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# Perinatal Mortality Rate and Associated Risk Factors Among Waynad Population in Tertiary Care Center

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**Abstract**

*Context:* The Perinatal Mortality Rate (PMR) gives good indicator of quality of Health care available to mother and new-born. As the PMR varies from one region to another region in Kerala and across the country, there is need to study the prevalence of PMR along with causative factors to know the quality of health care system of that region.

*Aim:* to find out the Perinatal Mortality Rate (PMR) and factors influencing the PMR among Wayanad population in tertiary care center for the past three years from 2016 to 2019.

*Settings and Design:* This was retrospective study which was conducted in DMWIMS from 2016 to 2018 after taking Institutional Ethical Committee clearance.

*Methods and Material:* In this study we collected the number deaths of babies between 28 weeks of gestation and 1st week after delivery from OBG and pediatrics NICU register and later we calculated the PMR from 2016, 2017, 2018 by using formula. The causes for still birth/IUD and early neonatal deaths were noted and entered in Excel sheet.

*Statistical Analysis Used:* This risk factors were analyzed and the results was depicted in percentages and bar graphs using the SPSS software version 16.

*Results:* In the present study the PMR was 25.17/1000 live births in 2016, 15.93/1000 live births in 2017 and 11.4/1000 live births in 2018 among the deliveries conducted in DMWIMS hospital. The prematurity, respiratory distress syndrome was most common cause of early neonatal death were as low birth weight with Abruptio placenta were the common cause of Still birth/ IUD.

*Conclusions:* This decrease in trend of PMR across the year was due to proper antenatal care, intrapartum care and provision of critical care units like NICU from the trained and experienced staff in both Pediatrics, Obstretrics and Gynaecology Department in this Tertiary care centre in Wayanad.

**Keywords:** Health care; Perinatal mortality rate; Quality; Risk factors.

## Introduction

Perinatal period extends from 22nd week of gestation (≥ 154 days or weighing ≥ 500 gm at birth) to less than 7days of life.[1] As currently defined, the term 'perinatal mortality' includes both late fetal deaths (stillbirths) and early neonatal deaths. The eighth revision of the International classification of diseases (ICD) defined the 'perinatal period' as lasting from the 28th week of gestation to seventh day after birth. The Ninth Revision (1975) of ICD added that: (i) Babies chosen for inclusion in perinatal statistics should be those above a minimum birth weight i.e. 1000g at birth. (ii) The gestation period of at least 28 weeks should be used and (iii) body length (crown to heel) of at least 35 cm should be used.[2] The value of perinatal mortality rate is that it gives a good indication of the extent of pregnancy wastage as well as the quality and quantity of health care

available to the mother and newborn. It reflects the results of maternity care more clearly than the neonatal death rate.[2]

According to 2012 survey the perinatal mortality in India is 28 in total, 31 in rural and 17 in urban population for 1000 live births. In Kerala it is 10 in total, 11 in rural and 7 in urban population for 1000 live birth.[2] A number of social and biological factors like low socioeconomic status, high maternal age, low maternal age, high parity, heavy smoking, malnutrition etc. which are known to be associated with PMR which varies from country to country and in between different states. An appreciation of these factors will certainly make the greatest impact on reducing perinatal mortality. The various causes of PMR may be grouped as (a) Antenatal causes, (b) Intra natal causes, (c) postnatal causes and unknown among which the main causes of death are intrauterine and birth asphyxia, low birth weight, birth trauma and intrauterine or neonatal infections which may vary from region to region. There are no much studies related to PMR in the Wayanad Region.

So, aim of the present study is to find out Perinatal mortality rate (PMR) and factors influencing the PMR among Wayanad population in tertiary care center.

### *Objectives of the study*

1 To study the PMR among Wayanad population for the past 3 years in the tertiary care hospital.

2. To study the risk factors associated with PMR of Wayanad population visiting the tertiary care center for the past 3 years duration.

## Materials and Methods

This study was conducted in the Department of Anatomy, DM-WIMS, Wayanad. It was a retrospective observational study for a period of three years from 2016 to 2018.In this study we collected the number deaths of babies between 28 weeks of gestation and 1st week after delivery from OBG and pediatrics NICU register and later we calculated the PMR from 2016, 2017, 2018 by using formula.

Perinatal mortality rate = Late foetal deaths (28 weeks + of gestation) + postnatal deaths (first week) in a year × 1000/Live births in a year.

Then the causes and risk factors influencing of perinatal mortality in antenatal, natal and postnatal period was documented from the OBG and NICU records after taking IRB and IEC clearance from the institution. This risk factors were analyzed and the results was depicted in percentages and bar graphs using the SPSS software.

## Results

Table 1 Showing the late foetal deaths (≥28 weeks of gestation) in three years from 2016 to 2018 among Wayanad population in tertiary care center.

**Table 1:** Showing the late foetal deaths (≥28 weeks of gestation) in three years from 2016 to 2018 among Wayanad population in tertiary care center.

| Month/Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| Jan | 1 | 5 | 0 |
| Feb | 1 | 4 | 0 |
| Mar | 1 | 3 | 0 |
| Apr | 1 | 0 | 0 |
| May | 1 | 0 | 0 |
| Jun | 0 | 1 | 2 |
| Jul | 1 | 0 | 0 |
| Aug | 0 | 0 | 1 |
| Sep | 1 | 2 | 0 |
| Oct | 0 | 0 | 0 |
| Nov | 1 | 0 | 0 |
| Dec | 2 | 0 | 0 |
| **Total** | 10 | 15 | 3 |

Table 2 Showing postnatal deaths (first week) in three years from 2016 to 2018 among Wayanad population in tertiary care center.

Table 3 Showing live births in three years from 2016 to 2018 among Wayanad population in tertiary care center.

**Table 2:** Showing postnatal deaths (first week) in three years from 2016 to 2018 among Wayanad population in tertiary care center

| Month/Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| Jan | 2 | 1 | 3 |
| Feb | 1 | 1 | 2 |
| Mar | 2 | 3 | 1 |
| Apr | 0 | 1 | 2 |
| May | 1 | 0 | 2 |
| Jun | 6 | 0 | 4 |
| Jul | 2 | 1 | 1 |
| Aug | 0 | 0 | 1 |
| Sep | 2 | 2 | 2 |
| Oct | 0 | 0 | 2 |
| Nov | 2 | 1 | 0 |
| Dec | 1 | 1 | 2 |
| **Total** | 19 | 11 | 22 |

**Table 3:** Showing live births in three years from 2016 to 2018 among Wayanad population in tertiary care center

| Month/Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| Jan | 64 | 105 | 166 |
| Feb | 58 | 147 | 174 |
| Mar | 81 | 133 | 177 |
| Apr | 106 | 107 | 160 |
| May | 96 | 123 | 144 |
| Jun | 111 | 137 | 170 |
| Jul | 90 | 146 | 170 |
| Aug | 108 | 150 | 185 |
| Sep | 99 | 154 | 185 |
| Oct | 100 | 139 | 219 |
| Nov | 117 | 152 | 210 |
| Dec | 122 | 139 | 217 |
| **Total** | 1152 | 1632 | 2177 |

Fig 1 Showing live births in three years from 2016 to 2018 among Wayanad population in tertiary care center.

