skulls, of which 80 were males and 52 were females. Student's unpaired 't' test were applied for analysis of all the sampled skulls. The lineal dimensions of all the variables of mastoid region (AST-Ms; AST-Po; Po-Ms) and area of mastoid triangle on right and left side of skull were higher in males than in females. The descriptive statistics with mean, standard deviation of all mastoid parameters for both the sexes, which were illustrated in table 1 for right side and Table 2 for left side, given below. The 'p' value and 't'value was also presented in respective tables.

Table 1 showed that, all the mastoid variables were higher in males than in females on right side of skull. The difference was found to be statistically significant.

The side wise (right and left) analysis of female skull by applying student's unpaired't' test showed significant difference for all the above mastoid variables with p value of ≤ 0.05. Whereas in males, the sidewise (right and left) analysis skull showed that only asterion to porion length (AST- Po) was significant with p value of <0.05, rest of the variables were insignificant.

When unpaired 't' test was applied for sexwise (male and female) analysis of all the sampled skulls for right side as shown in table 1 and for left side as shown in Table 2, proved that, all the mastoid measurements were found to be significantly larger in males than in females on both sides of skull with p value ≤ 0.0001 levels. It was also found that, in both sexes, the values on right side of mastoid region were higher than on the left side.

Table 1: Descriptive statistics for sex determination from **right** mastoid triangle (in mm & mm^2) with p value & t value for differences in means between both sexes

Sr. No.	Mastoid variable	Sex	N	Mean	Standard deviation	t value p value
1	Asterion- Mastoidale (mm)	Male	80	48.92	0.338	5.565
		Female	52	45.38	0.356	0.0001*
2	Asterion- Porion (mm)	Male	80	45.82	0.250	5.558
		Female	52	43.30	0.235	0.0001*
3	Porion- Mastoidale (mm)	Male	80	30.32	0.252	7.050
		Female	52	27.12	0.272	0.0001*
4	Right triangular area (mm^2)	Male	80	586.05	6.117	7.190
		Female	52	508.47	5.39	0.0001*

*highly significant

Table 2: Descriptive statistics for sex determination from **left** mastoid triangle (in mm & mm^2) with p value & t value for differences in means between both sexes

Sr. No.	Mastoid variable	Sex	N	Mean	Standard deviation	t value p value
1	Asterion- Mastoidale (mm)	Male	80	47.75	0.843	3.906
		Female	52	39.80	1.486	0.0001*
2	Asterion- Porion (mm)	Male	80	44.10	0.762	3.427
		Female	52	37.61	1.38	0.0001*
3	Porion- Mastoidale (mm)	Male	80	29.40	0.518	5.120
		Female	52	23.23	0.8954	0.0001*
4	Right triangular area (mm^2)	Male	80	565.30	11.47	5.209
		Female	52	436.37	16.74	0.0001*

*highly significant

Table 3: Statistics for total mastoid triangular area in males and in females

Sr. No.	Parameter	Sex	Right area	Left area	Total area(mm2)	t value p value
1	Total mastoid triangle area	Male	586.05	565.30	1151.3	6.967
		Female	508.47	436.37	944.85	0.0001

Table 3 showed that, the mean total area of mastoid triangle in male skulls was 1151.3 mm^2 which was statistically highly significant when compared with mean total area of female skull (944.85 mm^2).

The maximum values for the total area calculated in the males and females were 1490.6 mm^2 and 1232.4 mm^2 respectively whereas the minimum values for the same were 950.9 mm^2 and 863.4 mm^2 in males and females respectively.

It was found that the unpaired student's t test was extremely significant when male right side was compared with female right side as well as male left side compared with female left side which indicates that the measurements of mastoid variables can be used for sex determination in unknown skull.

Discussion

The present study aimed to develop population-specific, sex determining anthropometric standards for the mastoid triangle which are important for anthropometrical and forensic purposes.

Previous authors agree that qualitative aspects of mastoid process such as their size, robustness due to large muscle attachment and inclination of mastoid process, are very good indicators of sexual dimorphism. They concluded that the mastoid process is more robust in males with its large size. However, various discussions have put forward from the quantitative point of view.

With respect to quantitative aspects, the present study analyzes the dimensions of the denominated mastoid triangle, defined according to that described by De Paiva and Segre [5] in their original article, but measured directly on the skull as like Kemkes and Gobel [6].

We found that, mean values of all the three sides of mastoid triangle (Asterion- mastoidale; Asterion-porion; Porion- mastoidale), and total area of mastoid triangle were larger in males on both right and left side of skull. The difference was found to be statistically highly significant as revealed by 'p' value of <0.0001.

In the study done by, De Paiva and Segre [5], the average area in males was 1505 mm2 and in females was 1211 mm2 which was more as compared to present study having mastoid area in males as 1151 mm2 and in females 944.8 mm2. These differences may be the effect of their method which was using xeroghraphic copy for indirect measurements.

In the Portuguese population, Kemkes & Gobel [6] (2006), found all the lineal dimensions of mastoid region and area of mastoid triangle to be statistically significant in determination of sex similar to the result of present study. Whereas in German population, only the two sides [except asterion-mastoidale distance] and total area were significant. They stated that, the measurements show disparity in the population – specific of sexual dimorphism between German and Portuguese samples but the technique was not practical when the skull remains have to be independently assessed. They concluded that using mastoid triangle area as a sex determination was highly questionable.

Suazo and co-workers [8], in their study found that distance between porion to mastoidale, right mastoid triangular area and total area showed statistically significant difference between both sex groups with p value <0.01. Further they concluded that, the parameters of mastoid triangle were debatable for sex diagnosis in practice.

In Thai population, C. Manoonpol [9] also found that the mean values of all the three sides of mastoid triangle are significantly larger in males, which is similar to the present study. The total area in males was 1778 mm^2 and in females it was 1486 mm^2 which is larger than present study. This may be due to population specificity.

The studies done in South Indian population [10], in Gujarat population [11], concluded that the total mastoid triangular area in males were significantly larger than those of females ($p \leq 0.01$). In the present study, we established that the mastoid triangle is sexually dimorphic.

Conclusion

The results of the present study indicate that all the three sides of mastoid triangle and area of mastoid triangle are sexually dimorphic in the sampled Marathwada region of Maharashtra.

Although population specific differences are evident, this should be considered cautiously as the methodologies employed to study of mastoid triangle differ in the various reports published. The sexual dimorphism in the present study was based on direct measurement of dimensions of mastoid region by vernier caliper, so this technique is easy to execute, offers quick results to meet the needs and realities of the forensic investigation.

Hence, the sexual dimorphism can be assessed by using above variables for either a complete or

fragmented skull. The findings presented can be applied in the procedures of physical anthropology, forensic anthropology and Bioarchaeology.

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Original Article

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Femoral Neck Torsion: A Study of Adult Dry Femoral Bones

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Abstract

Background: Femoral torsion is defined as the angle formed between long axis of head and neck of femur proximally and the transverse axis of the femoralcondyles distally. When this axis passes forwards it is termed as anteversion and when it passes backwards it is termed as retroversion. It is important to know the angle of torsion, as it is varies widely from person to person. *Materials and Methods:* Unpaired 113 dry femurs, 58 right sided and 55 left sidedwithout any gross morphological deformities were used to measure the femoral torsion by goniometer. Maximum femoral length was measured by using osteometric board and the data were statistically analyzed. *Results:* Out of total 113 femur studied, 102 femur were found to be anteverted whereas 11 were found to be retroverted. Mean angle of anteversion was 10.39° irrespective of side. In case of right femurs mean value was 10.05° and for left it was 10.82°. Though mean values were higher in left sided bone, no statistically significant difference was found ($p < 0.05$). Mean value of retroversion was found to be 4.60° which is much lower than the mean value of anteversion. *Conclusion:* Any change in the angle of femoral torsion is associated with various clinical conditions. Study data will be useful for various orthopaedic procedures and diagnosis, in the fields of General Human Osteology and Forensic anthropology.

Keywords: Femoral Torsion; Anteversion; Retroversion; Length.

Introduction

Morphological study of femur includes recognition of the femoral neck torsion. The head of the femur passes forwards and medially with respect to the transverse axis of the lower end (angle of femoral torsion). Normal value of femoral anteversion ranges between 10°–15°. Angle may vary amongst individuals, races and different populations [1].

Lower average value of torsion of 7°- 8° degrees was seen in Caucasian skeletal studies [2,3] while greater average values of torsion of 19° was found in African population [4,5]. It is an important factor for longevity of the joints especially after total joint replacement surgery.

Femoral torsion in human is not only developmental but also a result of torsional stresses produced on the femoral neck during daily activities. This angle facilitates bipedal postures during locomotion by reducing the horizontal bending forces experienced at hip and thereby reducing bony tensile stress.

The knowledge of torsion angle is very important in hip replacement surgeries as properly placed implants not only reduce bony strain but also helps to prevent implant loosening and increase the stability of the joint as well [6,7].

The angle of femoral torsion is measured as the angle between the longitudinal axis of the head and neck of the femur proximally and the transverse axis of the femoral condyles distally (Figure 1).

The present study tries to evaluate the normal femoral torsion range in adult dry femora of Indian population. We also try to determine if there is any right and left sided difference as well as any correlation between maximum length of femur with femoral torsion.

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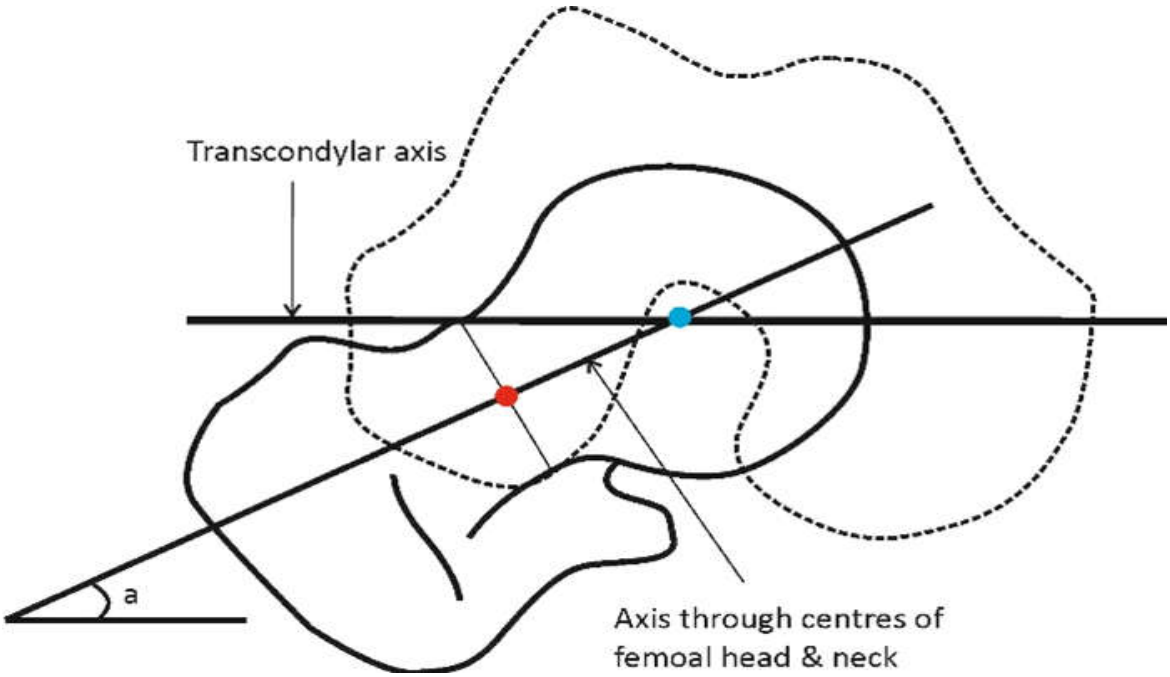

Fig. 1: Shows angle of femoral neck anteversion

Materials and Method

Unpaired 113 dry femurs, 58 right sided and 55 left sided without any gross morphological deformities were used to measure the angle of femoral torsion. The angle of femoral torsion was measured by Kingsley Olmsted method [8]. After placing the specimen at the edge of a glass horizontal surface so that the condyles of the inferior end rest on the surface, the horizontal limb of a goniometer was fixed at the edge of the experimental table. The vertical limb was held parallel along the axis of the head and neck of the femur. The horizontal surface represents the retrocondylar axis and the plane of reference against which the torsion is measured with the help of the axis of head and neck of the femur.

Axis of head and neck of femur: Centre of head was the center of maximum antero-posterior thickness of head of femur. The centre of neck was the center of maximum antero-posterior thickness at the base of the neck. Both these points were determined with the help of digital sliding caliper and were marked on the surface of head and neck respectively. The line passing through these points was the axis of head and neck of the femur.

Retrocondylar line: Line passes through posterior most points of both condyles of femur.

Maximum femoral length was measured by using osteometric board from the most superior point on the femoral head to the most inferior aspect of the medial condyle.

Result

The results obtained after measurement of the femoral torsion angles in dry adult bones were tabulated and analyzed.

The mean value of femoral torsion on right side was 10.05° with standard deviation of 6.746 and that for left side it was 10.82° with standard deviation of 6.162. The mean angle on left side was higher than the right side but the difference was not statistically significant.

Table 1: Angle of torsion for right and left side

Angle of torsion	Range	Mean	Standard deviation	Standard error	T and P value
Ungrouped (n=102)	0° - 28°	10.39°	6.475	.641	-
Right (n=57)	0° - 28°	10.05°	6.746	.894	t = 0.608
Left (n=45)	0° - 28°	10.82°	6.162	.919	p = 0.5444

Table 2: Percentage wise distribution of femoral anteversion angle in right and left femur

Angle of torsion	Right side		Left side	
	Frequency	Percent	Frequency	Percent
0-5 degree	18	31.58	9	20
5-10 degree	11	19.30	13	28.89
10-15 degree	16	28.07	15	33.33
> 15 degree	12	21.05	8	17.78
Total	57	100	45	100

Table 3: Pearson's correlation coefficient (r) of right and left anteversion angle with maximum femoral length

Correlations Anteversion angle & length	N	r-value	p-value
Ungrouped	102	-0.261	0.008
Right	57	0.065	0.065
Left	45	0.059	0.059

Table 4: Comparison of present study with previous studies

Author	Population	Year	Mean Anteversion Angle
Jain et al. [12]	India (Delhi)	2003	8.1 [right –7.3, left – 8.9]
Badjatiya et al. [13]	India (Udaipur)	2014	8.67°
Srimathi et al. [14]	India (Chennai)	2012	9.8°[right– 9.49°, left– 10.13°]
Sugano et al. [15]	Japan	1998	19.8°
Reikeras O et al. [2]	Norway	1983	13°
Eckhoff et al. [5]	Africa	1994	17° [right – 21°, left – 17°]
Maheshwari et al. [16]	India (Delhi)	2010	8°
Present study	India (Gujarat)	2017	10.39° [right – 10.05°, left – 10.82°]

In the present study, we also found 11 femur having retroversion. Out of these, 10 were of the left side and only 1 was of right side. The mean retroversion angle found in left side was 4.66° with maximum value of 10° and minimum value of 1° whereas angle of retroversion on right side femur was 9°.

Discussion

The knowledge of normal femoral torsion is very helpful in selection of patients for prosthesis and preoperative planning for total hip replacement surgery and anthropological studies. Results of western studies cannot be applied to Indian population because femoral torsion differs in different populations [9].

Changes in the stress placed on the femur diaphysis may affect the development of femoral neck torsion. In populations which are more habitual to do moderate to heavy ground level physical activities require an internally rotated posture. This is required to keep the femoral head in the acetabulum and hence result in femoral neck torsion to the anterior side. Ground level activities such as squatting, mopping, laundry, cooking, farming and preference of floor sitting are common in Indian population.

Our study does not show any significant difference ($p > 0.05$) between both side torsion as right side shows lower value. Highest cases (18) femur on right side had anteversion angle of 0-5 degrees followed by 16 cases where the angle was in range of 10-15 degrees. In left side, highest cases (15) femur had anteversion angle of 10-15 degrees followed by 13 cases where angle was in range of 5-10 degrees. So present study opposes the hypothesis that both limbs are symmetrical in development. We also found retroversion in 11 cases in which 10 were of left side and 1 was of right side. This further confirms the asymmetry in development and torsion between right and left sides.

Hamill et al. stated that any increase in bone lengths is accompanied by lower extremity adjustments as a result of excessive torsion [10]. Valmassy said that torsion of femur usually demonstrates angle of gait or posture changes which are caused due to overall growth spurts and increase in height [11]. Populations differ from each other in size and proportions and these differences can affect the metric assessment of femoral torsion [Table 4]. Table 4 also shows that angle of anteversion not also varies greatly in different populations of India as well. In our study no statistically significant correlation was found between femoral torsion and femoral length on the right side and left side ($p > 0.05$). This is in contrast to the study done by

Debnath et al. in Bengali population where a strong relation was found between angle of anteversion and length of the femur.

Measurement of femoral neck torsion is very important for various orthopaedic diagnosis and procedures, because measurement of femoral torsion in living subjects is complicated with several limitations [10,11,12].

Any increase or decrease from normal range of femoral torsion is related with different disease conditions. These problems vary from minor postural defects in children to immobilizing hip osteoarthritis in adults. Diseases with increased femoral torsion are perthes disease, cerebral palsy, poliomyelitis, apparent genu valgum, external tibial torsion, flat foot. Diseases with decrease femoral torsion are toing out, rickets, chondrodystrophy etc. Accurate measurement of femoral torsion is important for diagnosis and corrective procedures related to femur and hip joint [7,8,12,14,17].

Conclusion

The average angle of anteversion obtained by Kingsley and Olmsted method was 10.39 (SD 6.475°). The angles of anteversion in 26%, 24%, 30% and 20% were in the range of 1°-5°, 5°-10°, 10°-15° and >15° respectively. Altogether, 9.73% of femur showed retroversion. No statistically significant difference was found between the angle of anteversion in right and left side. Great amount of variation in angle of anteversion was found not only in populations of different countries but also in populations of different regions of India.

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Study of the Morphometrics of Fibula for Nutrient Foramina and Its Variations in Indian Population

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Abstract

Introduction: The fibula is located lateral to the tibia in the leg. The fibula is the bone of choice for grafting and to reconstruct large defects after tumor resection, because of its length, biomechanical stability, limited donor site morbidity and predictable vascular pedicle. *Objectives*: The objectives of the study are: (1) To locate and describe the position, number & direction of nutrient foramina of fibula. (2) To observe any variations in location,position and number of nutrient foramina of fibula. *Methods*: The study sample comprised of 80 dry adult human fibulae.Present study was conducted at bone bank of Department of Anatomy, Government Medical College, Aurangabad. The data pertaining to the above parameters were noted, subjected to statistical analysis and were photographed. *Results*: In the present study of 80 dry adult human fibulae, noted; (1.) Absence of nutrient foramen (NF) in 2 (2.5%) fibulae. (2.) Single nutrient foramen was present in 71 (88.75%) fibulae. (3.) 5 (6.25 %) fibulae showed double nutrient foramen. (4.) 2 (2.5%) fibulae showed triple nutrient foramen. (5.) The most common location of nutrient foramen was on medial crest in 52 (58.42%) and least common on anterior border in 1 (1.25%) fibulae. (6.) Out of total 89 foramena 84 (94.67%) foramen were on the middle third of the fibula. *Conclusion*: The present study showed 12.7% variation in number of nutrient foramen.Accurate anatomical knowledge about the location and distribution of nutrient foramen is useful for orthopedic and plastic surgeons in planning the vascularised fibular graft at middle third of the shaft. .

Keywords: Fibula; Foraminal Index; Nutrient Foramen; Vascularised Fibular Graft.

Introduction

The word foramen is derived from Latin word 'foro' (to pierce).Foramena meansan aperture or perforation through a bone or membranous structure. The role ofnutrient foramen is nutrition and growth of the bones [1]. The external opening of the nutrient canal, has a particular position for each bone usually referred to as the nutrientforamen [2]. The principle source of blood to a long bone particularlyduring its active growth period is the nutrient artery. Nutrientforamina, allow blood vessels to pass through the bone cortex [3]. The fibula is located on the lateral side of tibia in the leg. A little proximal tothe midpoint of the posterior surface, the fibular shaft is pierced by a nutrient foramen, receives a branch of theperoneal artery. The detailed anatomical knowledge of the peroneal artery in relationto the fibula is the key to raising osteofasciocutaneous free flaps incorporatingsegments of the bone. Free vascularized diaphysis grafts may also be taken on aperoneal arterial pedicle [4].