Table 4 Showing the incidence of perinatal mortality from 2016 to 2018 among Wayanad population in tertiary care center.

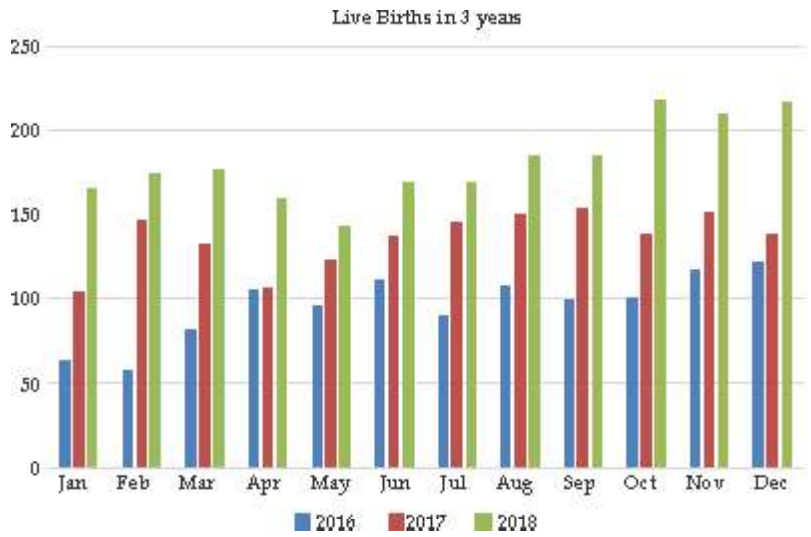


**Fig. 1:** Showing live births in three years from 2016 to 2018 among Wayanad population in tertiary care center

**Table 4:** Showing the incidence of perinatal mortality from 2016 to 2018 among Wayanad population in tertiary care center

| Sl. No | Year | Perinatal mortality rate |
|---|---|---|
| 1. | 2016 | 25.17% |
| 2. | 2017 | 15.93% |
| 3. | 2018 | 11.4% |

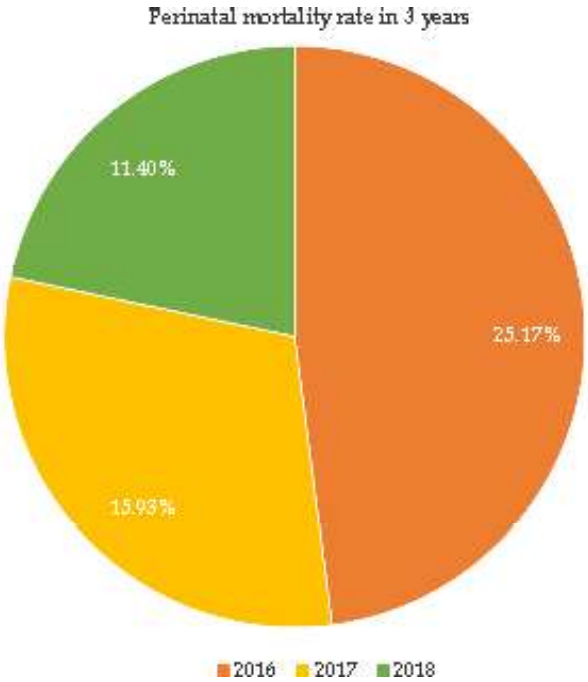


**Fig. 2:** Showing the incidence of perinatal mortality from 2016 to 2018 among Wayanad population in tertiary care center

Fig. 2 Showing the incidence of perinatal mortality from 2016 to 2018 among Wayanad population in tertiary care center.

Fig. 3 Showing the postnatal death and intrauterine deaths in three years from 2016 to 2018 among Wayanad Population in tertiary care center.

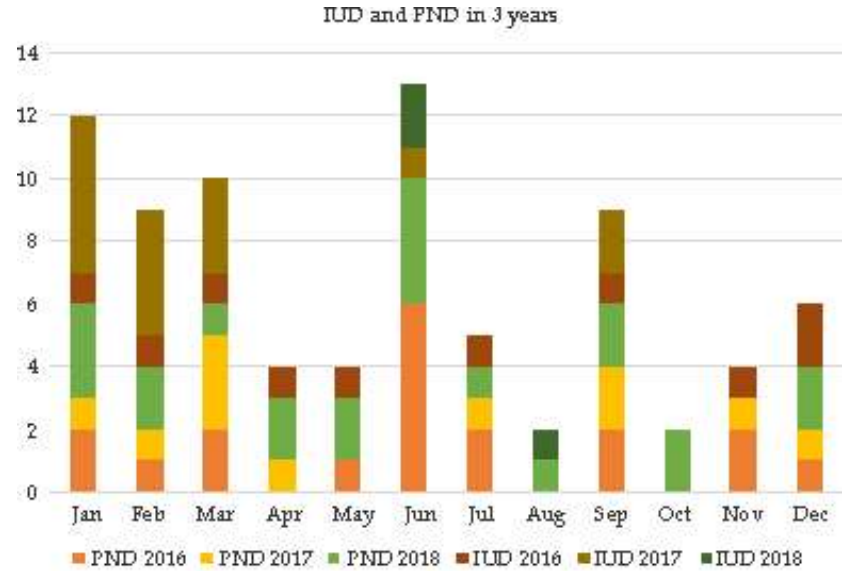


**Fig. 3:** Showing the postnatal death and intrauterine deaths in three years from 2016 to 2018 among Wayanad Population in tertiary care center

Table 5 Showing the different causes for still births from 2016 to 2018.

Table 6 Showing the different causes for early neonatal deaths from 2016 to 2018.

**Table 5:** Showing the different causes for still births from 2016 to 2018

| Sl. No | Causes for Still births | Number of cases in year 2016 | Number of cases in year 2017 | Number of cases in year 2018 |
|---|---|---|---|---|
| 1 | Abruptio placenta | 5 | 1 | 0 |
| 2 | Low birth weight less than 2 kg | 4 | 7 | 3 |
| 3 | Preterm | 2 | 3 | 2 |
| 4 | PIH | 1 | 0 | 0 |
| 5 | Meconium aspiration | 0 | 0 | 1 |
| 6 | Breech presentation | 2 | 1 | 1 |
| 7 | Hand prolapse | 1 | 0 | 0 |
| 8 | Transverse lie | 0 | 1 | 0 |
| 9 | Total number of IUD | 10 | 15 | 3 |

**Table 6:** Showing the different causes for early neonatal deaths from 2016 to 2018

| Sl. No | Causes for Early neonatal deaths | Number of cases in year 2016 | Number of cases in year 2017 | Number of cases in year 2018 |
|---|---|---|---|---|
| 1 | Birth Asphyxia | 3 | 0 | 5 |
| 2 | Perinatal Asphyxia | 0 | 0 | 2 |
| 3 | Respiratory distress | 6 | 2 | 6 |
| 4 | HMD | 2 | 0 | 0 |
| 5 | Sepsis-MODS | 2 | 1 | 2 |
| 6 | Hypoxic ischemic Encephalopathy-3 | 3 | 2 | 0 |
| 7 | CHD/CCHD | 1 | 4 | 0 |
| 8 | MAS | 1 | 0 | 1 |
| 9 | DIC | 0 | 1 | 2 |
| 10 | Perinatal Depression | 0 | 2 | 0 |
| 11 | ELBW | 1 | 1 | 1 |
| 12 | Pneumothorax | 1 | 1 | 1 |
| 13 | Congenital anomaly | 1 | 0 | 2 |
| 14 | Hypoglycemia | 0 | 0 | 1 |
| 15 | Neonatal Seizures | 0 | 0 | 0 |
| 16 | CLCP | 1 | 0 | 0 |
| | Total | 22 | 14 | 23 |
| 1 | Preterm | 14 | 6 | 13 |
| 2 | Term | 5 | 5 | 9 |
| | **Total** | 19 | 11 | 22 |

## Discussion

In 2014 as per SRS data estimated National Perinatal mortality rate (PMR) was 28 per 1000 live births with still birth of 5 per 1000 live births and Early Neonatal death of 23 per 1000 live births. There was marked interstate variability in PMR minimum was in Kerala that is 10/1000 and maximum of 37/1000 live birth in Odisha.[3]

According to Brahmanandan M et al. whose study in 2017 showed perinatal mortality rate was 29.12 per 1000 live births among patient delivered in SAT Hospital, Thiruvananthapuram, Kerala.[4]

In the present study the PMR was 25.17 per 1000 live birth which was little higher than the state average in that year, whereas the next year 2017 it showed 15.93 per 1000 live birth which was less when compared to the study by Brahmanandan M et al, this may be due to number of High risk deliveries were more in the SAT Hospital in that year and delay in the patient reaching to the Hospital.[4] In the year 2018 the PMR was 11.4 per

1000 live births which was less when compared to previous years due to better Antenatal care, intrapartum care and neonatal care in the hospital. There was also increase in the number of delivery cases and live births from 1152 to 2177 from 2016 to 2018 this is due to conduction of health awareness camps about Antenatal care for pregnant ladies among the Wayanad population, better OBG and pediatric specialty care services in the Hospital and also free conduction of labor for Tribal population.

According to Brahamandan M et al. study the major causes for PMR was prematurity which was 79 in number among 24,796 live births then comes other causes like birth asphyxia 40, prematurity-21, Sepsis-18, congenital anomalies, Meconium aspiration-25, placental insufficiency-15, term birth asphyxia-15, Abruptio placenta-8 and cord complication-6.[4]

In the present study the most common cause for the Still birth was Abruptio placenta, low birth weight along with prematurity. The common early neonatal death causes was prematurity which constituted 73% deaths in 2016, 54.54% in 2017 and 59% in 2018 which was almost similar to Brahamandan M et al. study. According to Lucy D et al. study in Orissa prematurity accounted for 42.5% PMR and another study by Ravi Kumar et al. showed 48.4% were pre-terms among the still birth.[5,6] This decrease in trend of prematurity across the years being the cause of still birth in the present study shows that there was increase in awareness of people for proper health checkup due to health awareness program conducted by the Hospital and also good care given by pediatrician in NICU.

Other causes for early neonatal deaths in 2016 was Respiratory distress in 6 cases, birth asphyxia in 3 cases and Hypoxic ischemic Encephalopathy in 3 cases. In 2017 the early neonatal deaths were due to congenital heart disease-4 cases, Hypoxic Ischaemic Encephalopathy Type 3-2 cases and respiratory distress-2 cases. In 2018 the causes for early neonatal deaths was due to Respiratory distress-6 cases, birth asphyxsia-5 cases and perinatal asphysxia-2 cases. The causes for PMR was varying across different years as per this study this may be due to various factors such as genetic, delay in coming to hospital, low socio economic status, etc.

## Conclusion

The present study conducted in Tertiary care hospital showed decrease in the trends of Perinatal mortality rate from 25.17/1000 to 11.4/1000 live birth across the year from 2016 to 2018. The most common cause being prematurity, Respiratory distress syndrome, abruption placenta giving rise to placental insufficiency. The decrease in trend suggests that there is increased awareness, proper facilities for ANC for all population including free treatment for tribal population, availability trained specialist in Department of Obstetrics and gynecology, pediatrics with proper NICU facilities which could have been the reason for decrease in trend of IUD, still births and neonatal deaths among Waynad population in this tertiary care center.

***Conflict of Interest:*** Nil

***Key Messages:***

In the present study the PMR decreased from 25.17/1000 to 11.4/1000 respectively from 2016 to 2018 which shows that quality of care provided by this tertiary care centre was good for Waynad Population due to trained staff and conduction of awareness camps.

### *Abbreviations*

PMR-Perinatal Mortality Rate

PND-Postnatal deaths

IUD-Intrauterine deaths

HMD-Hyaline membrane disease

MODS- Multiple organ disfunction

CHD/CCHD- Congenital Heart Disease

MAS- Meconium Aspiration Syndrome

DIC- Disseminated Intravascular coagulation

ELBW- Extremely Low Birth Weight

CLCP- Cleft Lip Cleft Palate

ANC- Antenatal care

NICU- Neonatal Intensive care unit

## References

1. Thora S, Awadhiya S, Chansoriya M, et al. Perinatal and infant mortality in urban slums under I.C.D.S. scheme. Indian Paediatrics 1986 Aug;23(8):595–8.
2. Hugara Siddalingappa, Narayana Murthy MR, Praveen Kulkarni, et al. Prevalence and Factors Influencing Perinatal Mortality in Rural Mysore, India, Journal of Clinical and Diagnostic Research 2013 Dec;7(12):2796–99.