Generally the direction of the nutrientforamina is determined by the growing end of the bone [5]. The fibula reverses the ossificatory pattern in respect to other long bones [6]. Detailed data on the blood supply to the long bones and the association withthe areas of bone supplied has been continued to be a major factor in the developmentof new transplantation and resection techniques in orthopaedics [7]. The exact knowledge of position of the nutrient foramina of fibula is important to proceed with the free transplants of the vascularized bone graft. Commonly, the nutrient foramen is located in the middle third of the posterior surface of the fibula. The present study is undertaken, as the knowledge of nutrient foramina of fibula is

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useful for, anatomists, forensic experts, orthopedic, anthropologists and plastic surgeons for fibula graft and micro-vascular bone transfer.

Aims & Objectives

1. To locate and describe the position, number and direction of nutrient foramina of fibula.
2. To observe for any variations in location, position and number of nutrient foramina of fibula.

Methodology

The present study was conducted on 80 dry adult human fibulae in the Department of Anatomy, Government Medical College, Aurangabad, Maharashtra.

Materials Used

a. Sliding digital verniercalliper.

b. Osteometric board

After determining the side of the fibula, the length of fibula was measured by osteometric board. NF were identified by the presence of well marked groove leading to them. The NF was studied in variousregards i.e. the number of foramina on the shaft, surface, border on which it is present, direction from growing end, location in relation with length of the fibula. Number, distribution and direction of nutrient foramen in relation to specific surfaces, border and growing ends of fibulae. Part of bone possessed the absence, single or multiple foramen were noted. For determining the distribution of NF along the length of fibula each fibula was divided into three parts (upper, middle and lower 1/3rd) after measuring the length of the fibula and dividing by 3. The length of fibula measuring 30.1 to 35 cm were categorized as Type I, 35.1 to 40 cm as Type II, and 40.1 to 45 cm as Type III. All the data were first collected in a standardized excel sheet followed by tabulation for calculating the percentages of distribution of nutrient foramen along the length of fibulae.

Calculation of the Foraminal Index

The position of all nutrient foramina was determined by calculating foraminal index (FI) using the formula:

FI = DNF÷TL x 100 (Hughes [8] formula)

DNF = the distance from the proximal end of the bone to the nutrient foramen measured by vernier digital caliper with an accuracy of 0.01mm, later converted into cms.

TL =Total fibula length in cm from proximal end of bone to tip of lateral malleolus in cm by sliding caliper.

Results

Variations in the Number of Nutrient Foramen

Out of 80 fibulae in 2 (2.5%) fibulaenutrient foramen was absent, 71 (88.75%) fibulae showed single NF, 5 (6.25%) fibulae had Double NF and 2 (2.5%) fibulae had Triple NF.

Distribution of Nutrient Foramina in Right 40 and Left 40 Fibulae

Most common nutrient foramen was Single NF observed in 38 (95%) right and 33 (82.5%) left fibula. And less common foramen, Triple NF was seen in one each of the (5%) right and (0%) left fibulae.

Variations in the Direction of NF

In the total number of NF 75 (93.75%) foramen were directed away from growing end and abnormal direction of NF were seen in 5 (6.25%) foramen, i.e., towards the growing end, violating the law of ossification.

Discussion

The fibula is an ideal graft for reconstructing a long bone, especially when the skeletal defect is large [9]. The growing end of long bones is always located opposite to the direction of nutrient foramen. The

Table 1: Showing Variations in the Number of Nutrient Foramen

No. of foramen	No. of fibulae	Percentage
0	2	2.5
1	71	88.75
2	5	6.25
3	2	2.5

Table 2: Distribution of nutrient foramina in right and left fibulae

No. of foramina	Right Fibulae		Left Fibulae	
	No.	%	No.	%
0	1	2.5	1	2.5
1	38	95	33	82.5
2	3	7.5	2	5
3	2	5	0	0

Table 3: Direction of foramen towards and away from the growing end of fibulae in foramen

Side of Fibula	No. of Fibulae	Towards growing end		Away from growing end	
		No.	%	No.	%
Right	40	3	7.5	37	92.5
Left	40	2	5	38	95
Total	80	5	6.25	75	93.75

Variation in Distribution of Nutrient Foramen

Table 4: Number and location of nutrient foramina and their foraminal index of fibulae

Anatomical Site	No of Foramina	Range	Mean ± SD	p-Value
Anterior border	1	30.14 to 42.37	35.19±7.26	0.001
Interosseous border	4	48.23 to 59.18	59.48±9.13	0.001
Lateral surface	2	39.48 to 47.59	51.12±4.23	0.001
Medial crest	52	27.38 to 49.47	35.74±3.64	0.001
Medial surface	2	28.79 to 49.28	28.11±2.86	0.001
Posterior border	1	41.61 to 60.12	43.89±5.01	0.001
Posterior surface	18	25.91 to 52.76	24.91±3.54	0.001

direction of nutrient foramen is easily remembered by a 'dictum' that says, "To the elbow I go and from knee I flee". In the milking cow position the direction of nutrient foramina is always directed downwards [16].

Present study shows vary similar findings with previous observations made by various authors. Some findings doesn't appear similar with previous studies, this might be due to geographical and racial variation.

Conclusion

Vascular integrity of a long bone is vital, and knowledge of the nutrient artery anatomy entering the bone through nutrient foramen may be of value to the orthopaedic surgeon. The surgical exposure and periosteal stripping in open reduction and internal fixation procedures of diaphyseal fractures present further vascular insult to existing osseous

Number of Nutrient Foramen

Table 5: Prevalence of variations in number of nutrient foramen by various authors

Researchers	Year	No. of NF in %			
		0	1	2	3
Priya R[10]	2010	4.7	89.1	6.1	0
Prashanth K[11]	2011	9.8	90.2	0	0
Sanjeev[12]	2012	0	17	3	0
Gupta R[13]	2013	4.46	78.58	12.5	2.67
Anusha P[14]	2013	2	88	10	0
Present Study	2017	2.5	88.75	6.25	2.5

Position of Nutrient Foramina

Table 6: Prevalence of variations in position of nutrient foramina by various authors

Researchers	Year	Upper Third (%)	Middle Third (%)	Lower Third (%)
O Malukar[15]	2011	4	79	9
Gupta R[13]	2013	9.02	95	2
Anusha P[14]	2013	4	94	2
Present study	2017	3.21	94.67	2.12

Location of Nutrient Foramen

Table 7: Prevalence of variations in location of nutrient foramina by various authors

Researchers	Year	More frequent	Less frequent
O Malukar[15]	2011	90.8% on PS	2.2% on LS
Gupta R[13]	2013	87.96% on PS	6.77% on LS
Anusha P [14]	2013	95% on PS	24% on MS
Present study	2017	91.22 % on PS	10.86% on AB

injury.The morphometric study of nutrient foramen with regard to the number, location and position is assumed to be of great importance for clinicians, radiologists, orthopaedicians and vascular surgeons. Exact position and distribution of the nutrient foramina in bone diaphysis is important to avoid damage to the nutrient vessels during surgical procedures to plan for vascularised free fibular grafts is to include endostealas well as periosteal blood supply. The morphometric analysis of the position of the nutrient foramen of the fibula will help in harvesting vascularized graft of the bone, to preserve the circulation within bone, also to reconstruct and close the bone defects.

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Original Article

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A Study on Incidence of Caroticoclinoid Foramen

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Abstract

Background: The caroticoclinoid foramen is an inconstant structure, which is located in the middle cranial fossa composed by the ossification of a fibrous ligament that begins on the anterior clinoid process and binds to the middle clinoid process. Carotico-clinoid foramen allows the passage of one of the six segments of the internal carotid artery, the clinoidal segment [1]. The fibrous ossification of ligament is considered a normal physiological process. *Materials and Methods*: This study was conducted in different medical colleges in South India. 300 skulls were collected from I MBBS students and the incidence of caroticoclinoid foramen was studied. *Results*: Out of 300 skulls of unknown sex, 2 skulls showed bilateral caroticoclinoid foramen and 5 skulls had unilateral caroticoclinoid foramen, the total incidence was 2.33%. *Conclusion*: The present study concludes that the knowledge about caroticoclinoid foramen will be helpful in brain surgeries and CT scan studies of intracranial haemorrhage.

Keywords: Carotico Clenoid Foramen; Intracranial; Internal Carotid Artery; Brain.

Introduction

The anterior and middle clinoid processes of sphenoid bone are connected by a ligament called caroticoclinoid ligament, which may be ossified forming the caroticoclinoid foramen. Ossification of some normally occurring ligaments of the human skull produces the bony bridges that connect to the clinoid processes with other surrounding structures. The ligaments are related to many anatomical structures and when ossified may cause compression of these structures. The carotico clinoid foramen, first described by Henle, formed due to ossification of the ligamentous structures of the skull may result in clinical problems such as compression of neighbouring structures or complications in regional surgery. Research studies have also reported the fact that an ossified carotico clinoid ligament makes the removal of anterior clinoid process more difficult, especially in the presence of aneurysm [1,2].

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Study by Hochstetter [3] revealed the presence of this foramen in 14.1% of skulls. The caroticoclinoid and interclinoid ligaments are related to the internal carotid artery and oculomotor nerve. In the presence of caroticoclinoid foramen, it is impossible to retract or mobilise the cavernous segment of internal carotid artery even after releasing the proximal and distal carotid rings [4].

Preoperative recognition of caroticoclinoid foramen is important because undue retraction of cavernous segment of internal carotid artery may tear or rupture it and cause fatal cerebral infarction [5].

The caroticoclinoid bridge could cause pressure on the internal carotid artery that lies in the cavernous sinus changing the morphology in the terminal end of the groove of internal carotid artery. Due to greater calibre of internal carotid artery in this region compared to the diameter of caroticoclinoid foramen, the possibility of headache due to compression by the foramen is high. Caroticoclinoid foramen is an important structure due to its relations with cavernous sinus and its contents, sphenoid sinus, and pituitary gland [6].

The present study is conducted to find out the incidence of carotico clinoid foramen in the skulls obtained from south india as the knowledge about this foramen may be helpful to neurosurgeons in their practice.

Materials and Methods

This study was conducted in different medical colleges in South India. 300 skulls were collected from I MBBS students and the incidence of caroticoclinoid foramen was studied. The collected skull bases were clearly observed to find out the carotico clinoid ligament ossification.

Results

Out of 300 skulls of unknown sex, 2 skulls had bilateral carotico clinoid foramen and 5 skulls had unilateral carotico clinoid foramen, the total incidence was 2.33% (Table 1).

Table 1: Showing the incidence of caroticoclenoid foramen

	Number of skulls	Total number skulls observed	Incidence (%)
Unilateral caroticoclenoid foramen	5	300	1.66%
Bilateral caroticoclenoid foramen	2	300	0.66%
Total	7	300	2.33%

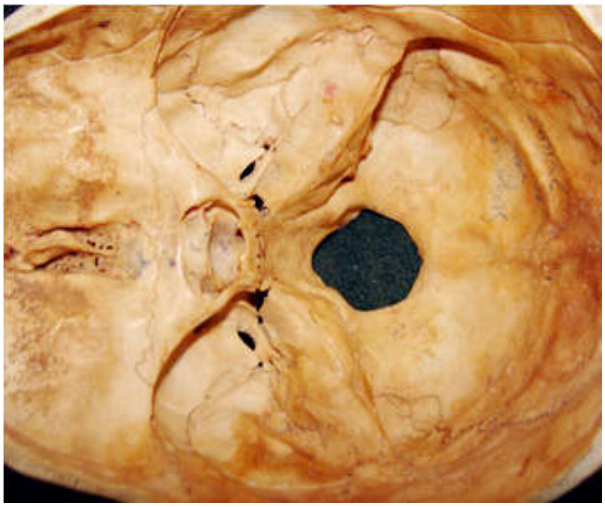

Fig. 1: Showing bilateral carotiococlenoid foramen

Fig. 2: Showing unilateral caroticoclenoid foramen

Discussion

Certain parts of the sphenoid bone are connected by ligaments which occasionally ossify such as the pterygospinous, the interclinoid and the carotico clinoid. The carotico clinoid foramen is the result of ossification either of the caroticoclinoid ligament or of a dural fold extending between the anterior and middle clinoid processes of the sphenoid bone.The existence of a bony caroticoclinoid foramen may cause compression, tightening or stretching of the internal carotid artery. Parasellar interclinoid bars are significant in surgical management while dealing with the vascular, neoplastic or traumatic lesions of the central skull base and can also compress the surrounding structures giving rise to various clinical symptoms. Removal of the anterior clinoid process is one of the most critical procedures to the successful and safe management of ophthalmic segment aneurysms and tumors located in the paraclinoid region and cavernous sinus. Special attention should be paid to the anatomic landmarks indicating the relationship between the anterior clinoid process and adjacent structures. Pneumatization of the anterior clinoid process should be evaluated preoperatively with computed tomography to avoid complications such as rhinorrhea and pneumocephalus [1,2].

In the present study, total 300 skulls were studied and the caroticoclinoid foramen was present in 2.33% of skulls. In a study involving 119 dry skulls and 52 cadaveric heads of Turkish population, Erturk et al [1] found the incidence of caroticoclinoid foramen in 35.67%. S.D Desai [2] reported the same as 37.19% out of 223 skulls. The study of Rani Archana [7] observed, out of the 250 dried indian human skulls 30 (12%) skulls showed caroticoclinoid foramen. Keyers [8] observed 34.84% incidence of caroticoclinoid foramen in American population.

In the present study bilateral caroticoclinoid foramen was found in 0.66% of skulls and unilateral caroticoclinoid foramen was found in 1.66% of skulls. In a study by S. D Desai [2], complete bilateral caroticoclinoid foramen was found in 10.31% and complete unilateral carotico clinoid foramen was found in 7.16% of skulls. In the study of Erturk [1], 11.69% of skulls were with bilateral caroticoclinoid foramen and 23.98% of skulls were with unilateral caroticoclinoid foramen. In a study on 270 dry human skulls by Azeredo [9], the fusion between the anterior and middle clinoid processes occurred bilaterally in 4.05% of skulls. A racial variation in the incidence of this foramen has been reported by Erturk et al [1]. A high incidence has been noted in Turkish (35.67%) and Caucasian Americans (34.84%) while a low incidence was found in Koreans (15.7%) and Japanese (9.9%). Hasan [10] reported bilateral caroticoclinoid foramen and absent mental foramen in an adult Asian female's dry skull. High incidence (15-38%) of this foramen has been associated with the idiots, criminals, epileptics, and those with hormone disturbances [11]. Since the incidence of caroticoclinoid foramen varies in different races and their geographical location, knowledge about its details will be helpful in surgeries of internal carotid artery and CT scan studies of skulls.

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Histopathological Evaluation of Cervix in Symptomatic Tribal Women of Jharkhand

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Abstract

Background: Cervical cancer is a major cause of mortality and premature death among women in their most productive years in low- and medium-resourced countries in Asia. *Aims:* Aim of this study to find the colposcopic findings in the symptomatic patients with cervical erosion and correlate the findings with cytology and histopathology. *Methods:* All the patients coming to gynaecological OPD with symptoms of white discharge, pruritus vulvae, menstrual irregularities were examined by per speculum examination and all those who had cervical erosion were included in the study and Pap smear and colposcopy both were done in all subjects. The colposcopic guided biopsy was done in women with abnormal findings on colposcopy (100 women) and reports were compared. Abnormal colposcopic findings were graded according to Reid's colposcopic index (RCI). *Results:* Majority of patients came with the complaint of white discharge per vaginum (55%). Out of total patients, 85 women (70.9%) had inflammatory pap smear and 35 women (29.1%) had abnormal pap smear. All patients underwent colposcopic examination and out of 100 patients, 67 (55.8%) showed normal colposcopic findings and 50 women (41.6%) had abnormal colposcopic finding and biopsy was taken. Only 3 women had unsatisfactory colposcopy. Histopathology confirmed 24 (48%) women with CIN I, 12 (24%) CIN II, 6 (12%) CIN III and only 2 (4%) women with carcinoma cervix. The colposcopy findings and histopathology correlated in 88%. *Conclusions:* Colposcopy should be prescribed to all symptomatic patients with cervical erosion as it is a good diagnostic tool for pre-malignant conditions of cervix and correlates well with histopathological findings.

Keywords: Cervical Erosion; Colposcopy; Cytology; Histopathology.

Introduction

Carcinoma of cervix is the second most common cancer among women world-wide, next only to breast cancer [1]. Every year cervical cancer is diagnosed in about 5 lacks women globally and is responsible for more than 2.8 lacks deaths annually. Wide variation in the incidence of cervical cancer across the globe. 80% of cases occur in developing countries, like India (reports one fourth of cervical cancer each year). In India - the commonest cancer among women. Cancer breast is the leading cancer among females as reported in registries from Mumbai, Delhi and Bangalore while in rest of registries, cancer cervix is the leading cancer followed by breast cancer [1,2].

According to WHO (2014) report India has the largest burden of cervical cancer patients in the world. 1 woman dies of cervical cancer every 8 minutes in India. India has a population of 453.02 millions women ages 15 years and older who are at risk of developing cervical cancer. Current estimates indicate that every year 122,844 women are diagnosed with cervical cancer and 67,477 die from the disease. Cervical cancer ranks as the 2nd most frequent cancer among women in India and the 2nd most frequent cancer among women between 15 and 44 years of age [3].

Cervical erosion/ectropion (or cervical eversion) is a condition in which the central (endocervical) columnar epithelium protrudes out through the external os of the cervix and onto the vaginal portion of the cervix, undergoes squamous metaplasia, and transforms to stratified squamous epithelium [2].

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When symptoms such as postcoital bleeding and troublesome vaginal discharge occur in women in the presence of cervical ectropion, it becomes important to identify promptly whether the ectropion is simply a benign lesion that has associated symptoms or whether it is a significant sign of associated infection, CIN or even cancer. Incidence of preclinical and invasive carcinoma is undeniably high amongst the group of "unhealthy cervix". Incidence of invasive carcinoma is reported to be 29 / 1000 in women with abnormal cervix but only 1.53 per 1000 in those with a healthy cervix. ICO Information Centre on HPV and cancer (Summary Report 2014-08-22). HPV and Related Diseases in India 2014 [4].

The incidence of cervical erosion along with cervical hyperplasia and carcinoma have been extensively observed and diagnosed separately since mid of 70's [5-6]. In present study we have studied the correlation among low socio-economic group of tribal women of Jharkhand has been poorly worked out.

Material & Methods

This prospective study was conducted in the department of Anatomy, MGM Medical College, Jamshedpur during January 2015 to April 2016. In this study 100 tribal women from low-socio-economic strata and of different age group with the main complain of vaginal discharge, pain lower abdomen and backache or irregular bleeding attended gynaecological OPD of MGM Medical College Jamshedpur and given consent to participate in the study were included. A complete clinical history and demographic status of the subject was recorded as per the proforma, with respect to age at presentation, age at marriage, parity, first child birth, socioeconomic status and literacy. Cases excluded from the study were**:** pregnant women, patients who have undergone hysterectomy, excessive vaginal bleeding at the time of examination and patients on therapy.

Conventional pap smears were taken with the help of the gynaecologists at the squamo columnar junction using Ayer's spatula in clockwise direction for 360°. The endocervical smears were made by rotating the endocervical brush. Two separate smears were made from the squamocolumnar junction and endocervical area on a single glass slide. The smears were immediately fixed in 95% Isopropyl alcohol for 30 minutes.

Biopsy was taken from cervix mainly in cases with epithelial cell abnormality on pap smears and badly eroded cervix, by applying 3% acetic acid (acetowhite areas). They were fixed in 10% formalin, routinely processed and stained with haematoxylin and eosin.

The pap smears were reported by adopting "The Revised Bethesda System of Classification (2001 TBS)" [7] and histopathology "WHO classification of tumours of uterine cervix" [8]. Correlation of cytological findings with histopathology was done considering histology as gold standard.

Results

A total of 100 participants were screened for the study. Majority of patients came with the complaint of watery white discharge per vaginum (54%) followed by Pain Lower abdomen and backache (23%) and Watery & Blood stained discharge per vaginum (11%) (Table 1).

Majority of patients were in the age group of 21-30 years (47%) followed by age group 41-50 years (27%) and age group 31-40 year (22%). There were no any patients reported above 60 years of age (Table 2).

The histological findings were depicted in Table 3 which showed that the majority of women (34%) had Cervicitis and 18% had hyperplasia. There were a significant number of women those histopathological reports showed both Cervicitis & Hyperplasia (31%). Dysplasia / CIN was reported in 13% of cases and 4 patients were reported as case of carcinoma cervix (Table 3).

Table 1: Distribution of cases according to major complaints (Symptoms)

Symptoms	Frequency (No.)	%
Watery Discharge per vaginum	54	54
Foul smelling discharge per vaginum	07	07
Blood stained discharge per vaginum	04	04
Watery & Blood stained discharge per vaginum	11	11
Pain Lower abdomen & backache	23	23
Irregular bleeding per vaginum	02	02
Total	100	100

Table 2: Showing distribution of patients according to age group

Age Groups (In Years)	Frequency (In NO.)	Percentage
21-30	47	47
31-40	22	22
41-50	27	27
51-60	04	04
Total	100	100

Table 3: Distribution of Cases according to Histological Findings

Histological Observation	Frequency (N=100)	%
Cervicitis	34	34
Hyperplasia	18	18
Cervicitis & Hyperplasia	31	31
Dysplasia / CIN	13	13
Invasive Ca	04	04

Table 4: Distribution of Histological Findings according to Age Group

Histological observation	Age in Years				Total
	21-30	31-40	41-50	51-60	
Cervicitis	20	06	08	00	34
Hyperplasia	06	05	05	02	18
Cervicitis & Hyperplasia	15	04	11	01	31
Dysplasia / CIN	05	05	02	01	13
Invasive Ca	01	02	01	00	04
Total	47	22	27	04	100

Table 5: Showing distribution of Histological observations according to duration of Marriage

Age in Years	Cervicitis	Hyperplasia	Cervicitis & Hyperplasia	Dyplasia / CIN	Invasive carcinoma	Total
Unmarried	02	0	0	0	0	02
10-15	02	01	0	01	0	04
16-20	13	11	17	05	01	47
21-25	11	05	13	04	02	35
26-30	05	01	01	01	0	08
More than 30	01	0	0	02	01	02
Total -	34	18	31	13	04	100

It was observed that the frequency of cases on the basis of Histological Findings and according to Age Group. It wasfound that majority of cases of cervicitis were in age group of 21-30 yrs followed by both cervicitis and hyperplasia (Table 4).

The Table 5 showed that the majority of patients with Cervicitis were from those attended marital age 16 20 years (38%) followed by 21-25 years (32%). Among the patients those suffering with hyperplasia majority (61%) were from age group 16-20 years and 27% were from age group of 21-25 years. Similar observation was found in patients those were suffering with Cervicitis & Hyperplasia (55%) and Dyplasia / CIN (38%).

So this table indicates that early marriage particularly below 20 yrs. make the women very much vulnerable for the development of different cervical lesion.

The Table 6 depicted that out of total cases 12% cases were nulliparous and 88% were parous. Among the parous majority were from multiparous (28%) followed by Triparous (24%). Amongst the nulliparous majority were from Cervicitis followed by Cervicitis & Hyperplasia. Similar observation was observed among the multiparous and Triparous. Thus maximum incidence of different cervical lesion is found in cases of high parity.

The Table 7 showed that the epithelial hyperplasia was more common (i.e. 68.6%) than Adenomatous hyperplasia (i.e. 31.3%). Amongst the epithelial hyperplasia, the majority of cases were of moderate and mild hyperplasia in the age gr. of 21 to 30 years followed by age group of 41-50 years. Similar findings were found in the patients those with adenomous hyperplasia.

Table 6: Showing distribution of Cases according to Parity

Histological observation	Nulliparous	Parous					Total
		Uniparous	Biparous	Triparous	Multiparous (Parity more than 3)	Total	
Cervicitis	4	5	7	8	9	29	33
Hyperplasia	2	3	3	5	5	16	18
Cervicitis &Hyperplasia	3	5	8	8	9	30	33
Dysplasia / CIN	2	2	2	2	5	11	13
Invasive Ca	1	0	1	1	0	2	3
Total -	12	15	21	24	28	88	100

Table 7: Showing Types and Grades of Hyperplasia according to Age Group

Age group In Year	Epithelial Hyperplasia (N=35)				Adenomatous Hyperplasia (N=16)				Total
	Mild	Moderate	severe	Total	Mild	Moderate	severe	Total	
21-30	7(13.7)	8(15.6)	0	15(29.4)	4(7.8)	4(7.8)	0	8(15.6)	23(45.09)
31-40	3(5.8)	5(9.8)	0	8(15.6)	2(3.9)	3(5.8)	0	5(9.8)	13(25.4)
41-50	2(3.9)	6(11.7)	0	8(15.6)	1(1.9)	2(3.9)	0	3(5.8)	11(21.5)
51-60	2(3.9)	2(3.9)	0	4(7.8)	0	0	0	0	4(7.8)
Total	14(27.4)	21(41.1)	0	35(68.6)	7(13.7)	9(17.6)	0	16(31.3)	51(100)

Discussion

Routine cervical cytology has been shown to be an effective screening tool for CIN and cervical cancer. However, negative cytology does not always rule out CIN [9-10].

In present study we observed that the maximum number of cases of unhealthy cervix were in the age group of 21-30 years (47%). While other study conducted in other part of country showed that majority of cases of unhealthy cervix were in the age group of 31–40 years [11-13]. It confirms the well-established fact that, unhealthy cervix is more common in women of reproductive age group who are sexually active.

The histological findings were depicted in table - 3 which showed that the majority of women (34%) had Cervicitis and 18% had hyperplasia. There were a significant number of women those histopathological reports showed both Cervicitis & Hyperplasia (31%). Dysplasia / CIN was reported in 13% of cases and 4 patients were reported as case of carcinoma cervix (Table 3).

It was observed that the frequency of cases on the basis of Histological Findings and according to Age Group. It wasfound that majority of cases of cervicitis were in age group of 21-30 yrs followed by both cervicitis and hyperplasia (Table 4).

Age of marriage and duration of exposure to sexual intercourse had a distinct role in genesis of cervical dysplasia. The majority of patients with Cervicitis were from those attended marital age 16-20 years (38%) followed by 21-25 years (32%). Among the patients those suffering with hyperplasia majority (61%) were from marital age group 16-20 years and 27% were from age group of 21-25 years. Similar observation was found in patients those were suffering with Cervicitis & Hyperplasia (55%) and Dyplasia / CIN (38%). So this table indicates that early marriage particularly below 20 yrs. make the women very much vulnerable for the development of different cervical lesion. This observation was also supported by Kushtagi*et al* (2002) [14], Sherwani RK *et al* (2007) [15] and MS Bal*et al* (2012) [16] who demonstrated that the severity of underlying CIN increased with increase in the duration of marital life and hence the increase in the duration of exposure to sexual intercourse.

The table-6 depicted that out of total cases 12% cases were nulliparous and 88% were parous. Among the parous majority were from multiparous (28%) followed by Triparous (24%). Amongst the nulliparous majority were from Cervicitis followed by Cervicitis & Hyperplasia. Similar observation was observed among the multiparous and Triparous. Thus maximum incidence of different cervical lesion is found in cases of high parity. Both Kushtagi P *et al* (2002) [14] andVaidya*et al* (2003) [17] also showed that the prevalence of CIN was significantly higher in parity of more than 2 and parity more than 4 respectively. The correlation of multiparity and cervical neoplasia may be attributed to hormonal and nutritional changes that occur in pregnancy, immuno suppression during pregnancy, and cervical trauma during vaginal delivery [18].

The Table 7 showed that the epithelial hyperplasia was more common (i.e. 68.6%) than Adenomatous hyperplasia (i.e. 31.3%). Amongst the epithelial hyperplasia, the majority of cases were of moderate and mild hyperplasia in the age gr. of 21 to 30 years

followed by age group of 41-50 years. Similar findings were found in the patients those with adenomous hyperplasia.

Conclusion

Cervical erosion is a very common finding on per speculum examination. It can be the outcome of infection or pre-neoplastic conditions. From our study, we conclude that all women with symptoms and presence ofcervical erosions on examination should undergo colposcopic examination and guided biopsies to detect more number of cases in premalignant state and early cervical cancers. There is good correlation between colposcopy and histopathology and both are complimentary to each other.

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Conflict of Interest

None declared

Ethical Approval

The study was approved by the Institutional Ethics Committee

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Morphometric Study and Variations in Plantaris Muscle

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Abstract

Introduction: Tendon of Plantaris muscle is one of the most desirable tendon used for reconstructive surgery. Other tendons are Palmaris longus, flexors as well as extensors of fingers and long extensors of the toes. The surgeon must base his selection of the donor tendon for grafting on the basis of tendon length or width. The Plantaris muscle is considered to be the one of the easiest tendon to harvest and therefore it remains one of the ideal choices for flaps or tendon grafts. *Aims and Objectives:* 1. To study the presence or absence of Plantaris muscle. 2. To study the variations of Plantaris muscle and its tendon. 3. To compare the prevalence of absence of plantraris muscle unilaterally or bilaterally. *Materials and Methods:* The study was done on 30 cadavers in the department of anatomy at Dr SCGMC Nanded and SRTR GMC Ambajogai. Plantaris muscle is subject to variations in the form of its presence or absence and attachments. Parameters like length of muscle, length of tendon and length of belly were measured using measuring tape and belly width and tendon width were measured using digital vernier caliper and recorded bilaterally and statistically analyzed. *Observations:* It was observed that length of tendon of plantaris muscle is more than the length of belly. There is statistically significant difference in the mean value of the total length of plantaris on the right and left side. There was unilateral absence of plantaris muscle on right side in 1 male cadaver and a bilateral absence in one female cadaver. Variations in insertion of plantaris were observed, like distal part of the tendon is fused with medial margin of soleus in a female cadaver on left side. Bilateral multiple slips from the tendon, few slips inserted to deep fascia, few slips to medial margin of soleus muscle and a long slip to calcaneum in a male cadaver. *Conclusion:* Based on the morphology and prevalence of the Plantaris muscle, it is ideal for use as the tendon graft or flap in reconstructive surgery.

Keywords: Plantaris Muscle; Prevalence; Variations; Reconstructive Surgery.

Introduction

The desire to replace missing tissue in the human body had existed since the beginning of the medicine [1]. The first efficient procedure of replacing mutilated nose with a tissue flap was accredited to susruta who lived in the 6th or 7th century [2].

In the 16th century the term flap originated from the Dutch word fleppe which means something that is loose and only attached by one side [3].

At the end of 19th century, physicians realized that by transferring tendons, functions of an extremity could be restored. The polio epidemic in Europe, in the 20th century, helped with the advancement of tendon transfers. Later tendon transfer surgery expanded not just to the patients with polio and cerebral palsy, but also to those who required reconstructive surgery for injuries during the First World War.

Tendons are frequently used for reconstructive surgery [4,5]. This includes Palmaris longus, plantaris, the long extensors of the toes and fingers [4,5,6]. The surgeon must base his selection of the donor tendon for grafting on the basis of tendon length or width. A tendon of more than 190 mm cannot be harvested from upper limb, while the lower limb can yield lengths upto 400 mm. The upper extremity can provide tendons as wide as 6 mm compared to lower limb that provides a maximum width of 4 mm. An important factor to consider is that difference in strength between 2 mm and 3 mm

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tendon could be significant. Thus according to Wehbe & Mawr(1992), tendons from upper limb should be considered when strength is important and lower limb tendons when length is a factor [4].

The most desirable tendons in reconstructive surgery are of Palmaris Longus and plantaris, while the long extensors of the toes and fingers as well as the flexor digitorum superficialis are regarded as suitable.

It is said that the existence and importance of the Plantaris muscle cannot be underestimated [7]. The Plantaris tendon is a great graft than the fascia lata, because it is easy to handle, harvesting, saves time and there is less mutilation of the body [8].

Aims and Objectives

1. To study the presence or absence of Plantaris muscle.
2. To study the variations of Plantaris muscle and its tendon.
3. To compare the prevalence of absence of plantraris muscle unilaterally or bilaterally.

Material and Method

Source of Data

The present study was carried out on 30 adult cadavers of both sexes in the anatomy department at Dr. Shankarrao Chavan Government Medical College Nanded and Swami Ramanand Treeth Rural Government Medical College Ambajogai, Dist. Beed, Maharashtra.

For this, approval of Institutional Ethical Committee was taken. The study was carried out over a period of two years.

Instruments Required

Dissection set, Digital Vernier Caliper and measuring tape, digital camera.

Inclusion Criteria

Adult cadaver of both sexes without any limb deformity.

Exclusion Criteria

Cadaver having any limb deformity was excluded from the study.

Method

The study was done on 30 cadavers in the department of anatomy of Dr SCGMC NANDED and SRTR GMC Ambjogai Dist Beed Maharashtra. Cadavers were dissected by routine dissection method. The study included 25 male and 5 female cadavers.

Origin of plantaris muscle is from the inferior part of the lateral supracondylar line of the femur and oblique popliteal ligament. Insertion is on the middle one third of posterior surface of calcaneum, medial to tendocalcaneus. Measurements included the length and the width of both belly and tendon of Plantaris. The origin, insertion and possible variations were observed and documented. Total length of muscle from its origin to insertion was measured using measuring tape. Length of belly was measured by its origin to the junction of fleshy and tendinous part of the muscle. Length of tendon was measured from the junction of fleshy and tendinous part of the muscle to the point of insertion on calcaneum. Width of both belly and tendon was taken at their widest parts.

The measurements of the length was done by using the measuring tape in centimeters and width of tendon in milimeters by digital vernier caliper. Each data was recorded bilaterally. The specimens with variations were photographed. The collected data was statistically analyzed.

Statistical Methods

Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in numbers.

Unpaired t test has been used to find out the significance of study parameters on continuous scale between two groups (inter group analysis) on metric parameters.

Observations

Dissection of 30 cadavers (25 male, 5 female cadavers) revealed the following details:

There is unilateral absence of plantaris muscle in one male cadaver on right side and bilateral absence in one female cadaver.

Table 2 shows that right plantaris was present in 28 specimens, absent in 2 specimens. Mean of right total length is 41.94643 cm and SD is 4.611458 and range is 32-51. The left plantaris was present in 29 specimen, absent in 1 specimen. Mean of left total

Fig. 1: Showing Instruments used for the study

length is 41.51724cm and S.D is 3.776059 and range is 33-49.

Table 3 shows that right plantaris was present in 28 specimens, absent in 2 specimens. Mean of right belly length is 7.453571cm and SD is 0.7366 and range is 6.5-9. The left plantaris was present in 29 specimens, absent in 1 specimen. Mean of left belly length is 7.472414cm and SD is 0.742533 and range is 6-8.7.

Table 4 shows that right plantaris was present in 28 specimens, absent in 2 specimens. Mean of right tendon length is 34.49286 cm and SD is 4.57877. The left plantaris was present in 29 specimens, absent in 1 specimen. Mean of left tendon length is 34.04483cm and SD is 4.004692.

Table 5 shows that right plantaris was present in 28 specimens, absent in 2 specimens. Mean of right belly width is 2.064286cm and SD is 0.527197 and range is 1.5-3.1. The left plantaris was present in 29 specimens, absent in 1 specimen. Mean of left belly width is 2.096552 cm and SD is 0.652185 and range is 1.5-4.

Table 6 shows that right plantaris was present in 28 specimens, absent in 2 specimens. Mean of right tendon width is 3.067857 mm and SD 0.88194 and range is 1.5-4. The left plantaris was present in 29 specimens, absent in 1 specimen. Mean of left tendon width is 2.87931mm and SD is 0.907658 and range is 1.5-4.

Table 1: Showing presence or absence of Plantaris

	Presence of Plantaris		Absence of Plantaris	
	Male(n=25)	Female(n=5)	Male(n=25)	Female(n=5)
Unilateral	24	5	1	0
Bilateral	25	4	0	1

Table 2: Comparison of total length of plantaris of both sides

	No. of specimens	Mean (cm)	Std. deviation	Minimum	Maximum
Rt total length	28	41.94643	4.611458	32	51
Lt total length	29	41.51724	3.776059	33	49

Table 3: Comparison of belly length of plantaris of both sides

	No. of specimens	Mean(cm)	Std. deviation	Minimum	Maximum
Rt belly length	28	7.453571	0.7366	6.5	9
Lt belly length	29	7.472414	0.742533	6	8.7

Table 4: Comparison of tendon length of plantaris of both sides

	No. of Specimens	Mean (cm)	Std. Deviation	Minimum	Maximum
Rt tendon length	28	34.49286	4.57877	24	43.5
Lt tendon length	29	34.04483	4.004692	24.6	42.1

Table 5: Comparison of belly width of plantaris of both sides

	No. of Specimens	Mean(mm)	Std. deviation	Minimum	Maximum
Rt belly width	28	2.064286	0.527197	1.5	3.1
Lt belly width	29	is 2.096552	0.652185	1.5	4

Table 6: Comparison of tendon width of plantaris of both sides

	No. of Specimens	Mean(mm)	Std. deviation	Minimum	Maximum
Rt tendon width	28	3.067857	0.88194	1.5	4
Lt tendon width	29	2.87931	0.907658	1.5	4

Tendon length and belly length is normally distributed.

In the total length, there is significant difference between right and left.

Right and Left total length P value is 0.7017

Right and Left belly length P value is 0.9237

Right and Left tendon length P value is 0.6954

Right and Left belly width P value is 0.8383

Right and Left tendon width P value is 0.43

Unpaired T test was used to compare the total length, tendon length, belly length, tendon width and belly width between right and left sides and it was found that, the P value was statistically not significant for all the parameters.

By dissection method it is observed that there is unilateral (right sided) absence of plantaris in one male cadaver and bilateral absence in one female cadaver.

In plantaris when mean of all the parameters of both sides were compared, the total length, tendon length and tendon width of right side was greater than left side. Belly length and belly width were greater on left side.

The mean and range of measurements from minimum to maximum in centimeters for total plantaris muscle n=57 specimens (1 unilateral and 1 bilateral absence of plantaris) are

1. Mean Total length is 41.731835 cm (32-51 cm)
2. Mean Tendon length is 34.171785 cm (24-43.5cm)
3. Mean Belly length is 7.46299 cm (6-9cm)
4. Mean Belly width is 2.077414 cm (1.4-4 cm)
5. Mean Tendon width is 0.2982415 cm (0.15-0.5 cm)

By dissection method it is observed that there was unilateral absence of plantaris muscle in 1 male cadaver on right side and bilateral absence in one female cadaver.

Variations in insertion of plantaris were present, like small muscle belly, with thick short tendon. Distal part of the tendon is fused with medial margin of soleus in a female cadaver on left side. Bilateral multiple slips from the tendon, few slips inserted to deep fascia, few slips to medial margin of soleus muscle and a long slip to calcaneum in a male cadaver.

Discussion

Aim of this study was to study the morphology and to determine the incidence of plantaris muscle.

Fig. 2: Showing Belly of Plantaris

Fig. 3: Showing measurement of total length of plantaris

Fig. 4: Showing measurement of tendon length of plantaris

The results of above mentioned study were then compared with what has been reported in the literature in previous similar studies. From information gained from this study, we hope to help orthopaedic and plastic surgeons, using these muscles as grafts or flaps in reconstructive surgery and to make knowledgeable decision based on the morphology of these muscles as well as on the analysis of the presence and or absence of these muscles.

The plantaris muscle is vestigial and may show variation in its structure, as well as in its point of origin and insertion [5]. This is important to realize when to plan to use the plantaris tendon in reconstructive surgery. Morphology of plantaris muscle was described. However the variation described up to date, and the location of this muscle in the lower leg, could be seen as a disadvantage when using this tendon in reconstructive surgery [9,8].

Slight differences were found between the current study and that reported in the literature. The prevalence of this muscle yielded the same result when compared to past studies.

Anatomy of the plantaris muscle examined on the cadaver specimens, correlated to the studies of previous workers. In Table 7 the measurements taken for the plantaris muscle is shown and compared to the measurements found in the previous studies.

White (1960) described the tendon length (300-400) and belly length (100 mm) of the plantaris muscle[6]. Carlson and co-workers (1993) noted the length of the plantaris tendon, which averaged 334 mm [5]. Daseler, Anson (1943) and Williams(1995) described the length of plantaris belly, which ranged between 70-100 mm [11,14].

The length of the plantaris tendon measured in the present study is longer than described in the literature (334 mm). Average width of the plantaris muscle tendon was found to be 5.53mm, and based on a search of similar studies conducted in the past, to the author's knowledge this is the first study to measure the width of the plantaris tendon on a cadaver sample. The length of the belly is within the range described in the previous studies. The total length of the plantaris muscle was, on an average, 420.3mm. The length of the plantaris tendon, in the current study, meets the requirements necessary to be used as a graft in reconstructive surgery. White (1960) [6] reported the length of the muscular belly of the plantaris muscle does seldom exceed 100mm and that the length of the tendon is about three to four times longer, meaning 300-400 mm . Daseler and Anson (1943) [11] and Williams (1995)[14] and reported a belly length of between 70 mm and 100 mm.