3. Public Health Foundation of India, All India Institute of Medical Sciences, Save the Children. Zodpey S, Paul VK, editors. State of India's Newborns (SOIN) 2014: A Report. New Delhi: PHFI, AIIMS, SC 2014.
4. Brahmanandan M, Murukesan L, Nambisan B, et al. Risk factors for perinatal mortality: A case control study from Thiruvananthapuram, Kerala, India, Int J Reprod Contracept Obstet Gynecol 2017 Jun;6(6):2452–58.
5. Lucy D, Umakant S, Niharika P. Perinatal mortality in a referral hospital of Orissa: A 10 year review. J Obstet Gynecol India 2005;55(6):517–20.
6. Ravikumar M, Devi A, Bhat V, et al. Analysis of stillbirth in a referral hospital. J Obstet Gynaecol Ind 1996;46(6):791–6.

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# Morphometric Study of Ventral Branches of Abdominal Aorta

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**Abstract**

*Introduction:* Abdominal aorta and its major branches supply oxygenated blood to all the organs in abdominal cavity and lower limbs. Ventral branches of abdominal aorta supply the gastrointestinal tract. Anatomical knowledge of the abdominal aorta and its branches is important not only to determines flow dynamics but also crucial in understanding pathogenesis of vascular diseases.

*Aim:* To measure the External diameters of ventral branches of abdominal aorta (coeliac trunk, superior mesenteric artery and inferior mesenteric artery) at it's origin

*Material and Method:* The study was carried out on 60 adult cadavers over a period of 2 years. Measurement of external diameters of ventral branches of abdominal aorta was taken with the help of digital vernier calliper.

*Result:* The mean external diameter of coeliac trunk, SMA, IMA at its origin is 0.64 ± 0.08 cm, 0.77 ± 0.07 cm, 0.37 ± 0.06 cm respectively.

*Conclusion:* The knowledge of normal arterial diameters in a specific population is of great importance in order to make correct and precise radiological diagnosis of arterial aneurysms.

**Keywords:** Abdominal aorta; Coeliac Artery; Superior Mesenteric Artery; Inferior Mesenteric Artery

## Introduction

Aorta enters the abdomen via the aortic hiatus in the diaphragm at the level of the 12th thoracic vertebra and ends at 4th lumbar vertebra in the transcristal plane. Abdominal aorta and its major branches supply oxygenated blood to all the organs in abdominal cavity and lower limbs. Ventral branches of abdominal aorta supply the gastrointestinal tract.[1] Anatomical knowledge of the abdominal aorta and its branches is important not only to determines flow dynamics but also crucial in understanding pathogenesis of vascular diseases.[2]

Despite that the celiac trunk anatomical variations are well explored in the literature, information on the arterial diameter of its main branches is still scanty. Arterial diameter of celiac trunk hepatic branches has gained importance especially due to development of techniques for liver transplantation.[2,3]

It is reasonable to assume that the life expectancy for the general population will continue to increase, generating a greater number of problems of vascular disease. New materials suitable for prostheses may help to meet the challenge. In addition to this, it is necessary for the surgeon to continue investigations in the pathogenesis of obstructive and aneurysmal aortic lesions and to review the anatomy of the vascular tree with a new perspective.[4]

The material reported in this paper will be helpful not only to the vascular surgeon, but also to those who study the fluid dynamics involved and to others engaged in designing the vascular prostheses of tomorrow.

## Materials and Methods

The Dissection of the abdominal aorta was carried out in 60 cadavers which were embalmed using 10% formalin. Each cadaver was kept in supine position, it was numbered.

Cadavers were procured from the department of Anatomy of Medical Colleges with prior permission. Ethics committee approval for the study was taken.

The skin was reflected from medial to lateral aspect in four quadrants towards the midaxillary line. Anterior abdominal wall was dissected layer by layer. Muscles of anterior abdominal wall were incised and reflected laterally. Peritoneal cavity was opened & branches of coeliac trunk were identified. Then as dissection proceeded, different organs of abdomen were removed & simultaneously different branches of abdominal aorta were identified. Satisfactory exposure of abdominal aorta and its branches was done. The following observations were made and noted.

**Fig 1:** External diameters of coeliac trunk.

**Fig 2:** External diameters of superior mesenteric artery.

**Fig. 3:** External diameters of inferior mesenteric artery.

External diameters of ventral branches, coeliac trunk (Fig. 1), superior mesenteric artery (Fig. 2) and inferior mesenteric artery (Fig. 3) of abdominal aorta were measured with the help of digital vernier calliper

### *Inclusion Criteria*

Cadavers of either sex with age group between 25 to 75 years

### *Exclusion Criteria*

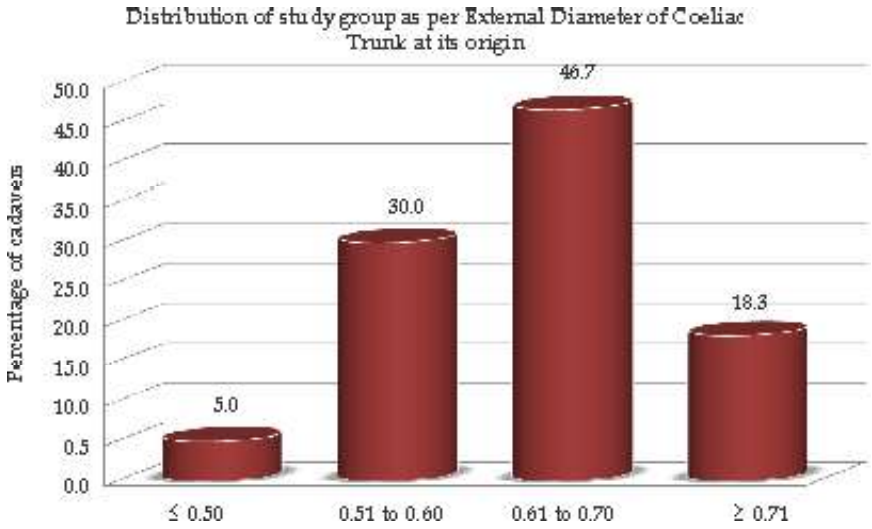
Cadavers of any other age than mentioned above were excluded. Cadavers showing anomalous tortuosities, dilatation and aneurysms of abdominal aorta were excluded.

## Results

The Abdominal Aorta was exposed from its aortic opening in diaphragm to its bifurcation into common iliac arteries in all cadavers. All the branches of abdominal aorta were identified and dissected meticulously. And all the features were noted and measurements were taken.