Variations were noted in the insertion of the plantaris muscle, like short tendon, inserted either on the gastrocnemius or soleus muscle. A female cadaver had a plantaris tendon that inserted on the soleus muscle in left lower limb and a male had a similar short plantaris tendon which inserted on the medial margin of soleus and to deep fascia with splitting of the tendon.

Table 7: Comparison of the measurements of the plantaris muscle to that described in the previous studies. The measurements are in millimeters (mm)

	Tendon length	Tendon width	Belly length	Belly width	Total length
White (1960)6	300-400	-	100	-	-
Carlson and co-workers(1993)5	334	-	-	-	-
Williams (1995)14	-	-	70-100	-	-
Daseler and Anson(1943)11	-	-	75-100	-	-
Present study(min-max)	240-435	1.5-4	60-90	15-40	320-510

Some of the characteristics of the plantaris muscle make it a fitting donor tendon for grafting procedures [11]. The plantaris tendon can be used for a variety of reconstructions, because of its length [11,12].

Prevalence of the Plantaris Muscle

Harvey (1983) contended that the dispensability of the plantaris makes it a fitting donor tendon for reconstructive surgery [12].

However, the prevalence of this muscle must first be determined before its suitability for grafting can be established. It is reported that the prevalence of the plantaris muscle may differ between different races [9].

The prevalence of the plantaris muscle was similar to what has been reported in previous studies (Table 8).

Daseler and Anson (1943) studied 750 leg specimens (375 individuals) and reported a bilateral absence of 3.5%[11]. When looking at all the studies done on the prevalence of the plantaris muscle, it is clear that the muscle is present on both sides in 83.45% of the population (1142/1369) and absent in 8.47% (116/1369). Globally the muscle is absent only on the left side in 4.31% (59/1369) and on the right side in 3.80% (52/1369). In present study plantaris is absent unilaterally on right side in 6.66% and unilaterally on left side in 3.33%. Other studies included more information regarding the morphology of the plantaris muscle, as seen in Table 7.

Table 8: Prevalence of the plantaris muscle, a comparison between different studies

Author	Total sample	Present bilaterally		Absent bilaterally		Unilateral absence (left)		Unilateral absence (right)	
		N	%	N	%	N	%	N	%
Daseler & Anson (1943)11	375	338	90.13	13	3.46	18	4.8	6	1.6
Harvey et al.,(1983)12	658	502	76.29	84	12.77	32	4.86	40	6.08
Vanderhooft (1996)10	186	174	93.55	6	3.23	4	2.15	2	1.08
Present study	30	29	96.6	1	3.33	1	3.33	2	6.66

Conclusion

Plantaris muscle is a muscle of superficial flexor compartment of the leg. It is one of the most variable muscle in human body, not only in terms of absence but also in terms of its muscle variation. It is phylogenetically classified as retrogressive muscle as it has short belly and long tendon.

It has been the subject of several cadaveric aswell as in vivo studies because of its clinical importance as donor tendon. Although it is well known that there is wide variation in the reported prevalence of absence or plantaris absence in different ethnic groups, it is clear that a standard prevalence of absence of plantaris muscle cannot be applied to all population.

Variation in form and attachment of the plantaris was found in one male cadaver and one female cadaver. Absence of plantaris unilaterally on right side in a male cadavers 3.3%. Knowledge of these variations are important before harvesting the tendon for graft. Plantaris tendon length and total length is normally distributed. And in total length, there is significant difference between right and left.

Summary

Plantaris muscle is a muscle of the posterior (flexor) compartment of leg. In the plantaris muscle, muscular belly ends in a long, slender tendon which descends between the gastrocnemius and soleus muscles, towards the medial border of the calcaneal tendon. The plantaris muscle is vestigial and subject to variation that may be brought about by "functional evolutionary influences".

The study was done in the department of anatomy at Dr. Shankarrao Chavan Govt. Medical College, Nanded and SRTR Govt. Medical College Ambajogai. Cadavers were dissected by routine dissection method. The sample included 25 male and 5 female cadavers. Variations were noted and photographed. Measurements of tendon length, tendon width, belly length, belly width and total length were obtained for plantaris muscle and results were statistically analyzed by unpaired t test and excel sheet.

There was unilateral absence of plantaris muscle on right side in a male cadaver. Percentage of unilateral absence is 3.3% and a bilateral absence of plantaris muscle in a female cadaver. Percentage of

bilateral absence is 3.33%. Upon investigation of the prevalence of plantaris muscle, it was found that the percentage values, obtained in this study, correlated well with what has been reported in the literature.

Variations in insertion of plantaris were present, like small muscle belly, with thick short tendon. Distal part of the tendon is fused with medial margin of soleus in a female cadaver on left side. Bilateral multiple slips from the tendon, few slips inserted to deep fascia, few slips to medial margin of soleus muscle and a long slip to calcaneum in a male cadaver.

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Morphometric Analysis on Renal Development According to Weight in Aborted Fetus

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Abstract

In the modern days there is a high prevalence of Hypertension, Non-Insulin dependent Diabetes Mellitus, cardiovascular disorders and soon. Barkers Hypothesis stated that low birth weight of fetus leads to Low nephron number is a factor that is responsible for these clinical conditions. In the work towards this I have studied the fetuses of various gestations, I have studied 50 fetuses of which 30 males and 20 females were observed various renal parameters like Length, width, thickness, number of lobulations and weight of the kidney. Morphometric parameters of kidney play a vital role in estimating the gestational age. The major problem in deciding gestational age of the fetus is bleeding during implantation is wrongly interpreted as last normal menstrual period by women results in abnormal gestational age. This problem can be solved by the ultra sound measurement of renal Parameters in addition to various regular parameters like crown rump length and crown heel length and so on. In the current study there are details obtained of various morphology and morphometric analysis of fetal kidneys of different age groups which are tabulated, described and discussed with various studies conducted at different time spans. The following research contributes in solving the problem with regarding gestational age finding.

Keywords: Gestational Age; Abortion; Hypertension; Kidney Length; Kidney Width; Kidney Thickness; Kidney Weight; Kidney Lobulations and Low Birth Weight.

Introduction

"Why a pregnancy runs successfully to full- term, while in other cases, it is interrupted without any visible or recognizable cause, remains a mystery." "The exact frequency of spontaneous abortions in the general population is unknown. It has only been suggested that pregnancy loss is common, affecting 10% to 15% and even to 20% of all pregnancies [1].

The terms 'spontaneous abortion' and 'miscarriage' are synonymous and are defined as loss of the fetus before the twenty eighth (28) week of pregnancy. This definition implies a legal perception of the age at which a fetus can survive out of the womb. With great advances in recent years in the ability to keep very premature babies alive, this definition is in need of revision."

"Accurate gestational age assessment is pivotal to Quality Maternal Care e. g, Diagnosis of Growth Disorders and Timing of Delivery." Failure can result in iatrogenic prematurity or post maturity, both of which are associated with an increased perinatal morbidity and mortality [2].

Historically, the dating of pregnancies was based on the first day of the LMP in a regular 28 days menstrual cycle. "Even when the LMP can be reliably recalled, factors such as Oligo - Ovulation and Hormone Therapy may delay ovulation and therefore cause inaccurate dating." Since the introduction of Diagnostic Ultrasound, more reliable approaches to the dating of pregnancies have been developed. Most of these methods can predict gestational age with a high degree of accuracy in "early second trimester." Gestational age can be better predicted by adding fetal kidney length to other routine parameters. Precise

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assessment of the Gestational Age (GA) is essential in prenatal medicine to predict fetal health and labor dating. Errors in determining the exact GA may interfere with critical management decisions, such as in preterm labor as well as growth disorders that are considered to be the leading cause of neonatal morbidity and mortality.

"Prenatal development is a very crucial period for human development. "Development of human kidney runs through a series of continual and mutually dependent changes, during which kidney obtains its morphological and functional maturity." Kidney parameters are most accurate for estimating gestational age than other biometric indices. The fetal kidney is easy to identify and measure, but has not been studied extensively as a Biometric index for gestational age estimation. Cohert et al demonstrated a strong correlation between gestational age and kidney length.

For diagnostic and therapeutic procedures in the field of medical sciences, with the advent of modern technology and equipment, it becomes important to have sound knowledge of developmental anatomy and basic human morphology. Urinary malformations are associated with Low Birth Weight, Placental Insufficiency, Maternal diseases, Maternal Exposure to drugs and Maternal Exposure to Environmental Pesticides. Living Environment and Socio – Economic Factors may also influence the incidence of urinary malformations [3,4].

Accurate gestational age estimation is very important to an obstetrician for diagnosis of Growth Disorders, Assessment of Wrong Dates, Assessment of Forgotten Dates, Assessing Timing of Delivery, either by Induction of Labour or by Caesarean Section [5]. Accurate gestational age estimation is particularly important in high risk pregnancies like Severe Pre – Eclampsia, Chronic Hypertension, Severe Intra Uterine Growth Retardation,Central Placenta Previa, Sensitized Rh-Negative Mother etc, to decide early termination of pregnancy, as soon as fetus becomes mature, in some cases."

Materials and Methods

This work was conducted in the department of Anatomy Vinayaka Missions Kirupanandavariyar Medical College, Salem Poly Clinic, Akshaya Fertility Center and Saraswathi Nursing Home, Salem, TN, India and SV Medical College, Tirupati in collaboration with the Departments of Obstetrics and gynecology of Govt. Maternity Hospital and Department of nephrology, Sri Venkateswara Institute of Medical Sciences Hospital, Tirupati, AP, India. Instituitional Ethical committee Clearance is obtained to perform the study at VMKV Medical college, Salem TN India. This study is taken in Partial Fulfilment for the award of Degree of Doctor of Philosophy in Anatomy. A total of 50 dead fetuses of both sexes in which 20 female and 30 male collected from places with relevant clinical history were utilized for the present study. A special data sheet was designed for recording various parameters observed. The fetal weight, and external visible congenital anomalies were recorded. The fetuses were collected in 10% formalin solution. The fetuses were preserved by injecting 10% formalin solution in to the pleural, peritoneal and cranial cavities. The extremities were preserved by multiple injections technique.

Abdominal cavity of each fetus was opened and the position, shape, and size of the liver stomach, coils of intestine, spleen, pancreas, and large intestine were observed and deviations if any were recorded and appropriate photographs taken. All the above mentioned organs were removed by applying ligatures at the proximal and distal part of the gut to prevent spillage of gut contents. The retroperitoneal organs i.e. kidneys, supra renals, and ureters, abdominal aorta and inferior venacava and their branches were exposed by cleaning the adjacent tissue.

The position and immediate relations of kidneys, hilar structures and their arrangement were observed. Both the kidneys with ureters and abdominal aorta with renal arteries upto their entries into the kidney were exposed and were removed from abdominal cavity as a single unit. The weight, length, width, thickness and number of lobulations of the kidneys were recorded and tabulated (Table 1). The kidney specimens collected were categorized according to the weight of the fetus into three groups Group I are fetuses of less than 1000gms weight, Group II are fetuses of 1000 to 2000gms and Group III are fetuses of more than 2000gms weight.

Results

According to weight of fetuses:

Group I: (Table 1): Among 50 fetuses collected for this study 28 fetuses were in Group I (<1000gms weight) that weighed from 400-1000gms with a mean weight of 725gms. Their gestational periods were from 21 to 29 weeks of gestation with a mean of 24.21 weeks.

Table 1: Showed the mean values for morphometric parameters of Group I, Group II and Group III kidneys on both sides in different gestational periods according to weight of fetuses

Group	Side	No. of kidneys	Age in weeks	Weight of fetus (gms)	Length (cms)	Width (cms)	Thickness (cms)	Lobules	Weight of kidney (gms)
Group-I	Right	28	24.21	725	2.82	1.64	1.3	16.1	3.65
	Left	28	24.21	725	2.81	1.67	1.29	15.92	3.64
	Mean	28	24.21	725	2.82	1.66	1.3	16.01	3.65
Group-II	Right	14	29.6	1535	2.98	1.66	1.28	20.8	3.19
	Left	14	29.6	1535	3.1	1.85	1.45	20.5	3.89
	Mean	14	29.6	1535	3.04	1.76	1.37	20.65	3.54
Group-III	Right	8	32	2400	3.23	1.9	1.87	23.67	6.39
	Left	8	32	2400	3.4	2.15	1.65	19.5	5.32
	Mean	8	32	2400	3.32	2.03	1.76	21.59	5.86

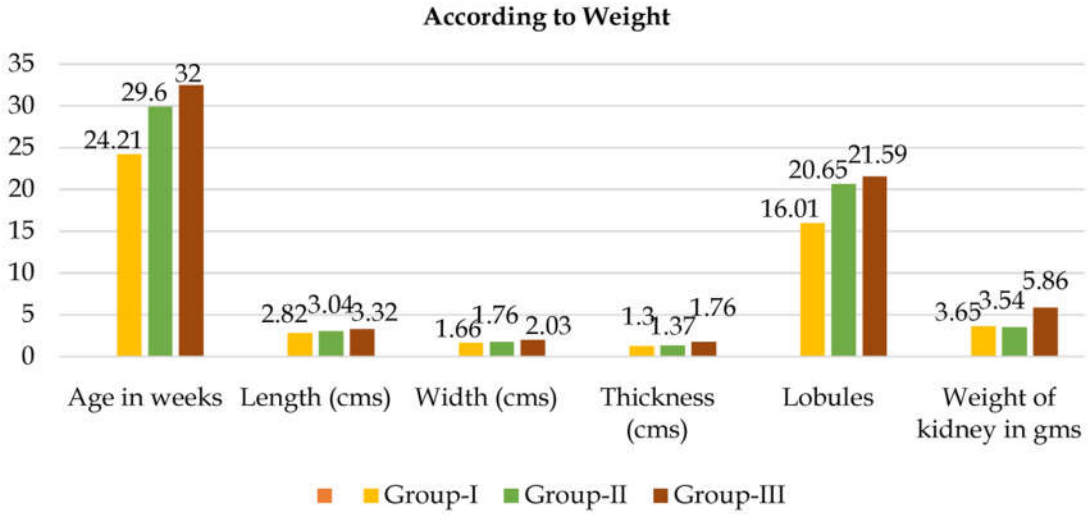

Fig. 1:

In this group kidneys weighed from 1.47gms to 13.67gms on right side and 1.4gms to 14.17gms left side with a mean weight of 3.65gms on right side and 3.64gms on left side. Mean weight of right kidney is slightly more than the left though the range is wider on the left side. Mean of the number of lobules was 16.1 on right side and 15.92 on left side.

Among all kidneys a female fetus of gestational period 24 weeks of weight 600gms showed kidneys of abnormal weights as 13.67gms and 14.17gms on right and left sides respectively.

Other morphometric parameters such as length, width and thickness were 2.82 X 1.64 x 1.3cms and 2.81 X 1.67 X 1.29cms on right and left sides respectively. These values indicate that there is a little hike in right kidney when compared with the left side mean values.

Group II: (Table 1)

Among 50 fetuses collected for this study 14 fetuses were of 1000 -2000gms of weight. Their gestational period ranged from 27 to 33 weeks. Weights of the fetuses in Group II ranged from 1100 to 1750gms. Mean weight of the fetuses for this group is about 1535gms.

In this group kidney weight ranged from 1.85 to 4.08gms with a mean weight of 3.19gms on its right side and the values for the left side were between 2.6 to 4.94gms with a mean value of 3.89gms. Mean weights of left one showed 0.8gms increase in weight.

Other morphometric parameters such as length, width and thickness were 2.98 X 1.66 X 1.28cms and 3.1 X 1.85 X1.45 on right and left sides respectively. Mean of the number of lobules was 20.8 on right side and 20.5 on left side. These values indicate that there is a little hike in left kidney when compared with the right side mean values.

Group III: (Table 1)

Among 50 fetuses collected for this study 8 fetuses were of more than 2000gms of weight. Their

gestational period ranges from 26-34 weeks. In this group we studied 8 fetuses and their average weight was 2400gms.

In this group the mean values of the kidneys were 3.23gms on right side and 3.4gms on left side. The mean values indicate that there is a little hike on left side when compared to right side.

Other morphometric parameters such as length, width and thickness were 3.23x1.9x1.87cms and 3.4x2.15x1.65cms on right and left sides respectively. Mean of the number of lobules was 23.67 on right side and 19.5 on left side These values indicate that there is a little hike in left kidneys when compared with the right side mean values.

Overall observations among the 3 groups in this study by the mean values from both right and left side indicates that there is a slight increase in morphometric parameters from Group I to Group II and Group II to Group III.

Graph showed the mean values for morphometric parameters of Group I, Group II and Group III kidneys on both sides in different gestational periods according to weight of fetuses.

The graph illustrates that among the 3 groups in this study by the mean values from both right and left side indicate that there is a slight increase in morphometric parameters from Group I to Group II and Group II to Group III.

Discussion

Very few studies are performed with respect to the renal development of which some studies are conducted with the help of Ultrasound technique of which some studies exist for direct measurements of Kidney length which are compared with present study. There are few studies with respect to Renal length and breadth they are discussed below.

According to Nirmalendu Das et al [6] mean kidney length was 2.3cm, Konje et al [7] mean kidney length was 2.42cm, Shiva Lingaiah N et al[8] 2.41cm, Sunitha V et al [9] 1.88cm, at 24 weeks of gestation but our study reveals that mean average length is 2.82 cm at 24.21 weeks of gestation. There is no study available regarding the breadth, width, thickness, lobule number and weight of the kidney at this gestational age.

According to Nirmalendu Das et al [6] mean kidney length was 2.9cm, Gupta et al [10] mean kidney length was 3.14 cm at 29th Gestation week and present study mean kidney length at 29.6th week is 3.04cm. Mean kidney breadth was studied by Nirmalendu et al [6] and Ahmedi et al mean kidney breadth at 30th week of gestation was observed as 1.41cm and1.94 respectively. At 32nd gestational week kidney mean average length in our study was 3.32cm which is coinciding with Konje et al [7], mean kidney length value is less in studies performed by Nirmalendu das et al [6], Shivalingaiah N et al [8], Sunitha V et al [9] as 3.2cm, 3.2cm, 3.62cm, 3.28cm, 2.8cm, respectively and mean kidney length was greater than the present study observed by Gupta DP et al [10] as 3.47cm. Mean kidney breadth was studied by Nirmalendu Das et al [6] and Ahmadi F et al [11] as 1.48cm and 2.06cm and the values obtained by the current study are 2.03cm which is close to Ahmadi F et al [11]. Over all observation of the values we can say that there is a linear growth in length, width, thickness from group I to Group II and Group II to Group III. Number of lobules in the kidney and weight of the kidney decreased from group I to Group II slightly and Increased from Group II to Group III.

Conclusion

Kidney morphometrical parameters play a vital role in defining the gestational age which can be known by various techniques like ultrasound and medical imaging and also defining area of the cortex which in turn decides the number of glomeruli present in the kidney contributes for the prenatal counselling of hypertension, Non-Insulin dependent diabetes mellitus and other cardiovascular disorders in infantile state and prone to be predicted hypertensive in later part of life which is due to low nephron number .

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Original Article

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A Study on Bifurcation of Brachial Artery in South Indian Population (Tamil Nadu and Puducherry)

Vijisha Phalgunan[1], Anandaramajayan Nallathambi[2]

Abstract

Aims: The primitive aim of the study is to determine the level of termination of the brachial artery in the South Indian population (Tamil Nadu and Puducherry). *Methods and Material*: The present study was carried out in 30 cadavers in the department of Anatomy, at Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry from 2014 to 2017. The dissection was done precisely according to the Cunningham's manual of anatomy upper limband lower limb. The variations were observed and the photographs were taken for reference. *Statistical Analysis Used:* SPSS T- TEST. *Results:* In 60 upper limbs, 3 (5%) specimens possessed a higher level of bifurcation of brachial artery. *Conclusions:* A Higher bifurcation of brachial artery can be present in a significant number of patients; hence its presence should be evaluated during vascular mapping prior to any clinical procedures.

Keywords: Brachial Artery; Bifurcation; Radial Artery; Ulnar Artery.

Introduction

The main arterial supply of the arm comes from the brachial artery. It begins as the continuation of 3rd part of axillary artery, it extends from the lower border of teres major to the level of neck of radius. On its course it gives origin to arteriapro fundabrachii, superior & inferior ulnar collateral artery, nutrient artery and few muscular branches [1]. Further it terminates in the Cubital fossa at a distance of 3.0cms from the intercondylar line, near the neck of radius into radial and ulnar artery [2]. Variatons in the arterial anatomy are less frequent unlike venous system. Among the arteries of limbs brachial artery variations are the most reported ones, out of which a high division of brachial artery is the most common, least prevalent are the high origin of radial artery or the existence of a double brachial artery [3]. In the upperlimb, six different patterns of brachial artery have been described till now. Anatomically and clinically the knowledge of detailed description of vascular pattern and its variations are of utmost important. Variations in the course and branching pattern of the brachial artery are of great importance in cardiac catheterization for angioplasty, radiology and arterial grafting [1].