**Table 1:** External diameter of Coeliac Trunk at its origin (in cm)

| Distribution by groups | | |
|---|---|---|
| **Diameter in cm** | **No. of Cadavers** | **Percent (%)** |
| ≤0.50 | 3 | 5.0 |
| 0.51 to 0.60 | 18 | 30.0 |
| 0.61 to 0.70 | 28 | 46.7 |
| ≥0.71 | 11 | 18.3 |
| **Total (*N*)** | 60 | 100.0 |



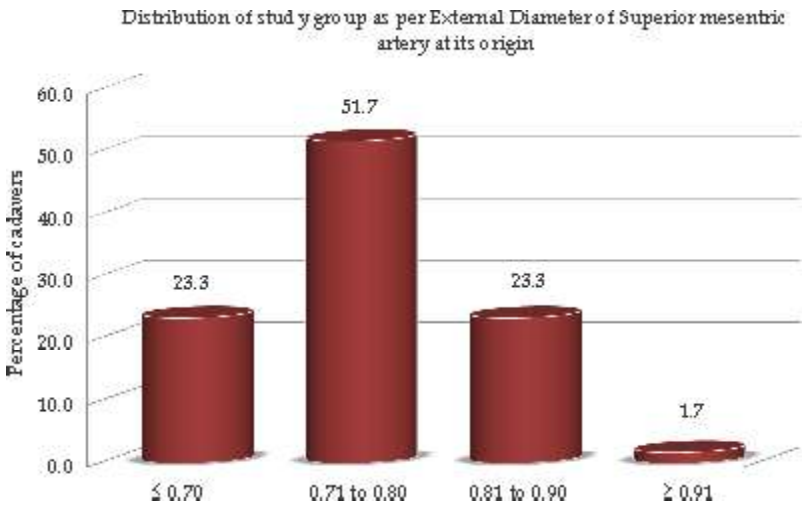

**Graph 1:** The distribution of study group as follows.

The data was tabulated and statistically analysed for various parameters described subsequently.

Out of 60 cadavers, maximum number (46.7%) of cadavers were having the External diameter of Coeliac Trunk at its origin in the range of 0.61 cm – 0.70 cm and minimum number (5%) of cadavers were having the same in the group of less than or equal to 0.50 cm (Table 1 and Graph 1).

**Table 2:** External diameter of Superior mesenteric artery at its origin in cm

| Distribution by groups | | |
|---|---|---|
| **Diameter in cm** | **No. of Cadavers** | **Percent (%)** |
| ≤0.70 | 14 | 23.3 |
| 0.71 to 0.80 | 31 | 51.7 |
| 0.81 to 0.90 | 14 | 23.3 |
| ≥0.91 | 1 | 1.7 |
| **Total (*N*)** | 60 | 100.0 |

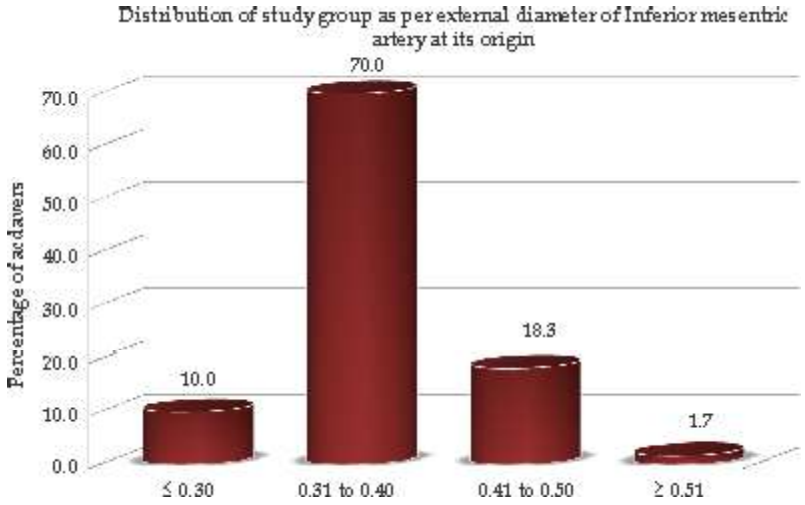



**Graph 2:** The distribution by groups as follows.

Out of 60 cadavers, maximum number (51.7%) of cadavers were having the External diameter of Superior mesenteric artery at its origin, in the range of 0.71 cm – 0.80 cm and minimum number (1.7%) of cadavers were having the same in the group of more than or equal to 0.91 cm (Table 2 and Graph 2).

**Table 3:** External diameter of Inferior mesenteric artery at its origin (in cm)

| Distribution by groups | | |
|---|---|---|
| **Diameter in cm** | **No. of Cadavers** | **Percent (%)** |
| ≤ 0.30 | 6 | 10.0 |
| 0.31 to 0.40 | 42 | 70.0 |
| 0.41 to 0.50 | 11 | 18.3 |
| ≥ 0.51 | 1 | 1.7 |
| **Total (N)** | 60 | 100.0 |




**Graph 3:** The distribution by groups as follows.

Out of 60 cadavers, maximum number (70%) of cadavers were having the External diameter of inferior mesenteric artery at its origin, in the range of 0.31 cm – 0.40 cm and minimum number (1.7%) of cadavers were having the same in the group of more than or equal to 0.51 cm (Table 3 and Graph 3).

## Discussion

We think that the demographic information of the cadavers from which the specimens were taken is consistent with the demographic data of adults in our country. Therefore, we think that the results obtained from AA and its ventral branches can be considered as data belonging to the average individuals.

### *The external diameter of coeliac trunk at its origin*

The external diameter of coeliac trunk at its origin (0.64 cm) in present study is in agreement with the study of Ahmet Songur[7] (0.64 cm).

Best IM et al. (1991)[8] determined diameter of Coeliac trunk by using 3MHz duplex scanner in 11 normal controls and 14 diabetic patients and found average diameter of coeliac trunk as 0.8 ± 0.09 cm.

Sehgal G. et al. (2013)[9] measured the diameter of Coeliac trunk near its origin in 50 subjects during computed tomographic angiography and found to range from 4 mm to 10 mm.

**Table 4:** Comparison of external diameter of coeliac trunk

| Authors | No. of Cadavers | Mean Diameter | Standard Deviation |
|---|---|---|---|
| Pennington (2005)[3] | 15 | 0.76 cm | 0.2 |
| Silveira LA et al. (2009)[5] | 21 | 0.79 cm | 0.04 |
| D Malnar et al. (2010)[6] | 90 | 0.78 cm | 0.08 |
| Ahmet Songur (2010)[7] | 95 | 0.64 cm | 0.1 |
| Present study (2013) | 60 | 0.64 cm | 0.08 |

External diameter of coeliac trunk in study by Pennington[3] (0.76 cm), Silveria[5] (0.79 cm) and Malnar[6] (0.78 cm) is more than external diameter of coeliac trunk (0.64 cm) in present study this could be attributed to the racial differences in the study sample. Arterial diameter of celiac trunk branches is of importance especially because of development of organ transplant surgery and precise radiological diagnosis of arterial aneurysms.[6]

### *The external diameter of Superior Mesenteric Artery at its origin*

Akira imura et al. (2007)[10] observed the external diameter of SMA as 0.66 cm in a case report.