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Subjects and Methods

The present study was done in the Department of Anatomy of Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry from a period 2014 to 2017. The study was carried out during the routine dissection for 1st year M.B.B.S students. In 30 cadavers 60 upper limbs (30 right and 30 left) were dissected according to the manual of Cunningham's manual of anatomy. The measurement was taken using a metric scale and nylon thread.

The Following Parameters were Observed

1. Normal course of the brachial artery in the arm
2. Brim of the brachial artery
3. Terminal branching pattern of brachial artery

Results

Out of 60 limbs dissected, a variation in the terminal branching pattern of the brachial artery was encountered in three cadavers.The terminal

branching pattern was higher than usual. This was observed unilaterally occurring in both the limbs irrespective of their sides, in our study we observed one on the right limb and two on the left limb. The observations are described as below:

Cadaver 1

A higher level bifurcation of the brachial artery into radial and ulnar artery was seen. The brachial artery bifurcation was found higher than the usual, which was 13cm from the intercondylar line. This was found on the left upperlimb of a male cadaver Figure 1. The right upperlimb bifurcation was at the usual site.

Cadaver 2

Another similar variation of a high level bifurcation of the brachial artery was found unilaterally occurring in a male cadaver on the left upperlimb. The artery bifurcated into radial & ulnar artery at a distance of 7.5cm from the intercondylar line. At the level of bifurcation, the ulnar artery was lying initially on the lateral side and radial artery was on the medial side. By the time it reaches the cubital fossa, the radial artery crosses the ulnar artery to reach the lateral aspect of the limb and further continues its normal course Fig 2. No variations were observed on the left limb of the cadaver.

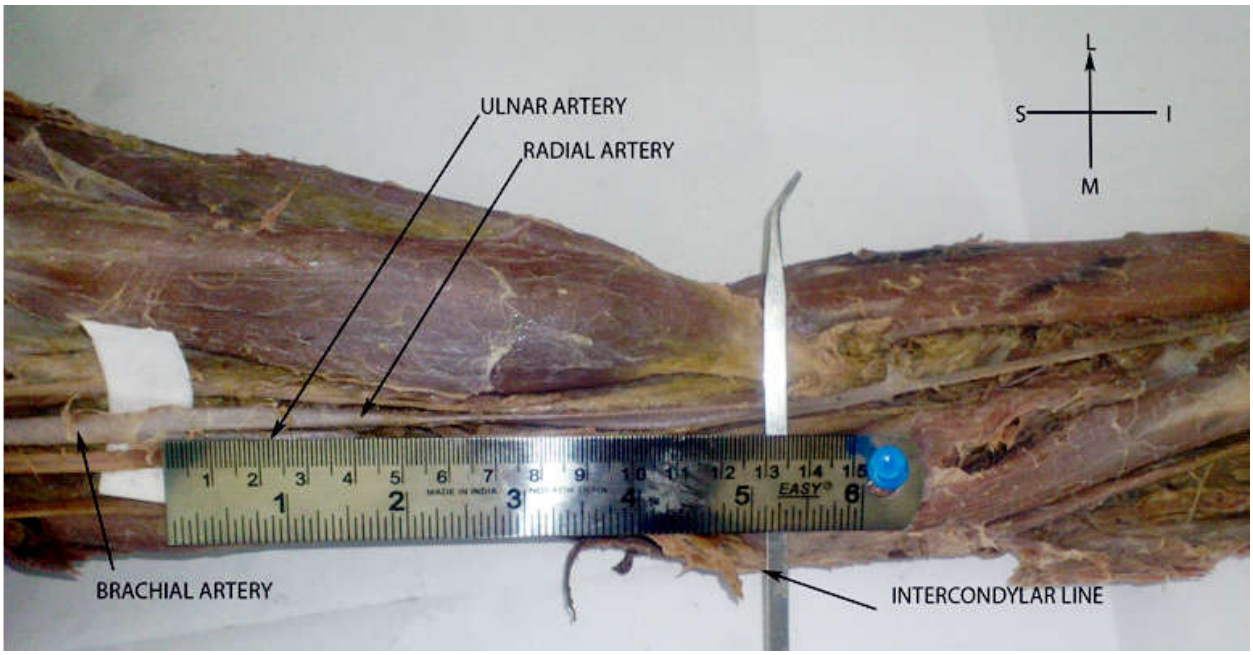

Fig. 1:

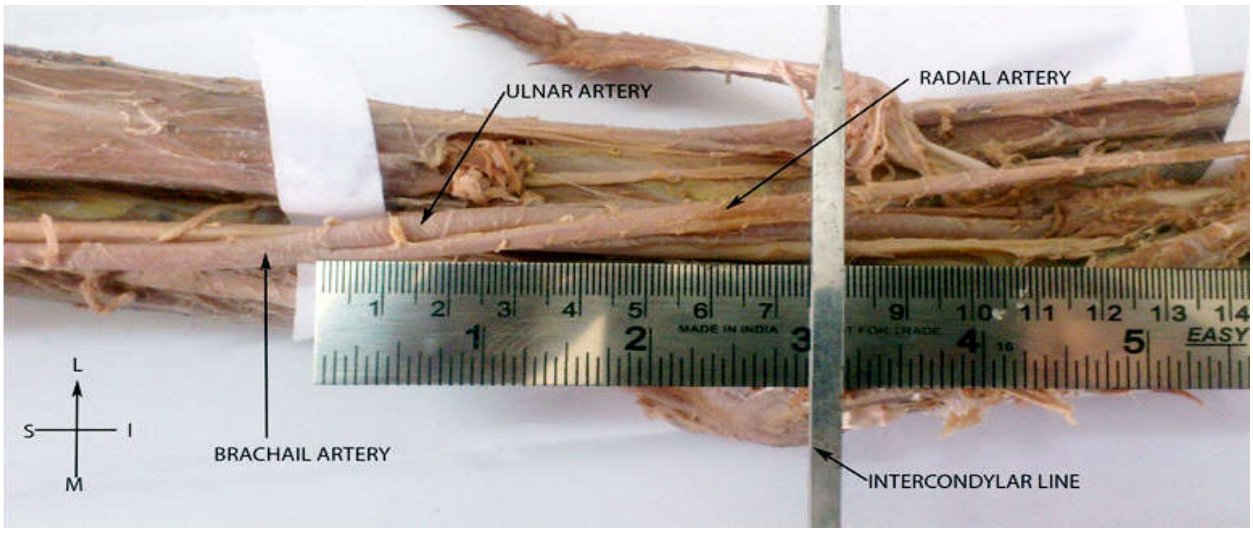

Fig. 2:

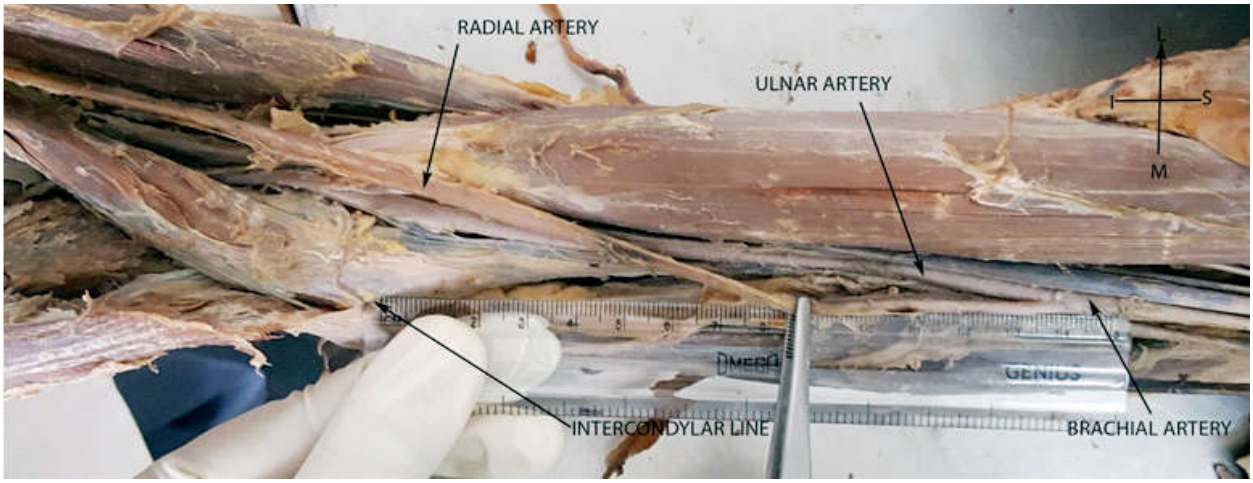

Fig. 3:

Cadaver 3

In another male cadaver, high level bifurcation of brachial artery at a distance of 13.5cm from the intercondylar line was observed on the right upper limb. Here too after the bifurcation, the ulnar artery was lying on the lateral side and radial artery was on the medial side initially and by the time it reaches the cubital fossa the radial artery crosses the ulnar artery and reaches the lateral aspect of the limb Fig 3. The left limb had a normal course of brachial artery with branches.

The radial artery in the arm gave small branches to the muscles and continued distally crossing the elbow joint into the distal part of the forearm normally. The ulnar artery also gave the same course as in the arm, cubital fossa beyond which it continued as a normal ulnar artery.

Discussion

Anomalies in origin of principal arteries might be prone to damage in orthopedic and plastic surgeries. Diagnostically the evaluation of angiographic images may be difficult [4].

In the present study, brachial artery is bifurcated into its terminal branches proximal to the intercondylar line into radial artery and ulnar artery. All the other branches of brachial artery were found to be having a normal origin and course. In all the three limbs the brachial artery presented with higher level terminating branching pattern, but it occurred unilaterally on one side only. The other limb brachial artery branching pattern was normal.

SATYNARAYANA. N observed an unusually short segment brachial artery with a high up division of brachial artery at the level of insertion of coracobrachialis in the middle of the right arm [5]. The brachial artery was 11.5cm in length and having slightly less caliber than usual. However, it bifurcated normally into radial and ulnar arteries [6]. In another study, the high division of the brachial artery observed in an individual situated 20 cm above the cubital fossa and 8.5cm below the axilla, in the right arm and 21.5 cm above the cubital fossa and 7.0 cm below the axilla in the left arm by 23 Rossi et al [7].

Vishal et al have reported a case of high division of brachial artery into medial and lateral branches, 9.5 cm distal to the lower border of teres major muscle [8]. Brachial artery variations occur in almost 20% of the cases and are encountered during routine clinical practice or dissection [9-11]. The brachial artery may be absent in rare cases [12], trifurcating [13,14], or divided at a higher level [15]. The division of anomalous arteries in the arm are determined with the line between the two condyles called intercondylar line of the humerus. Brachial artery giving its terminal branches proximal to the intercondylar line is considered as a variation [16].

The terminating branching pattern of brachial artery was also studied in detail by earlier investigators [2,11,17-19]. The highest percentage of variations contributes to the high origin of radial and ulnar artery. A high origin of radial artery may arise as high as the axillary artery but most commonly arises from the proximal one third of the arm [10]. Many authors have described the arterial variations in detail [10,20,21]. Mccormack observed in 750 cases, in which he found 18.5% anatomical variations, 77% of the cases with the high origin of radial artery and 12.2% variations of ulnar artery [10]. In another study done by Pelin observed an

incidence of 14.27% of high origin of the radial artery (axillary or brachial artery) in dissections of cadavers and 9.75% in an angiographic study [22].

In a study done in 25 cadavers, 1 specimen reported a high level of bifurcation variation out of three [23]. A case of bifurcation was reported as high as just below the lower border of teres major [4]. In our study done in 30 cadavers, 3 specimens are found to have a higher bifurcation of the brachial artery and no other variations were observed.

In a Brazilian cadaveric study high division of brachial artery was found in only 0.5%. The bifurcation of the brachial artery was found above bicondylar line in 11.1% cases [24]. In a recent study, early bifurcation of the brachial artery was found in the middle of the arm in 1 out of 25 cadavers [23].

High Brachial artery Bifurcation can have major clinical implications including high failure rate and decreased functional patency of an arteriovenous fistula. In a clinical study, ultrasound examination was used to map the arteries of the upper extremities. 69 out of 481 (12.3%) demonstrated High Brachial artery Bifurcation [25]. The presence of high Brachial artery Bifurcation should be evaluated during vascular mapping prior to an arterio – venous access creation, as it can have a significant impact on the AV access [4].

Embryological Basis

A review of embryological development can to an extent explain this type of variation. Peripheral vascular anomalies are in one way or the other related to the genesis, regression or persistence of one or the other segment of the embryological axial artery [11,26]. Arterial supplies of limb buds are derived from the intersegmental arteries and are supplied by axis artery. Axillary and brachial arteries are formed from the proximal part of the main trunk, the distal part of the trunk persists as an anterior interosseous artery. Last arteries to appear in the forearm are the radial and ulnar arteries.

Radial artery emerges from the main trunk more proximally than the ulnar artery. A new connection is established later by the radial artery with the main trunk near the origin of ulnar artery, the upper portion of the original stem usually disappears to a large extent. The radial artery does not establish a new connection with the main trunk near the origin of ulnar artery if the proximal origin of radial artery fails to disappear. Thus the radial artery originates at a higher level than usual [4].

Conclusion

Clinicians and academicians should be well aware of this commonly occurring variation of higher terminal bifurcation of the brachial artery, with its course well before the cubital fossa and at the level of cubital fossa as it is an important artery of the upperlimb used in various clinical procedures.

Acknowledgement

NIL

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Original Article

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Anthropometric Measurements of Hypertensive Patients with Special Emphasis on Facial Features

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Abstract

Context: Anthropometric measurements are being used profusely for various medicalresearches. Studies on craniofacial anthropometry have allowed for identification andquantification of syndromic clinical features, planning for treatment, monitoring ofoperative outcomes and sometimes assessment of longitudinal change.Considering that Anthropometry can be important tool in early suggestion of diseases, anattempt was made to study facial Anthropometry in healthy individuals andhypertensive subjects. *Aim:* The aim of the study was to compare the Anthropometric Measurements in hypertensivepatients and healthy control subjects. *Settings and Design*: The study was conducted in the Anthropometry section of Department of Anatomy, Mahatma Gandhi Institute of Medical Sciences (MGIMS) incollaboration with Department of Medicine. It was a cross-sectional, Observational study design incorporating a total of 100subjects. *Methods and Material*: Out of hundred registered for study, fifty were healthy controls and fifty patients in theage range of 34-50 years diagnosed to have hypertension from Sevagram village (a rural area in Vidharbha region of Maharshtra). The instruments used for study are Stadiometer, Digital weighing balance, Spreading Caliper, Vernier caliper and measuring tape and sphygmomanometer for measuring Blood Pressure. Various measurements were made pertaining to facial anthropometry andon the basis of the findings as per literature available, the indices calculated are Physiognomic Facial Index, Morphological Facial Index, Mandible Width-Face Height Index, Sagittal Naso-FacialIndex, Mandible-Face Width Index, Chervinïs Transverse Cephalo-Facial Index. *Results*: The indices thus obtained are compared for males and female's separately. Most of the indices are non- significant except Mandible-Face Width Index in femalesand Physiognomic Facial Index and Morphological Facial Index in males. *Conclusion*: Facial Anthropometry was done on healthy and hypertensivesubjects. Though the data analysis have not concluded any change in facialanthropometry in hypertensive subjects with affirmation but the data obtained forcontrol subjects in Central Indian Population can further be utilised byAnthropometrics, , Anatomists, Forensic Experts and Plastic surgeons too.

Keywords: Anthropometry; Facial Anthropometry; Hypertensive Patients.

Introduction

Anthropometry is a biological anthropology or art of science used for the measurement of soft tissue and body proportions for the study of human evolution [1]. Anthropometric measurements are used eventually for various medical researches. Anthropometry is a branch of Morphometry which is the study of size and shape of biological components and their variations in populations.[2] Morphometrics has gone under revolution in the last two decades as numerous new techniques have been produced to address shortcomings in the Traditional Multivariate Analysis of Linear distances, Angles and Indices [3]. Analysis of Face is not only useful for Identification, Sports Medicine, Tele-Communications but also has got a clinical application for diagnosis of many diseases [4].

Changes in lifestyles, nutrition, and ethnic composition of populations lead to changes in the distribution of body dimensions (e.g. the obesity

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epidemic), and require regular updating of anthropometric data collections. Studies on craniofacial anthropometry have allowed for identification and quantification of syndromic clinical features, treatment planning, monitoring of operative outcomes, and assessment of longitudinal change [5,6].

Hypertension is defined as systolic and/or diastolic blood pressure of 140/90 mm Hg or more, and/or medication use for decreasing hypertension [7,8,9].

The World Health Organization (WHO) categorizes high blood pressure (BP) as the top risk factor for death rate, accounting for 13% of fatalities globally. Also, hypertension, or the 'silent killer' as it is also known, has been recognized as an important risk factor for cardiac arrest, stroke, kidney disease, and increased mortality rates in adults (WHO 2014) [10].

High blood pressure, also called "hypertension," is a serious medical condition. It happens when the force of the blood pumping through your arteries is too strong. The flow and pressure of blood in the arteries rises with each pump or pulse; this is the systolic or higher pressure reading. The resting or lower pressure between each pulse is called the diastolic pressure.

A person's blood pressure reading includes both figures, systolic/diastolic, expressed in millimetres of mercury.

A variety of symptoms may be indirectly related to high BP but are not always caused by it, such as facial flushing. Facial flushing occurs when blood vessels in the face dilate.

Since edema is also closely linked with hypertension, and because the accumulation of an excessive amount of body fluid in the tissue spaces between cells or in body cavities are noticeable in the overall physical appearance of the individual especially the face [11].

The aim of the study was to evaluate the Anthropometric Measurements in patients of hypertension and healthy control subjects. Following objectives were catered to:

1. To study the anthropometric measurements especially the facial proportions of hypertensive subjects and healthy controls.
2. To compare the anthropometric measurements and facial proportion of hypertensives and control population. Comparison was done amongst same sexes in two groups.

Material and Methods

Type of Study

It was a cross-sectional, Observational study design incorporating a total of 100 subjects.

Study Participants

Out of 100, fifty were healthy controls with Systolic BP <120 mm of Hg or Diastolic BP < 80 mm of Hg and fifty patients in the age range of 35-50 years diagnosed to have hypertension (Systolic BP >140mm of Hg or Diastolic BP > 90 mm of Hg), from Sevagram village of Wardha region of Maharashtra were recruited as cases [10]. Out of these fifty, 22 were females in both group and 28 males in both the group.

Setting

The study was conducted in the Anthropometry section of Department of Anatomy, Mahatma Gandhi Institute of Medical Sciences (MGIMS) in collaboration with Department of Medicine of the same institute. It is a rural Medical College & hospital located in a village, Sevagram in Wardha district in central India.

Ethics Consideration

A written informed consent was obtained from all study participants. It was ensured that consent is (a)given voluntarily, (b)fully informed, (c)and is obtained from the persons who are competent to do so.

In the consent form, the aims of the study were explained, the anticipated benefits and the risks, and the right to withdraw from interview process at any time without any reprisals. The use of confidential patient data will be fully within the recent guidelines from the Indian Council of Medical Research (ICMR) about the use of personnel information in medical research. Approval for conducting the study from the institutional Ethics Committee was received before commencement of the study.

Sample Size

Sample size was estimated using statistical software with following assumptions.

Confidence level - 95%

Confidence Interval- 10

(Population of Sevagram is approximately 7000) Sample size estimated was 95. Taking this into account, we planned to go for total of 100 subjects divided into two groups of cases and control subjects considering the economic feasibility as well as the time frame required for the completion of the short term research.

Sampling Procedure

By Random sampling method, samples had been recruited.

Inclusion Criteria

1. Persons from age group of 35-50 years.
2. Diagnosed patients of hypertension will be the cases and healthy people of the same age group with normal Blood Pressure and without any h/o significant illness will be included as controls.

Exclusion Criteria

- Previous history of Facial surgery or orthodontic treatment,
- Any obvious defect or deformity.
- Patients suffering from Diabetes , Thyroid Disease, Liver Failure, Haemolytic Jaundice, Renal diseases, Psychosis and other metabolic disorders.

Anthropometric Measurements

Somatometric measurements were conducted over both the groups (case and control) by the same individual at the same fixed time as per standard procedure laid by Singh P and Bhasin MK(2004) [2].

[1] Breadth Measurements of Head and Face

A. Maximum Head Breadth

It measures the straight distance between the two eurya(eu).