Best IM et al. (1991)[8] determined diameter of Superior mesenteric artery by using 3MHz duplex scanner in 11 normal controls and 14 diabetic patients and found average diameter of Superior mesenteric artery as 0.7 ± 0.07 cm.

**Table 5:** Comparison of external diameter of Superior Mesenteric Artery

| Authors | No. of Cadavers | Mean Diameter | Standard Deviation |
|---|---|---|---|
| Pennington (2005)[3] | 15 | 0.91 cm | 0.2 |
| Ahmet Songur (2010)[7] | 95 | 0.73 cm | 0.16 |
| Present study (2013) | 60 | 0.77 cm | 0.07 |

External diameter of Superior mesenteric artery in Pennington[3] study (0.91 cm) is more than external diameter of Superior mesenteric artery in present study (0.77 cm) this could be attributed to the racial differences in the study sample.

### *The external diameter of Inferior Mesenteric Artery at its origin*

External diameter of Inferior mesenteric artery in Pennington[3] study (0.45 cm) is more than external diameter of Inferior mesenteric artery in present study (0.37 cm) this could be attributed to the racial differences in the study sample.

**Table 6:** Comparison of External diameter of Inferior Mesenteric Artery

| Authors | No. of Cadavers | Mean Diameter | Standard Deviation |
|---|---|---|---|
| Pennington (2005)[3] | 15 | 0.45 cm | 0.1 |
| Ahmet Songur (2010)[7] | 95 | 0.36 cm | 0.07 |
| Present study (2013) | 60 | 0.37 cm | 0.06 |

**Conclusion**

The knowledge of normal arterial diameters in a specific population is of great importance in order to make correct and precise radiological diagnosis of arterial aneurysms. Also, evaluation of arterial diameters is fundamental for liver transplantation follow up. Previous knowledge of the normal and expected values for a specific artery might help the early diagnosis, through radiological exams, of an arterial stenosis, even before clinical signs of low arterial flow.

## References


1. Borley NR. Chapter 68 Posterior abdominal wall and retroperitoneum. In: Standring S., Collins P., Wigley C., editors. Gray's Anatomy. 39th Edition. London: Churchill Livingstone, Elsevier Ltd 2005–06.pp.1116–20.
2. McMINN R. M. H. Last's Anatomy. 8th Edition. Edinburgh. Churchill Livingstone, Medical Division of Longman Group Ltd 1990.p.681.
3. Pennington N, Soames RW. The anterior visceral branches of the abdominal aorta and their relationship to the renal arteries. Surg Radiol Anat 2005 Sep;27:395–403.
4. Feller I, Russell MD, Woodburne T. Surgical Anatomy of the Abdominal Aorta. Annals of Surgery 1961 Dec;154:239–52.
5. Silveira LA, Silveira FB and Fazan VP. Arterial diameter of the celiac trunk and its branches. Anatomical study. Acta Cirúrgica Brasileira 2009;24(1):43–47.
6. Malnar D, Klasan GS, Miletic D, et al. Anatomical Properties of the Celiac Trunk, Coll. Antropol 2010;34(3):917–21.
7. Songür A, Toktaş M, Alkoc O, et al. Abdominal Aorta and Its Branches: Morphometry - Variations In Autopsy Cases. European Journal of General Medicine 2010;7(3):321–325.
8. Irwin M Best, Annette Pitzele, Andrew Green et al., Mesenteric blood flow in patients with diabetic neuropathy 1991;13(1):84–89.
9. Sehgal G, Srivastava A, Sharma P, et al. Morphometry of celiac trunk: A multidetector computed tomographic angiographic study. Journal of The Anatomical Society of India 2013;.62(1):23–27.
10. Iimura A, Oguchi T, Shibata M, et al. An Anomalous Case of the Hepatic Artery Arising from the Superior Mesenteric Artery. Okajimas Folia Anat Jpn. 2007 Aug;84(2):61-5.

*Original Article*

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# Morphometric Study of Thyroid And Cricoid Cartilages in Adults By CT Method

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**Abstract**

*Background:* The increasing application of sophisticated electro-physiological & radiological methods for the diagnosis and treatment of laryngeal disorders requires an extensive knowledge of the size and proportions of the human larynx & its cartilaginous components.

*Aims:* The present study was done to know the morphometric features of Thyroid and Cricoid cartilages in adult males and females by CT method in South Indian population and to compare with other studies.

*Materials and Methods:* The present study was done on 62 (31 Male, 31 Female) patients undergoing CT neck attending the Department of Radiology, KR Hospital attached to Mysore Medical College & Research Institute, Mysore for a period of 1 year from Jan 2014 to Dec 2014.

In the Computerized Tomography of Neck measurements of Thyroid & Cricoid cartilages were taken. The following measurements were taken for Thyroid cartilage, thyroid angle, maximum thyroid width, median antero-posterior diameter, antero-posterior length of right and left lamina. And for Cricoid cartilage antero-posterior and transverse diameter, thickness of Arch and thickness of Lamina were measured.

*Results:* In both thyroid and cricoid cartilages the mean values of all parameters were correspondingly higher in males except for angle between thyroid laminae which was more in females. Mean thyroid angle in males was 75.43 ± 12.09 and females 89.87 ± 12.79. Mean thyroid width in males was 40.81 ± 5.98 and females 35.52 ± 4.84. Mean median antero-posterior length in males was 29.45 ± 4.57 and females 28.7 ± 4.63. Mean antero-posterior length of right lamina in males was 36.90 ± 5.12 and females 28.7 ± 4.63. Mean antero-posterior length of left lamina in males was 38.4 ± 4.17 and females 28.8 ± 4.17.

Mean antero-posterior length of Cricoid cartilage in males was 27.5 ± 2.84. Mean transverse diameter in males was 27.27 ± 2.36 & females 20.89 ± 2.06. Mean thickness of arch in males was 1.96 ± 0.84 & females 1.94 ± 0.9. Mean thickness of lamina in males was 4.24 ± 1.31 & females 4.51 ± 1.18.

*Conclusion:* These morphological differences have important clinical and surgical implications. They are critical to the accurate placement of needles and probes in laryngeal electro myography and vocal cord injection, medialization procedures, in performing supraglottic laryngectomy, as well as precise planning of laryngeal framework surgery.

**Keywords:** Larynx; Thyroid Cartilage; Cricoid Cartilage; Morphometry; Sex determination.

## Introduction

The larynx is made up of a series of cartilages interconnected by ligaments and fibrous membranes. The laryngeal cartilages are the unpaired cricoid, thyroid and epiglottic cartilages, and the paired arytenoid, cuneiform, corniculate and tritiate cartilages.[1]

Anatomy of larynx is necessary for those who are involved in fields of surgical treatment of larynx such as speech therapists, anaesthetists, oncologists, pulmonologists, radiologists, general practitioners, ENT specialists and Phoniatritians.[2]

A knowledge of dimensions of cartilages of larynx and trachea is a must for transplantation, stenting, intubation, crico-thyroidotomy and endoscopic procedures.[3]

Subglottic stenosis and post intubational stenosis of lower respiratory tract were two main factors which lead anatomists to work for measurements of various cartilages in early ninties.[4]

Data such as endolaryngeal angles, airway lumina and thickness of parts of laryngeal skeleton can be helpful in planning of endolaryngeal surgical intervention or transcutaneous placement of electrodes for electro myography or the analysis of CT and MRI scans of the larynx.[5]

The increasing application of sophisticated electro physiological, radiological and surgical methods for the diagnosis and surgical methods for the diagnosis and treatment of laryngeal disorders requires profound knowledge of size and proportion of human larynx and its cartilaginous compounds.[5,6]

Symmetry of larynx is extremely important from clinical point of view as a rotated thyroid cartilage and dislocation of superior thyroid cornua projecting in to ipsilateral pyriform fossa may lead to globus pharyngeous, sticking of food in upper neck, dysphagia or odynophagia.[7]

It has also been hypothesized that foramen thyroideum may provide a pathway for adeno carcinaoma and pyriform recess or transglottic tumours but remains resistant to laryngeal cancer as rest of thyroid lamina.[8]

A procedure called 'laryngofissure' that is cutting through the thyroid cartilage and removing the inner perichondrium and everything inward of that in an area of carcinoma is effective in a high percentage of carefully chosen cases. It is emphasized that this approach avoids the necessity of removing the entire larynx.[9]

Thus knowledge of different parameters of various laryngeal cartilages is necessary before attempting different surgical or other interventions. So the present study was designed to attain this information in detail about thyroid and cricoid cartilages.

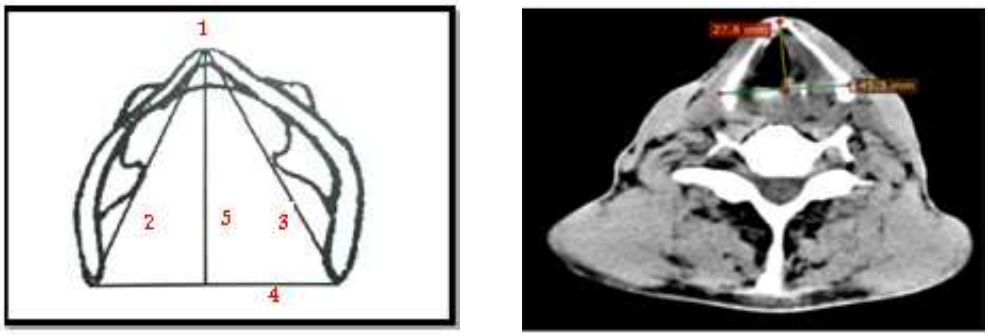
## Materials and Methods

The present study was done on 62 (31 Male, 31 Female) patients undergoing CT neck attending the Department of Radiology, KR Hospital attached to Mysore Medical College & Research Institute, Mysore. The duration of study was 1 year from Jan 2014 to Dec 2014. The present study includes CT scans of both male and female patients of adult age group (18 to 70 years). We have excluded CT scans of patients below 18 years & above 70 years age and also CT scans done for cases with history of previous laryngeal surgery.

The details of the case such as name, age, sex, address, in patient number and indications for CT scan were collected. In the Computerized Tomography of Neck measurements of Thyroid & Cricoid cartilages were taken.

In the present study, the computerized tomography films will be taken in 3–4 slices and measurements will be taken at two levels by using Radiant Dicom Viewer software.

Following five measurements of Thyroid cartilage was taken at one level, where both Thyroid laminae were clearly visible and joined to each other at an angle and the length of lamina was maximum (Fig. 1).




(a) (b)

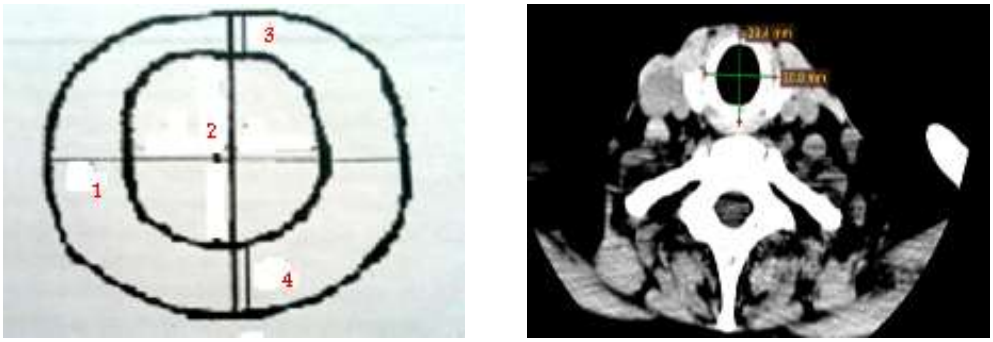
**Fig. 1:** Showing various measurements of thyroid cartilage (a) line diagram, (b) CT photograph.

Thyroid angle (angle between two thyroid laminae)

1. Antero-posterior length of right lamina (distance from Thyroid angle to the posterior margin of the right lamina)
2. Antero-posterior length of left lamina (distance from thyroid angle to the posterior margin of the left lamina)
3. Maximum thyroid breadth (distance between the posterior margins of the two laminae)
4. Median antero-posterior diameter (distance between the thyroid angle and a point midway between maximum thyroid breadth)

Following measurements of Cricoid cartilage were taken at one level where a complete ring of cartilage was clearly visible (Fig. 2).

1. Transverse diameter (outer)
2. Antero-posterior diameter (outer)
3. Thickness of arch
4. Thickness of lamina




(a) (b)

**Fig. 2:** Showing various measurements of Cricoid cartilage (a) line diagram, (b) CT photograph.

## Results

In thyroid cartilage the mean values of all the parameters in males were correspondingly higher than females except for angle between thyroid laminae (Table 1). A significant difference was observed between the values of both sexes in all parameters ($p < 0.05$). The antero-posterior length of right & left lamina was almost equal in females where as in males, left lamina was found slightly more compared to right lamina.