B. Physiognomic Facial Height

It measures the straight distance between trichion(tr)and gnathion(gn)

C. Morphological Facial Height

It measures the straight distance between nasion(n)and gnathion(gn)

D. Bizygomatic Breadth

It measures the straight distance between the two zygia(zy)

E. Bigonal Breadth

It measures the straight distance between the gonia/gonion**.**

F. Nasal Height

It measures the straight distance between nasion(n)and subnasale(sn)

[2] Indices of Face

A. Physiognomic Facial Index

Physiognomic Facial Height ÷ Bizygomatic Breadth ×100

B. Morphological Facial Index

Morphological Facial Height ÷ Bizygomatic Breadth×100

C. Mandible Width-Face Height Index

Bigonal Breadth÷Morphological Facial Height ×100

D. Sagittal Naso-Facial Index

Nasal Height÷ Morphological Facial Height×100

E. Mandible-Face Width Index

Bigonal Breadth ÷ Bizygomatic Breadth×100

F. Chervinïs Transverse Cephalo-Facial Index

Bizygomatic Breadth ÷ Maximum Head Breadth×100

Anthropometric Instruments used

Stadiometer, Digital weighing balance, Spreading Calliper, Vernier calliper and measuring tape.

BP measurement was done using mercury sphygmomanometer.

Data Collection Method

All the data were abstracted on a standardized data collection form. MS excel spreadsheet was used

to enter the data electronically. Data were expressed as mean ± SD.

Statistical Analysis

Chi-square test and some graphical tools were employed for finding association between categorical variables.

Results

A total of six indices were obtained for both the sexes in each group.

The findings for females and males are as follows:

For Females-

The mean± SD of Physiognomic Facial Index for experimental females is found to be 141.71±9.98 whereas for control females it was 136.01±12.07.

The mean ± SD of Morphological Facial Index for experimental females was found to be 85.21±8.04 whereas for control females it was 84.99±9.26

The Mandible Width-Face Height Index for experimental females was obtained as 103.88±10.65 whereas for control females it was 97.28±10.23.

Sagittal Naso-Facial Index for experimental females was estimated as 42.92±6.40 whereas for control females it was 44.73±6.04.

Mandible- Face Width Index for experimental females was evaluated as 87.42±4.99 whereas for control females it was 81.92±4.53.

Chervind's transverse Cephalo-Facial Index for experimental females was found to be 96.39±4.26 whereas for control females it was 96.39±5.48.

For Males

The Physiognomic Facial Index for experimental males was found to be 135.10±8.86 whereas for control males it was 140.16±10.64.

The Morphological Facial Index for experimental males was found to 81.31±6.59 whereas for control males it was 87.59±12.17.

The Mandible Width-Face Height Index for experimental males was found to be 105.01±12.40 whereas for control males it was 100.38±11.15. Sagittal Naso-Facial Index for experimental males was found to be 43.69±5.76 whereas for control males is 43.79±9.70.

Mandible- Face Width Index for experimental males was found to be 84.74±5.88 whereas for control males it was 86.80±4.89.

Chervind's transverse Cephalo-Facial Indexfor experimental males was found to be 101.14±7.38 whereas for control males it was 98.91±3.86.

The data thus obtained was compared in control and cases group. The comparison is as shown in Table 1 & 2.

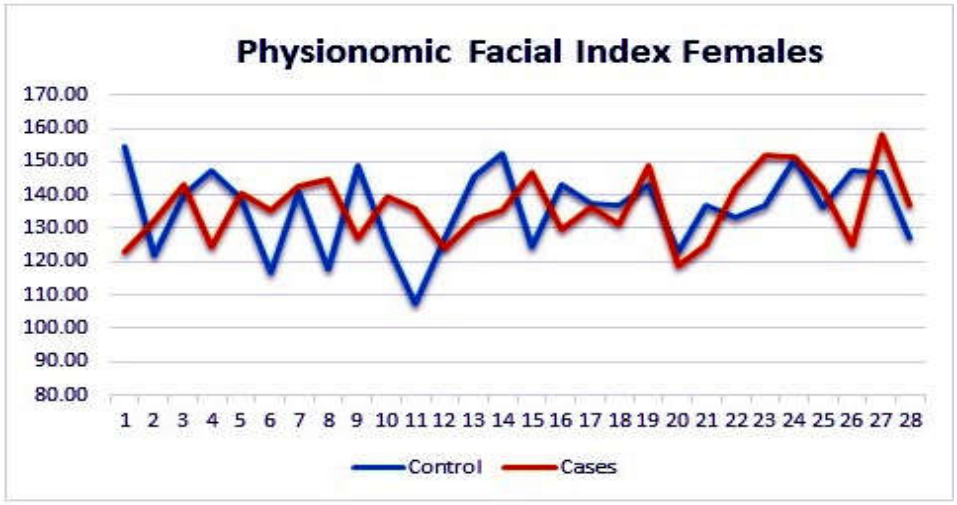
Individual facial anthropometric indices sex wise are shown in Figure1 and Figure 2.

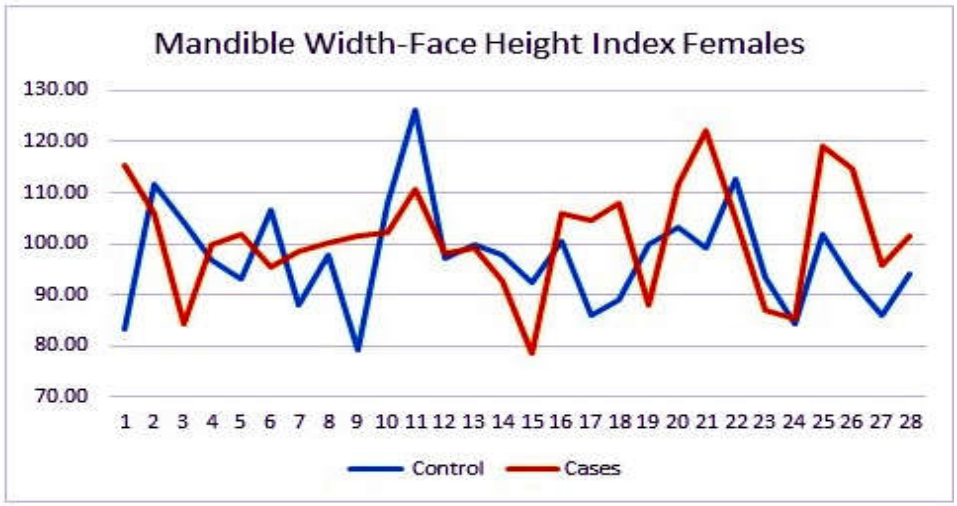
Table 1: Comparison of various indices in Females

	Physiognomic Facial Index	Morphological Facial Index	Mandible Width-Face Height Index	Sagittal Naso-Facial Index	Mandible-Face Width Index	Chervind's Transverse Cephalo-Facial Index
p Value	0.41	0.41	0.09	0.40	0.01	0.19
	Non-significant	Non-significant	Non- significant	Non-significant	Significant	Non significant

Table 2: Comparison of various indices in Males

	Physiognomic Facial Index	Morphological Facial Index	Mandible Width-Face Height Index	Sagittal Naso-Facial Index	Mandible-Face Width Index	Chervind's Transverse Cephalo-Facial Index
p value	0.05	0.02	0.10	0.48	0.11	0.11
	Significant	Significant	Non-significant	Non-significant	Non-significant	Non-significant





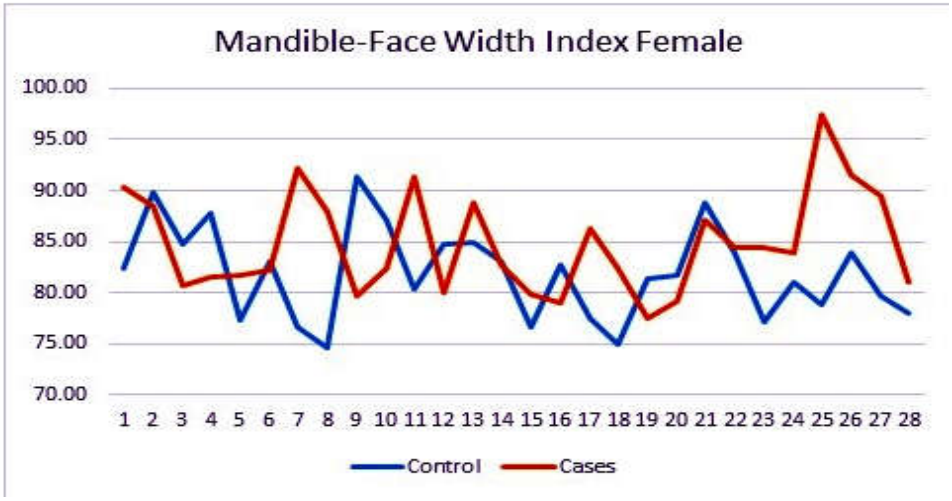
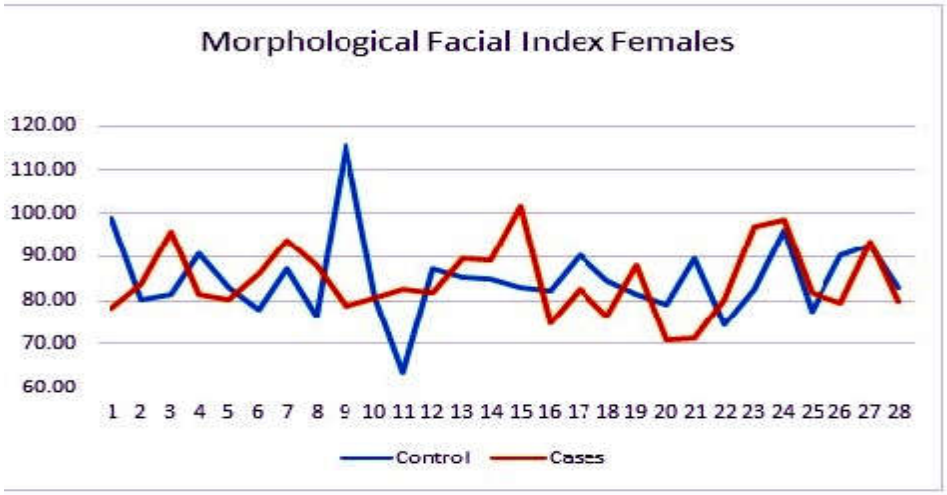
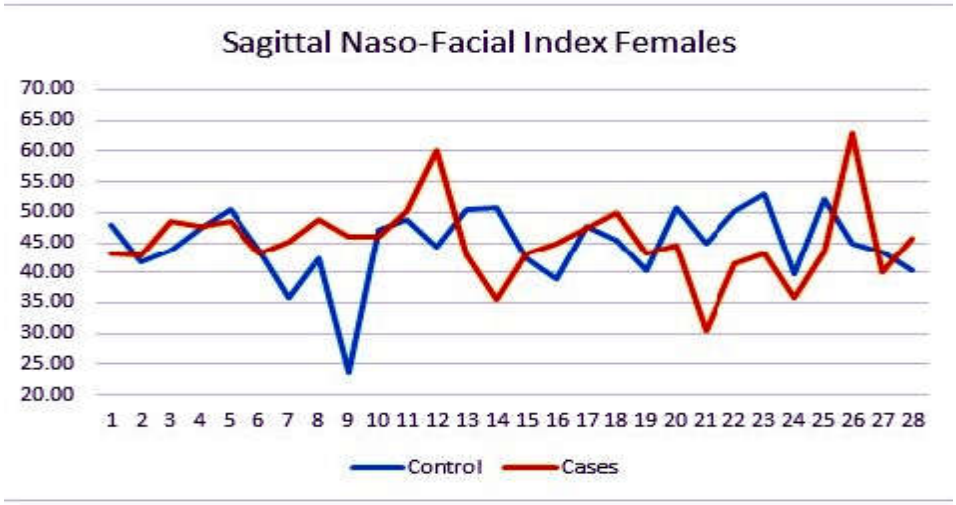
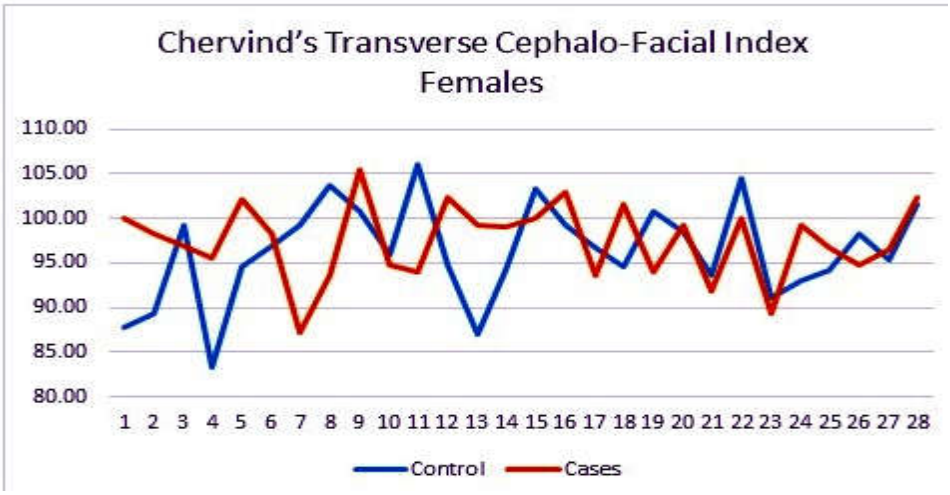


Fig. 1: The various charts are showing depiction of individual findings obtained in controls and cases for Females







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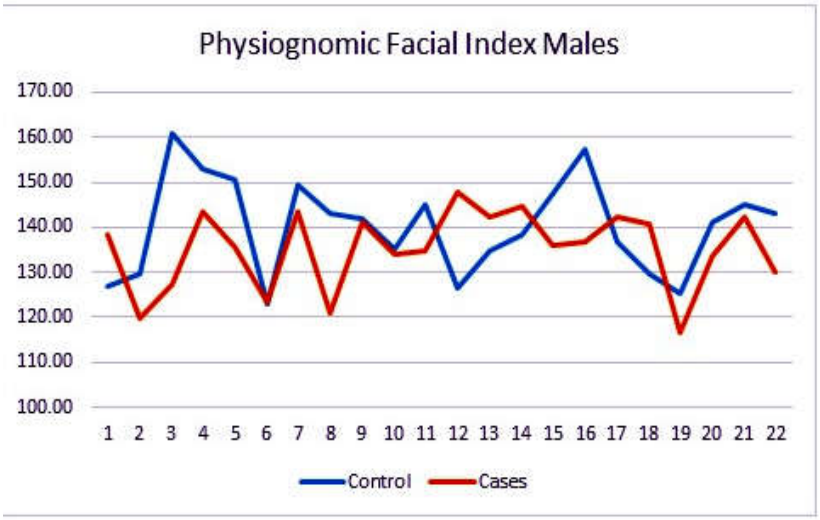
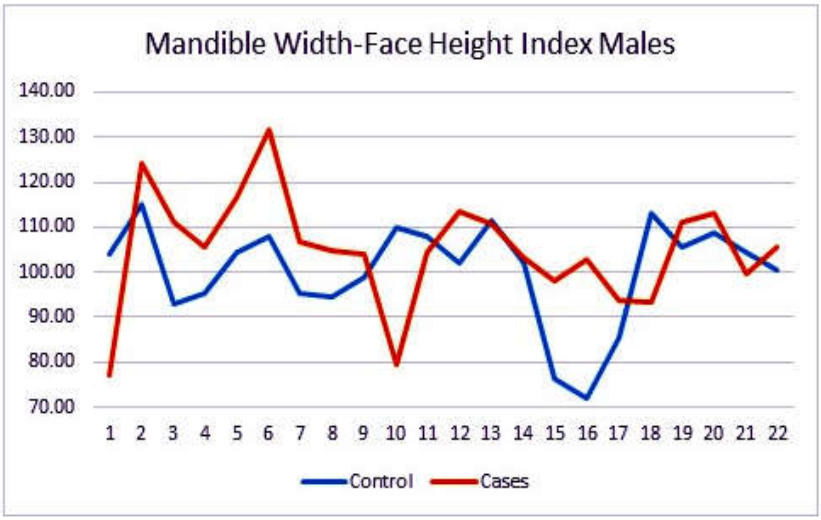




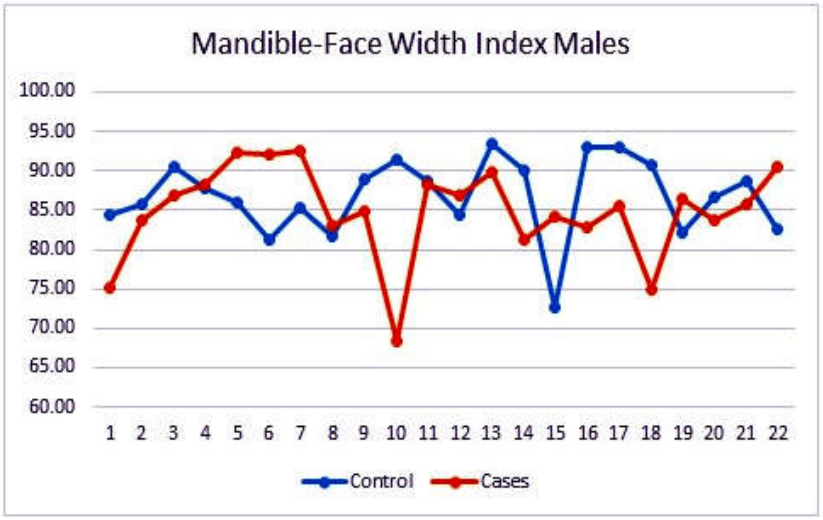
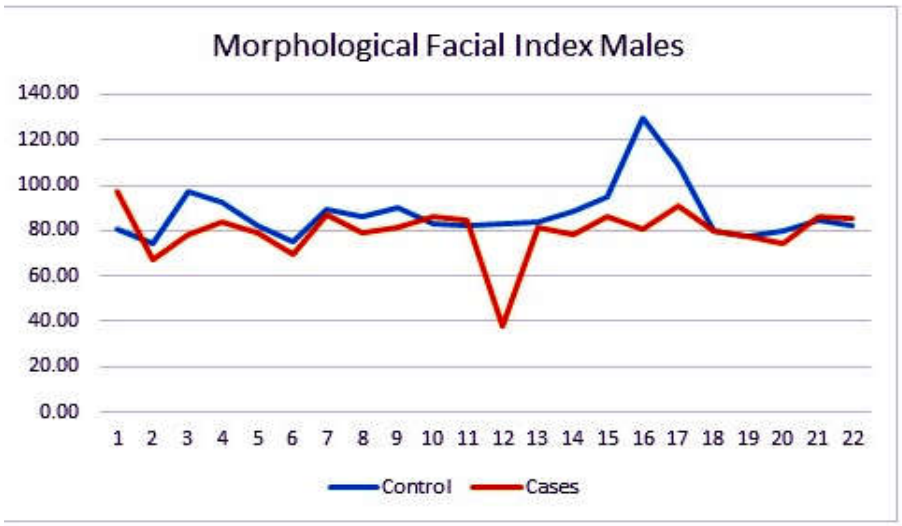
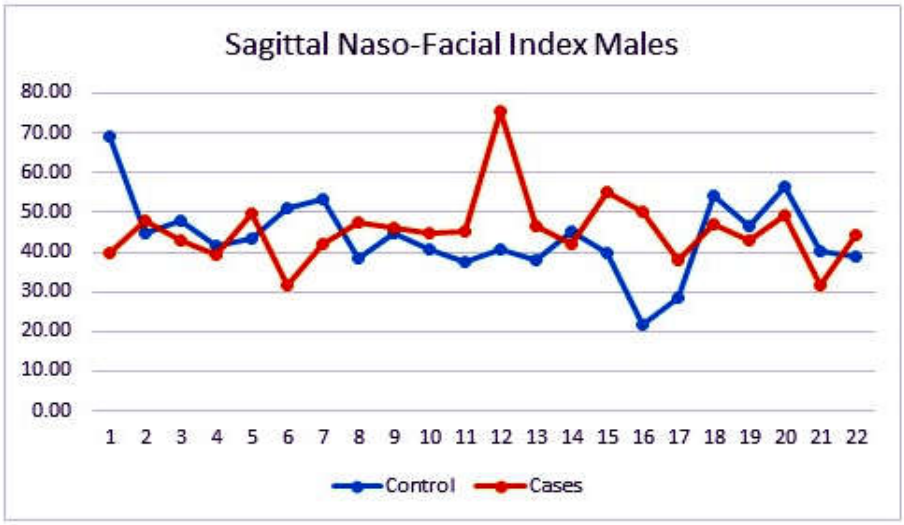


Fig. 2: Showing various charts of the observations of different indices in males in cases and control





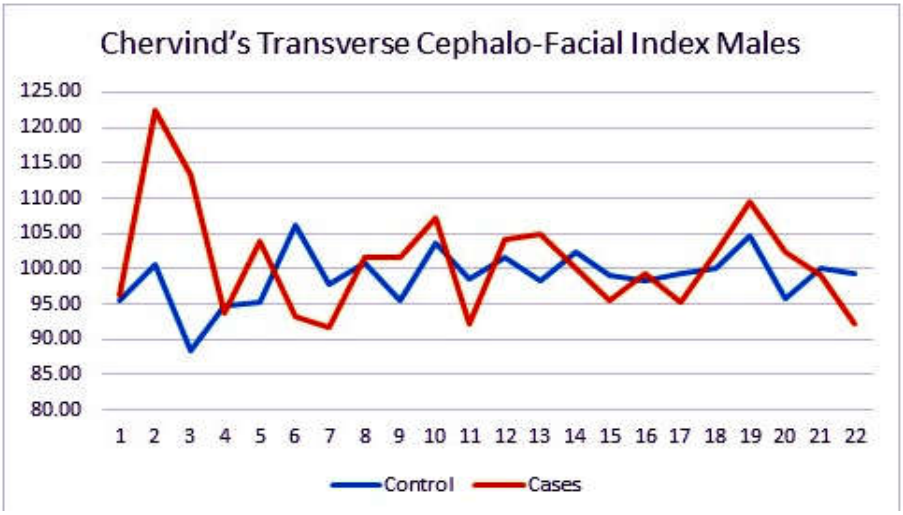


Fig. 2: Showing various charts of the observations of different indices in males in cases and control

Discussion

Facial analysis has been quite crucial in studies of health related concerns [12-15]. While there are studies that show minor anomalies occurring in normal human populations at low frequencies, deviations from normal values can be indicative of a health problem [14,15].

In the present study, the variations in facial morphometrics between diabetics and non-diabetics was explored. The observations of this study are not in accordance with many studies which have reported changes in the face of people with chronic diseases such as diabetes, hypertension and arthritis [16,17,18].

Based on the analysis of landmarks as shape variables, the face shape of diabetics was found to be rounder and less tapered compared to that of nondiabetics in a study by Demayo et al (2009) [4].

They analyzed that there is a Facial asymmetry, drooping of the brow ridge, compression of the face towards center, downward folding of the skin in the area of the eyes in Diabetics without any sexual variation by Geometric Morphometrics by image analysis.

Moore SE et al (2001) [19] analyzed that Fetal alcohol syndrome (FAS) and Parietal Fetal alcohol syndrome(PFAS) have a facial dysmorphology which could be used for screening Prenatal exposure to alcohol. They had taken total 131 study population amongst which 100 were cases (41 FAS, 59 PFAS) and 31 control group for study amongst which 6 craniofacial dysmorphology have been explored.

McGrath J et al (2002) [15] have found effective distinguishing features in Psychotic disorder such as in schizophrenia, there is smaller temporal lobes in patients as comparable to controls based upon Anthropomorphic study. They have recruited 310 cases and 303 controls and analyzed that Psychotic disorder found to be more in wider skull base, protruding ears, shorter and wider palates.

Chandra HJ et al (2012) [1] have obtained Anthropometric disproportion between the local populations and American Caucasians. They have studied facial anthropometric measurement in 50 males and 50 females of adult age group belonging to same ethnic group. They had used standard anthropometric landmarks for Anthropometric measurements and indices.

Solon ECC et al (2012) [20] have surveyed geometric morphometrics by Image Analysis amongst hypertensive and non-hypertensive and have come to a conclusion that there is facial dysmorphology between hypertensive and non-hypertensive patients.

Batiha AM (2015) [21] et al tried to find any correlation between hypertensive population of Jordia and their anthropometric indices. They have included hip circumference, waist circumference, height, weight, waist-to-hip ratio, and a body shape index in their study.

Conclusion

Though the data analysis have not concluded any change in facial anthropometry in hypertensive subjects with affirmation but the data obtained for control subjects in Central Indian Population can further be utilised by Anthropometrics, Forensic Experts, Anatomists and Plastic surgeons too. More firmly conclusion can be drawn if study is carried out further with larger number of subjects.

Conflicts of Interest

There are no conflicts of interest in this study.

Acknowledgement

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Study of Variations in Branching Pattern of Renal Arteries

Siraj Ahmed Shirbadgi[1], Vijay Kumar Shinde[2]

Abstract

Renal arteries are paired branches of abdominal aorta; these arteries are important due to increase in interventional radiological procedures, urological and vascular operations, and renal transplantation. Kidney specimens and arteries were explored, dried with hair drier, 1:10 thin solution of quick fix and acetone applied over arteries and painted with PO red colour. Variations in morphological patterns and segmental patterns of renal arteries were noted. In present study out of 50 specimens in 7 (14%) observed superior polar artery which is the branch of abdominal aorta. A branch originating from the renal artery (superior renal polar branch) was observed on the right hand side in 10 (20%) and in 17 (34%) on the left side. The results are statistically significant. 20 kidney specimens we were found duplicated renal arteries. This multiple renal artery variations are of great clinical significance to radiologists, nephrologists and urologists in imaging, procedures and urological surgeries respectively.

Keywords: Renal Artery Variations; Superior Polar Artery; Inferior Polar Artery.

Introduction

The kidneys are one of the vital organs in the human body. It receives rich blood supply, nearly 25% of the cardiac output pass through the renal arteries to be filtered by the kidneys. These are end arteries with no anastomosis. Variations in the number and arrangement of the renal vessels are extremely common [1].

Near the hilum of the kidney, each renal artery divides into anterior and posterior branch, which in turn divides into a number of segmental arteries supplying the different renal segments. Classically, a single renal artery supplies each kidney. Variations in the number and arrangement of the renal vessels are extremely common. The so called aberrant or accessory arteries were in fact, normal segmental arteries [3].

Knowledge of the variations of renal vascular anatomy has importance in exploration and treatment, renovascular hypertension, renal artery embolization, angioplasty or vascular reconstruction for congenital and acquired lesions, surgery for abdominal aortic aneurysm and conservative or radical renal surgery. The advent of more conservative methods in renal surgery has necessitated a more precise knowledge of renal vascularisation and its importance in partial and total renal transplantation surgeries [3].

When they are present in the pelvic cavity, they take their blood supplies from branches of iliac arteries, and as they ascend their blood supplies also shift from the iliac arteries to the abdominal aorta [4].

Presence of abnormal number, site and accessory (superior polar & inferior polar artery) arteries are due to the persistence of embryonic vessels which are formed during the ascent of the kidney. It is essential for surgeons to bear in mind the possibility of such additional superior polar arteries before performing any transplantation surgeries, as kidney transplantation with multiple renal arteries has a chance of rejection, tubular necrosis, or poor graft function [5].

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Materials and Methods

A total of 50 formalin fixed specimens irrespective of sex of cadavers constituted the material for the study, during routine abdominal dissection conducted in department of anatomy and autopsy specimens from department of forensic medicine.

Chemicals Used

Acetone, quick fix, synthetic enamel (PO Red) These kidneys and their arteries were explored, dried with hair drier, 1:10 thin solution of quick fix and acetone applied over arteries and painted with PO red colour. Variations in morphological patterns and segmental patterns of renal arteries were noted.

Observations

Specimen No. 1: Superior polar artery present in left kidney along with normal renal artery. Inferior polar arteries are present in both kidneys.

Specimen No. 2: Duplicated renal arteries are present.

Fig. 1:

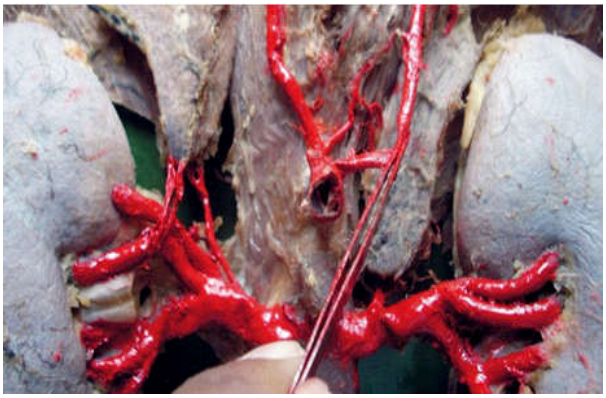

Fig. 2:

Results

Table 1: Percentage distribution of right and left kidneys

	Types of variations in arteries	Right kidney	left kidney	Total
1	Single renal artery	16 (32%)	15 (30%)	31 (62%)
2	Multiple renal arteries	8 (16%)	6 (12%)	14 (28%)
3	Double hilar arteries	3 (6%)	4 (8%)	7 (14%)
4	Three hilar arteries	0 (0%)	1 (2%)	1(2%)
5	Superior renal polar artery	6 (12%)	4 (8%)	10 (20%)
6	Inferior renal polar artery	10 (20%)	7 (14%)	17 (34%)
7	Extra hilar superior polar artery	4 (8%)	1 (2%)	5 (10%)
8	Extra Hilar inferior polar artery	2(4%)	5 (10%)	7 (14%)

Table 2: Comparison of percentage variations of renal arteriesin different populations

No	Authors	Population	2HA%	3HA%	SPA%	IPA%
1	Saldarringa et al (2008) [6]	Columbian	12.1		4.3	10.8
2	Sampio et al (1992) [7]	Caucasians	7.9	1.9	6.8	5.3
3	Khamanarong et al2004) [8]	Thai	7	1	7	3
4	Cicekcibasi et al (2005) [9]	Turkish	11.1		3.3	10.5
5	Weld et al (2005) [10]	American	12.3		9.6	
6	Talovic et al (2007) [11]	Bosnian	9	1	2	10
7	Palmieri et al (2011) [12]	Brazilian	45.5	18.8	9.4	3.2
8	**Present study (2010)**	**Indian**	**14**	**2**	**20**	**34**

2HA= double hilar arteries
3HA= three hilar arteries
SPA= superior polar arteries
IPA= inferior polar arteries

Discussion

In present study out of 50 specimens in 7 (14%) observed superior polar artery which is the branch of abdominal aorta. A branch originating from the renal artery (superior renal polar branch) was observed on the right hand side in 10 (20%) and in 17 (34%) on the left side.

Present study shows considerable similarities and statically significance with different workers.

Conclusion

This high incidence of presence of additional renal arteries is significant in the invasive interventions such as renal transplantation, interventional radiologic procedures and urologic operations, renal artery embolization, angioplasty or vascular reconstruction for congenital and acquired lesions. The evaluation of renal angiograms will be difficult unless you know these anatomical variations. More over renal arteries are functional end arteries, the ligation of which may lead to degeneration of that segment of kidney. So prior to surgical intervention renal angiogram is mandatory.

Conflicts of Interests

None

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Original Article

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Dermatoglyphics: A Diagnostic Tool

T.M. Sucharitha[1], S.V. Phanindra[2]

Abstract

Dermatoglyphics includes the study of ridge pattern on the pulp of fingers, lips and foot prints etc. Finger prints proved their uniqueness in identification. Besides this the finger print pattern indicates future risk of certain diseases like Cancer, Diabetes and Hypertension. This paper is aimed at looking such relationship between major finger print patterns and diseases like Diabetes and Hypertension.

Keywords: Finger Prints; Diabetes; Hypertension.

Introduction

Like any other living being, each human differs from others (Quetelets law) [1]. So also the finger prints.

In 1858 Sir William Herschel used finger prints for the first time in India to prevent impersonation. Sir Francis Galton systematized it for identification, which was officially adopted in England in 1894 and was further modified by Sir Edward Henry [2].

The study of finger print patterns is called as "Dactylography" where as the term "Dermatoglyphics" not only includes finger print patterns but all patterns of skin folds like foot prints, lip prints, palate prints etc.

Apart from the usage of finger prints in identification, studies were conducted to know association between *dermatoglyphics* and diseases like breast cancer, Alzheimer's disease, tuberculosis, Diabetes and Hypertension [3].

The present study is to correlate such relationship between diseases like Diabetes, Hypertension and major finger print patterns and also to assess the frequency of occurrence of any one major prints like Archs, Loops, Whorls and Composite types in Diabetes, and Hypertension.

Developmental Anatomy

Different people will have different finger print ridge patterns and pores.The pattern of finger prints and pores also differ from finger to finger of the same individual.While it seems that the general pattern of friction ridges may be genetic, the specific pattern or fine details called "*minutiae*" is unique.

Human skin contains hair follicles and oil glands and is smooth. However certain areas like digits, palms and soles are devoid of hair follicles and oil glands. Instead these areas show sweat pores and friction ridges that take various forms and shapes. The study of pattern of these friction ridges is known as "*dermatoglyphics*".

Homozygous twins have similar general patterns of ridges but the fine details or '*minutiae*' differ. The development of minutiae is epigenetic in nature. They are due to environment and external stresses and pressures while foetus is in the womb [4].

The development of primary ridges is dictated by overall geometry and topography of the volvar 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

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nearly absorbed, the individual will develop an Arch pattern. The timing of these events is genetically linked.

Materials and Methods

This study is conducted among the parents of Medical students studying in Narayana Medical College, Nellore residing in the state of Andhra Pradesh. Plain finger prints were obtained from the parents by using ink pad on the given proforma. Finger Prints were obtained after taking informed consent. Finger prints of the parents were obtained by the students at their homes as parents were residing all over the state.

The material included.

1. Blue/ Black ink pad
2. Proforma
3. Consent form
4. Magnifying glass with light source.

Parents of Sixty students (Thirty male and Thirty female) for taken for this study the finger prints of parents included normal (normotensive and normoglycemic) Diabetic and Hypertensive.

Collection of the Prints

The subjects were asked to wash their hands. Ink pad is used to smudge their fingers. Then the smudged fingers were applied carefully in the respective spaces of the proforma. Only plain prints are obtained. No roll prints.

Prints of only four fingers, namely left index finger, left thumb, right index finger and right thumb are used for this study. These four fingers are chosen because thumb print is the commonly used one for identification and the index finger commonly used in biometrics. Personal and family history of Diabetes mellitus and Hypertension was noted in the pro forma. The finger prints thus obtained are categorized into various patterns like Loops, Whorls, Arches and Composites.

This study has approval of institutional ethical committee.

Observations and Results

Plain finger prints of one hundred and twenty 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. Family history of Diabetes mellitus and Hypertension was also obtained.

A total 480 finger prints thus obtained,[four finger prints acquired from 120 individuals (father and mother of 60 medical students)] 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. Then the data is analyzed for predominance of any particular major ridge pattern in hereditary diseases like Diabetes mellitus and Hypertension.

The comparative analysis is made between finger print patterns of normal parents (control group) and with that of Diabetic mellitus and Hypertensive parents (subject group) respectively. For this purpose the finger print pattern of all the parents (120 individuals) were fed into computer by using Microsoft Excel sheet and then the continuous data was presented as mean ± S.D, categorical data as proportions.Categorical data was analyzed by Chi Square Test. A 'P' value of less than 0.05 in the above data is considered as significant.

Table 1 indicates, there is significant increase of Whorls in Diabetes mellitus patients when compared with normal individuals. The P value is significant (0.04). Though there is slight increase in Arches in Diabetes mellitus patients when

Table 1: Normal vs Diabetics (P value)

	L	W	A	C
N vs DM	0.14	0.04	0.81	AB

Table 2: Normal vs Hypertensives (P value)

	L	W	A	C
N vs H	0.29	0.15	0.45	0.50

L-Loops, W-Whorls, A-Arches and C-Composites, AB-absent

compared to normal individuals. The P value is not significant (0.81).

Table 2 shows the correlation between normal individuals and Hypertensive patients. Though there is an increase of Whorls in Hypertensives, the P value is not statistically significant (P value 0.15). There is also increased percentage of Composites in Hypertensives when compared with normal.

Discussion

This study indicates individuals with increased number of Whorls and Arches in their finger prints have increased risk of Diabetes mellitus.

This study also indicates individuals with increased number of Whorls in their finger prints have increased risk of Hypertension.

These findings are compared with similar studies in relation to Diabetes and Hypertension.

Diabetes

The study conducted by Manoj Kumar Sharma and Hemalatha Sharma reveals that there is an increased tendency of Whorls in Diabetic when compared to normal individuals. Similar results were also observed by the study conducted by Sant S.M. et al and Vera et al (1995) [6].

The studies conducted by M. Pramila Padmini et al and Verbav showed an increased percentage of Arches also in Diabetic patients [7].

Hypertension

The studies conducted by doctors at the Southampton General Hospital related to systolic blood pressure in a group of 139 (both sexes) found that the average systolic pressure was 8 mm higher in people who had a Whorl pattern in their finger print in one or more fingers as compared to people who had a simple Arch pattern. They opined that the Whorl pattern and narrow palm are indications of impaired foetal development and are associated with raised blood pressure in adults [8].

Studies conducted by Oladipo G S et al on rivers Indigenes also reveal similar results [9].

Studies conducted by Dike Eberechi U et al reveal an increased percentage of Whorls in Hypertensive patients [10].

Study conducted by department of Anatomy St. John's medical college, Bangalore indicates that there was a significant correlation between the incidences of Hypertension in those with Arch type pattern in comparison to the control groups, particularly in the left middle finger [11].

Limitations and Recommendations

The limitations of this particular study include;

- Small sample size - parents of only sixty medical students were included. The sample size is limited due to difficulty in obtaining finger prints from parents, single/both (non availability / refusal of either or both parents etc,).
- The sample size of Diabetes mellitus and Hypertensive parents was too small. Out of one hundred and twenty parents, eighteen individuals are Diabetic and eighteen individuals are Hypertensive.
- The Diabetics and Hypertensive among parents were identified only after acquiring their details through pro forma. (No clinical or Laboratory correlation)
- Study group restricted to a small geographical area, the state of Andhra Pradesh.
- The following recommendation is made with above limitations a larger group including more Diabetics and Hypertensive involving a larger geographical area is necessary to arrive at a conclusion.

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Review Article

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Lateral Pterygoid Muscle

Brijendra Singh

Abstract

Lateral pterygoid muscle is one of the four classical muscles of mastication including masseter, temporalis and medial pterygoid. Main function of lateral pterygoid muscle is to open the mouth or lower the mandible at temporomandibular joint. The upper/superior head of lateral pterygoid muscle originates from the infratemporal surface and infratemporal crest of the greater wing of sphenoid bone, and lower/inferior head from outer or lateral surface of lateral pterygoid plate. Inferior head inserts into the pterygoid fovea at neck of condylar process of the mandible; upper/superior head inserts into articular disc and fibrous capsule of temporomandibular joint. The mandibular division of trigeminal nerve, specifically nerve to lateral pterygoid nerve, innervates the lateral pterygoid muscle. The primary function of the lateral pterygoid muscle is to pull the head of the condyle out of the mandibular fossa along the articular eminence to protrude the mandible. A concerted effort of the lateral pterygoid muscles helps in lowering the mandible and open the jaw whereas unilateral action of a lateral pterygoid produces contralateral excursion (a form of mastication), usually performed in concert with the medial pterygoids. Unlike the other three muscles of mastication, the lateral pterygoid is the only muscle of mastication that assists in lowering/depression of the mandible (opening the jaw). At the beginning of this action it is assisted by the digastric, mylohyoid and geniohyoid muscles.

Keywords: Lateral Pterygoid Muscle; Muscle of Mastication; Temporomandibular Joint.

Introduction

Lateral pterygoid, one of the key muscle of mastication is short, thick and comprise of two heads. The upper/superior head originates on the infratemporal surface and infratemporal crest of the greater wing of the sphenoid bone, and the lower/inferior head on the lateral surface of the lateral pterygoid plate. Inferior head inserts onto the neck of condyloid process of the mandible; upper/superior head inserts on articular disc and also on fibrous capsule of temporomandibular joint. Structures superficially related to Lateral pterygoid muscleare mandibular ramus, masseter, maxillary artery, superficial head of medial pterygoid and tendon of temporalis muscle. Deep head of medial pterygoid, sphenomandibular ligament, middle meningeal artery and mandibular nerve are deeper relations of lateral pterygoid muscle. Temporal and masseteric branches of the mandibular nerve come in relation to upper border while lower border is related to its lingual and inferior alveolar branches. Buccal nerve along with maxillary artery pass between its two heads that is upper and lower. As maxillary artery crosses (LPM), it gives pterygoid branches. Muscle also recieves supply from ascending palatine branch of facial artery. Anterior trunk of mandibular nerve innervates both the heads.

Lateral pterygoid muscle(LPM) plays an important role in the mandibular movements and dynamics of temporomandibualr joint(TMJ). Temporomandibular joint (TMJ) disc displacement is a common disorder in patients with internal derangement. The variation in anatomical insertion of lateral pterygoid muscle makes patients prone to TMJ disc displacement. Spasm of lateral pterygoid muscle elicits tenderness in case of temporomandibular joint dysfunction syndrome, when palpated behind maxillary tuberosity high in the buccal sulcus (Pterygoid sign).

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With the contraction of right and left LPM together condyle is pulled forward and slight downward,this protrusive movement assist the opening of jaw. LPM and medial pterygoid togetherhelps in grinding of food.Upper head pulls the articular disc when the jaw is opened.

Anterior displacement of the disc and temporomandibular dysfunction has been related to the insertion of upper head of LPM in the TMJ disc. The lateral pterygoid muscle works in harmony with the other muscles of mastication (the temporalis, masseter and medial pterygoid) to ensure adequate function [1-5].

Context

A detailed understanding of anatomy and functions of lateral pterygoid muscle is necessary to optimize preoperative planning in Temporo-mandibular joint (TMJ) surgeries, operative technique and provide a basis for improved outcomes.

Objectives

To evaluate the literature regarding anatomy and functions of the lateral pterygoid and related structures and current surgical strategies to have best of existing knowledge regarding the subject for better outcome in oral and maxillofacial surgeries.

Methods

More than forty original articles and books that were relevant to this reviewwere studied.The articles and texts were used for this review were published between 1991and 2016, were systematically reviewed for the anatomy and functions of lateral pterygoid during TMJ surgeries.

Discussion

The lateral pterygoid of human plays important role in movements of jaw during mastication. This literature review gives certain important updates on some aspects of the normal function of the lateral pterygoid muscle and its importance of both the heads during movements at TMJ. The upper or superior head (SHLP) and the lower or inferior head (IHLP) of the lateral pterygoid get insertion predominantly into the neck of the condyle [5] but some fibers of SHIL embedded in the disc of TMJ which causes development of anterior disc displacement and temporomandibular dysfunction [6-9].

LPM hyperactivity can cause progression of anterior disc displacement however the lateral pterygoid muscle can be reattached during total joint reconstruction surgery to the sigmoid notch when performing total prosthetic joint reconstruction can provide the patient with a greater interincisal opening and improved lateral and protrusive movement [10].

In recent studies recording of jaw movements and electromyography (EMG) from the lateral pterygoid is carried out, where through computer tomography imaging verification of electrode location has been achieved. From these studies, there is no evidence of background EMG activity within IHLP or SHLP when the jaw is in the clinically determined postural jaw position. There is little evidence for a reciprocal relation in activity between SHLP and IHPL, and both SHLP and IHPL play an important role in contralateral, protrusive, and jaw-opening movements and force generation [10]. There is evidence for independent activation of sub compartments within the lateral pterygoid muscle to allow a range of force vectors to be delivered to the condyle [10,11].

With the help of Micro-CT images the insertion of lateral pterygoid is found into the anterior impression and attached to the medial impression of the process [12].

The patients were assessed for the anatomical insertion of superior head of lateral pterygoid muscle to the condyle -dics complex and possible correlation with the disc position with the help of magnetic resonance (MR) imaging. There was a lack of correlation between attachment pattern of the superior head of LPM and presence or absence of anterior disc displacement [13].

Conclusion

The lateral pterygoid muscle is a difficult muscle to access, and only verified recordings from the muscle will yield definitive conclusions.The electromyograpic recordings are questionable so the palpation of the muscle is important. Micro CT is also giving the co-relation between the anatomic insertion of lateral pterygoid and TMJ dysfunction. With the finding through MRI this co-relation is lacking. So certain types of the LPM insertion are correlated with TMJ dysfunction.

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29	Journal of Global Public Health	2	12000	11500	896	858
30	Journal of Microbiology and Related Research	2	8500	8000	664	625
31	Journal of Orthopaedic Education	2	5500	5000	430	391
32	Journal of Pharmaceutical and Medicinal Chemistry	2	16500	16000	1289	1250
33	Journal of Practical Biochemistry and Biophysics	2	7000	5500	547	430
34	New Indian Journal of Surgery	4	8000	7500	625	586
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5	Indian Journal of Medical Psychiatry	2	8000	7500	625	586
6	Indian Journal of Surgical Nursing	3	5500	5000	430	391
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8	Indian Journal of Waste Management	2	9500	8500	742	664
9	International Journal of Pediatric Nursing	3	5500	5000	430	391
10	Journal of Forensic Chemistry and Toxicology	2	9500	9000	742	703
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Disse and his Space

Arráez-Aybar La[1], Aller Ma[2], Arias J.[2], Mérida-Velasco Jr[1].

Abstract

This article aims to review the work of the German anatomist Joseph Disse (1852-1912), specifically with regard to the contents of his „Ueber die Lymphbahnen der Säugethierleber". In this he described a thin space, until that moment not referred, located between the hepatocyte and the sinusoidal membrane (sinusoids).

Keywords: Perisinusoidal Spaces; Liver Anatomy; Liver Nodes; 19th Century German Histologists; 19th Century German Anatomists.

Together with the parenchyma, stroma of the conjunctive tissue and sinusoids, the *perisinusoidal spaces (PS)* are one of the structural components of the liver [1]. They are located between the basal spaces of hepatocytes and the sinusoidal endothelium. It is an area where blood and hepatic cells are exchanged. This space is named after the man who discovered it: Joseph Hugo Vincenz Disse (1852–1912), a German anatomist and histologist (Figure 1). J.Disse was born on 25 December 1852 in Brakel-an-der-Weser (North Rhine-Westphalia) where his father, Andreas Disse, was Königlicher Kreisphysikus (district physician) of the District of Höxter [2].

J. Disse studied medicine at the Universities of Würzburg, Göttingen, München and Erlangen. On 7 March 1875 he earned his medical doctorate from the University of Erlangen for his dissertation "Beiträge zur Anatomie des menschlichen Kehlkopfes" *(Contributions to the Anatomy of the Human Larynx*). Later, he specialized in Anatomy at the University of Strasbourg. He remained in Strasbourg for four years (1876-1880) and worked as assistant to the anatomist Heinrich von Waldeyer-Hartz (1836-1921). Waldeyer-Hartz is known in medicine for being the first to introduce the name "chromosome" and for consolidating the neuron theory of organization of the nervous system. He is also remembered in three macroanatomical structures of the human body which were named after him as: Waldeyer's tonsillar ring (the lymphoid tissue ring of the naso- and oropharynx), Waldeyer's glands (of the eyelids) and Waldeyer's sheath (the sheath that encircles the terminal ureter) [3].

From 1880 to 1888, J. Disse taught gross anatomy, histology, embryology and anatomical pathology at the University of Tokyo. On his return to Germany and after a short period in Berlin he accepted (1889) a position as "Privatdozent" at the Anatomical Institute of the Georg-August-University in Göttingen, where he became professor in the same year under Friedrich Sigmund Merkel (1845-1919), who in 1875 provided the first full description of Tastzellen (touch cells) which occur in the skin of all vertebrates. In February 1894 he became an "außerordentlicher Professor", while retaining his prosector position. Three months later, he accepted a call to the Anatomical Institute in Halle but resigned because of the lack of equipment and problems in his collaboration with his colleagues. From 1895 to November 1911 he was a professor at the University of Marburg, first as a prosector, later as an "außerordentlicher Professor" and since 1907 "Honorarprofessor" of anatomy and director of the university's anatomical institute. Near the end of his career he retired to Bavaria where he died from tubercular meningitis in Oberstdorf on 9 July 1912 [4].

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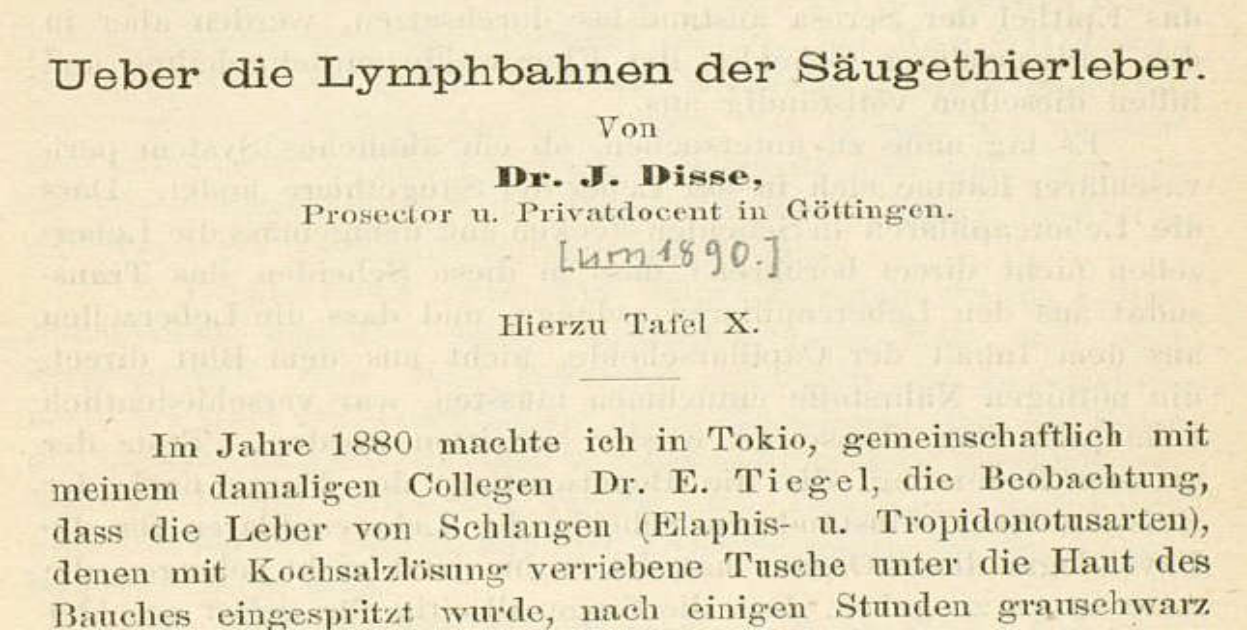
J. Disse was an experimental pathologist of unusually wide scope often with an emphasis on functional or evolutionary and was a renowned embryologist and histologist at the time. Among his publications are those about the development of the nerve nerve (olfactor nerve) and the olfactory region (olfactory region). He completed impressive works on anatomical microscopy, specifically on lizards and small mammals, by subcutaneously injecting them with a saline and diluted dye solution. Disse's interest in the lymphatics of the liver was kindled by a casual observation he and his coworker Tiegel made in snakes and lizards that had been injected with india ink. A few hours after subcutaneous administration of the ink, the reptile's liver was seen to turn dark gray. Disse discovered this to be caused by the dense accumulation of dye granules in fine spaces situated between the sinusoids and the hepatocyte plates. Free granules never appeared in the blood but occasionally were seen engulfed by white cells. Disse concluded from these observations that the lobular sinusoids are encased in a fibrous sheath separating their lumen from a perisinusoidal cylindrical space bordered peripherally by the hepatocyte plates [2]. Results reported in your paper „Ueber die Lymphbahnen der Säugethierleber" (*Regarding the Lymphatic Tracts of the Mammalian Liver*) published in 1890 in *Archiv für mikroskopische Anatomie (*vol 36:203-224) (Figure 2). This original contribution of the hepatic structure was quickly recognized by the pathologists of his time with his eponym. However, some authors, such as Hans Eppinger, pointed out that it was not related to the lymphatic system and others such as Wilhem Pfuhl called it pericapillar lymphatic sheath [5].

Table 1 lists Disse's publications [6]. In addition, Disse delivered a number of larger papers in the „ Ergebnisse der Anatomie und Entwicklungs geschichte" (*Results of Anatomy and Development History*) [7].

Table 1: Manuscripts published by Joseph Hugo Vincenz Disse

1.	Beiträge zur Anatomie des menschlichen Kehlkopfes. Arch. f. mikr. Anat., Bd. 11, 1875.
2.	Die Entstehung des Blutes und der ersten Gefäße im Hühnerei. Arch, f. mikrosk. Anat., Bd. 16, 1879.
3.	Die Ausbildung der Nasenhöhle nach der Geburt. Arch. f. Anat. Und Phys., 1889.
4.	Beiträge zur Kenntnis der Spalträume des Menschen. Ebenda 1889.
5.	Über die Lymphbahnen der Säugetierleber. Arch. f. m. Anat., Bd. 36, 1890.
6.	Untersuchungen über die Lage der menschlichen Harnblase und ihre Veränderungen im Laufe des Wachstums. Anat. Hefte, Bd. 1, S. 1, 1891.
7.	Grundriß der Gewebelehre. Stuttgart, Enke, 1892.
8.	Über die Veränderungen der Epithelien in der Niere bei der Harnsekretion. Nachr. d. Ges. d. Wiss., Göttingen, 1892.
9.	Über die Spinalganglien der Amphibien. Verhdl. d. Anat. Gesellsch., VII. Versammlung.
10.	über Epithelknospen in der Regio olfaetoria. Nachr. d. Ges. d. Wiss.. Göttingen und Anat. Hefte, Nr. 17. ,
11.	Anatomie des Rachens. Heymanns Handbuch der Laryngologie, Wien 1899.
12.	Über die erste Entwicklung des Riechnerven. Sitzgsb. Ges. zur Beförd. der Naturw. in Marburg, 1896, s. a. Anat. Hefte, Nr. 28-30, 1897.
13.	Zur Anatomie der Niere. Sitzb. Ges. zur Bef. der Naturw., Marburg 1898 und 1900.
14.	Die Niere winterschlafender Tiere. Ebend. 1900.
15.	Zur Anatomie des menschlichen Harnleiters. Ebend. 1901.
16.	Wirbelsäule und Thorax. Handbuch der Anatomie, herausgegeben von K. v. Bardelkben, 1896.
17.	16a. Harnorgane. Handb. der Anat., herausgeg. von K. v. Bardelebex, 1902.
18.	Early development of the olfactory nerve. Journ. Anat. Phys., vol. 35, 1902.
19.	Über die Blutgefäße der menschlichen Magenschleimhaut. Sitzb. Ges. zur Bef. d. Naturw. in Marburg, 1903, s. a. Arch. f. m. Anat., Bd. 63, 1904.
20.	Untersuchungen über die Durchgängigkeit der jugendlichen Magen-Darmwand für Tuberkelbazillen. Berliner klinische Wochenschr., 1903.
21.	Über die Entwicklung des Kloakenhöckers bei Talpa europaea. Sitzgsb. der Ges. zur Bef. der Naturw., Marburg 1904, s. a. Anat. Hefte, Nr. 82, 1905.
22.	Über die Vergrößerung der Eikammer. Verhdl. der Deutschen Ges. Für Gynäkologie, Kiel 1905 (Leipzig 1906) — s. a. Stzgsb. d. Ges. zur Bef.d. Naturw., Marburg 1905 und Arch. f. mikr. Anat., Bd. 68, 1906.
23.	Weitere Mitteilungen über das Verhalten des Schleims im Magen von menschlichen Embryonen und von Neugeborenen. Beiträge zur Klinik der Tuberkulose, Bd. IV, 1905.
24.	Über die Bildung des Zahnbeins. Sitzungsber. d. Gesellsch. zur Bef. der Naturw., Marburg 1908.
25.	Über die Bildung des Knochengewebes. Ebend. 1908, s. a. Arch. f. mikr. Anat., Bd. 73, 1909.
26.	Wie entsteht die Grundsubstanz des Zahnbeins? Anat. Anz., Bd. 35, 1909.
27.	Über die Lymphbahnen der menschlichen Magenschleimhaut. Stzgsb. d. Ges. zur Bef. der Naturw., Marburg 1910.
28.	Über die Bildung der Grundsubstanz des Knochengewebes. Verhdlg. d. Anat. Gesellsch., Leipzig 1911. 25. Versammlung.



Ueber die Lymphbahnen der Säugethierleber.

Von

Dr. J. Disse,

Prosector u. Privatdocent in Göttingen.

[um 1890.]

Hierzu Tafel X.

Im Jahre 1880 machte ich in Tokio, gemeinschaftlich mit meinem damaligen Collegen Dr. E. Tiegel, die Beobachtung, dass die Leber von Schlangen (Elaphis- u. Tropidonotusarten), denen mit Kochsalzlösung verriebene Tusche unter die Haut des Bauches eingespritzt wurde, nach einigen Stunden grauschwarz

Fig. 1: Joseph Hugo Vincenz Disse (1852–1912)

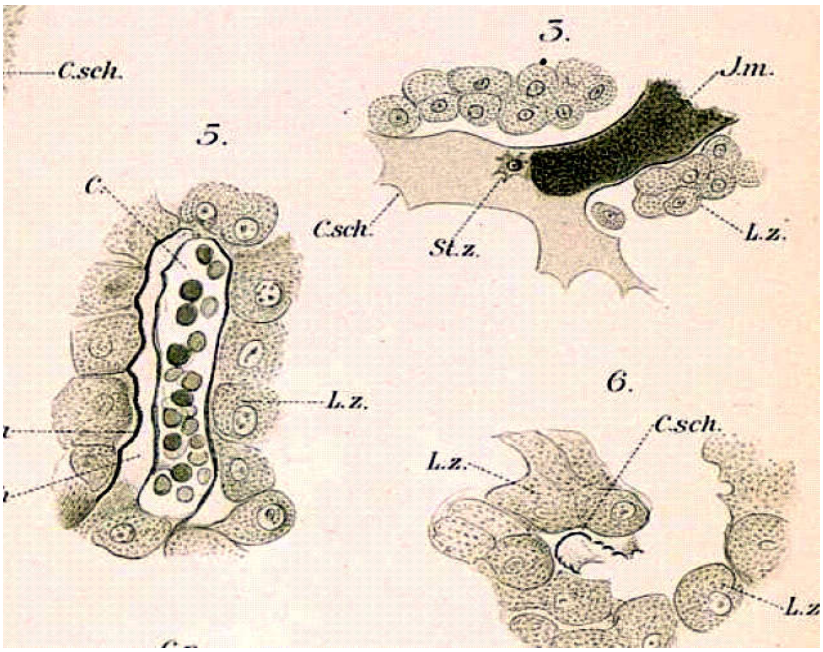


Fig. 2: Disse's paper, with a partial view of his figures, where reported its findings

The Perisinusoidal Space of *Disse, Today.*

The Hepatic Sinusoids (HS) are capillary spaces that receive blood from the branches of the portal vein and the hepatic artery at the periphery of lobules and deliver it to central veins. HS are lined with rectoendothelial cells (Kupffer cells, predominantly in the periportal area) and by a thin discontinuous endothelial that has a discontinuous basal lamina, which is lacking in many cases. HS would be kept open by a connective fibrillar network. From the surface of the hepatocytes, small irregular microvilli project to the PS. The microvilli extend, up to six times, the length of the available surface area for exchanging substances between the hepatocytes and plasma. Through the PS, proteins and lipoproteins in the hepatocytes are transported to the blood. All the hepatic secretions, except for the bile, follow this path.

Fenestration and discontinuity of the endothelium facilitates this transport. Sinusoidal endothelial cells form a fenestrated monolayer within the sinusoidal endothelium. This discontinuous structure allows contact between hepatocytes and lymphocytes.

The PS also contains hepatic stellate cells (HSC) also known as perisinusoidal cells or Ito cells (earlier lymphocytes or fat-storing cells which store fat or fat soluble vitamins (like vitamin A). HSC do not proliferate in the healthy liver. However, a variety of insults that cause inflammation can result in HSC transforming to myofibroblasts, resulting in collagen production, fibrosis, and cirrhosis [8,9].

Most of the lymph originates in the PS and circulates in the same direction as bile. The plasma that remains in the PS drains towards a small periportal gap: the space of Mall, between the stroma of the portal canal and the outermost hepatocytes of the hepatic lobule. These lymphatic branches open to the interlobular lymphatic ducts. The lymphatic vessels that form may be superficial or deep. Superficial lymph vessels move along the subperitoneal fibrous capsule and deep lymph vessels follow the portal branches or the hepatic veins. A large part of the superficial and deep lymph vessels drain into the hepatic pedicle lymph nodes. Other lymph vessels (superficial coming from the back portion, which accompanies the hepatic veins) pass from the bare area of the liver through the diaphragm to the phrenic nodes and posterior mediastinal lymph nodes, near the inferior vena cava. Some lymph vessels of the posterior portion of the liver follow the falciform ligament and reach the parasternal lymph nodes. The paraesophageal zone of the left lobe drains lymph into the left gastric node [10]. Around 80% of the hepatic lymph flows into thoracic duct [1].

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

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[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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