**Table 1:** Comparison of various Parameters of Thyroid and Cricoid cartilages measured between male and female by CT scan that is in living individuals

| | Male | | | | Female | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameters** | **Mean** | **Std. Dev** | **min** | **max** | **mean** | **Std. Dev** | **Min** | **max** |
| **Thyroid cartilage** | | | | | | | | |
| Thyroid angle | 75.43 | 12.09 | 52.9 | 111.2 | 89.87 | 12.79 | 69.1 | 123.3 |
| Maximum thyroid width | 40.81 | 5.98 | 30.8 | 57.3 | 35.52 | 4.64 | 27.1 | 45.3 |
| Median AP diameter | 29.45 | 4.57 | 19.1 | 38.8 | 21.10 | 3.52 | 16.6 | 29.6 |
| AP of right lamina | 36.90 | 5.12 | 22.7 | 45.8 | 28.7 | 4.63 | 20.9 | 38.6 |
| AP of left lamina | 38.40 | 4.17 | 27.1 | 44.7 | 28.8 | 4.17 | 22.4 | 38.7 |
| **Cricoid cartilage** | | | | | | | | |
| AP diameter | 27.5 | 2.84 | 23.4 | 34.4 | 22.72 | 2.61 | 18.6 | 31.2 |
| Transverse diameter | 27.27 | 2.36 | 22.2 | 30.5 | 20.89 | 2.06 | 16.8 | 24.9 |
| Thickness of Arch | 1.96 | 0.84 | 0.5 | 3.8 | 1.94 | 0.90 | 0.90 | 4.1 |
| Thickness of Lamina | 4.24 | 1.31 | 2 | 7.6 | 4.51 | 1.18 | 3 | 7.8 |

In Cricoid cartilage the antero-posterior and transverse diameter are equal in males, where as in females antero-posterior diameter is more compared to transverse diameter. There was no significant difference between male and female with respect to thickness of arch and thickness of lamina. The thickness of lamina was more compared to thickness of arch in both the sexes.

## Discussion

Morphology of larynx has gained clinical significance with the introduction of CT scan and MRI. This knowledge is helpful for trans-cutaneous trans-cricothyroid membrane approach to endolaryngeal structures which is used for techniques such as placement of electrodes for laryngeal electromyography and transcutaneous botulinium injection of the paralyzed vocal fold.[10]

Laryngological imaging and elaboration of new surgical concepts for the treatment of phonatory disorders has recently awakened new interest in larynx morphometry.[11]

The size of thyroid and cricoid cartilages is reported to be smaller in women as compared to men in cadaveric studies[4] and also in the present study by CT scan. Number of workers noted that 90% of women had post-intubation glottis and subglottic stenosis.[12] This can explain higher incidence of post intubation laryngeal injury in women.

Table 2 showing the mean values of Thyroid and Cricoid cartilages are larger in males compared to females in both the studies except the angle. Mean values of all parameters of both cartilages are more in the present study compared to the study done by Monica Jain[10] which may be due to racial difference. In present study the mean antero-posterior measurement of Cricoid cartilage is equal to the mean transverse diameter in males, where as in females the mean antero-posterior measurement is more compared to the mean transverse diameter.

**Table 2:** Comparison with study done by Monica Jain[10]

| Sl. No | Parameter | Monica Jain[10] (Mean ± SD) | | Present study (2019) (Mean ± SD) | |
|---|---|---|---|---|---|
| | | Male | Female | Male | Female |
| 1 | Thyroid angle | 72.60 ± 8.26 | 84.87 ± 8.12 | 75.43 ± 12.09 | 89.87 ± 12.79 |
| 2 | Maximum thyroid width | 37.8 ± 3.6 | 34.9 ± 4.5 | 40.81 ± 5.98 | 35.52 ± 4.64 |
| 3 | AP of right lamina | 36.8 ± 4.8 | 29.7 ± 5.1 | 36.90 ± 5.12 | 28.7 ± 4.63 |
| 4 | AP of left lamina | 35.2 ± 5.9 | 29.2 ± 4.6 | 38.40 ± 4.17 | 28.8 ± 4.17 |
| 5 | AP diameter of Cricoid cartilage | 28.6 ± 4.9 | 23.2 ± 4.1 | 27.75 ± 2.84 | 22.72 ± 2.61 |
| 6 | Transverse diameter of Cricoid cartilage | 25.7 ± 3.2 | 21.3 ± 4.7 | 27.27 ± 2.36 | 20.89 ± 2.06 |

Lipton et al.[11] reported a study on the sectional anatomy of larynx with respect to the cricothyroid membrane as applied to the transcutaneous approach to endolaryngeal structures. For example, thyroarytenoid muscle could be approached in a saggital plane approximately 5 mm from the midline at an approximate angle of 50° and a depth of 9–13 mm in males and at an angle of 40° and depth of 7–9 mm in females. Such measurements were obviously related to the size of laryngeal cartilage and were important for the placement of electrographic electrodes and for the injection of botulinium toxin for spastic dysphonia suggesting the importance of taking measurements of larynx in living.

Shin et al. reported mean height of Cricoid cartilage marrow In 13.6 mm (range 5.5 to 20.5 mm) in women & 17.5 mm (range 13.0 to 24.5 mm) in men. The mean thickness of Cricoid cartilage marrow was 3.17 (range 1.22 to 4.75 mm) in women and 5.13 mm (range 3.42 to 7.6 mm) in men[13] which is less compared to present study.

## Conclusion

Thus to conclude in the present study all parameters of thyroid and cricoid cartilages are more in males compared to females except thyroid angle which was more in females.

The mean antero-posterior measurement of Cricoid cartilage is equal to the mean transverse diameter in males, where as in females the mean antero-posterior measurement is more compared to the mean transverse diameter.

The size of thyroid and cricoid cartilages is reported to be smaller in women as compared to men in the present study by CT scan.

## References


1. Standring S. Larynx. In: Barry K B Berkovitz (editors). Gray's Anatomy. 40th Edition. London: Elsevier Charchill Livingstone: The anatomical basis of clinical practice; 2006. pp.577–93.
2. Kutta H, Knipping S, Claassen H and Paulsen F. Functional anatomy of the larynx from clinical viewpoints. Part I: development, laryngeal skeleton, joints, insertion structures, musculature. HNO 2007;55(7):583–98.
3. Randestad A, Lindholm CE and Fabian P. Dimensions of the cricoid cartilage and the trachea. The Laryngoscope 2000;110:1957–61.
4. Ajmani ML. A metrical study of the laryngeal skeleton in adult Nigerian. J Anat 1990;171:187–91.
5. Eckel HE, Sittel C, Zorowka P, et al. Dimensions of the laryngeal framework in adults. Surg Radiol Anat 1994;16:31–36.
6. Jain M, Dhall U. Morphometry of the thyroid and cricoid cartilages in Adults. J Anat Soc of India 2008;57(2):119–23.
7. Hajiioannou JK, Florou V and Kousoulis P (2010). Superior thyroid cornu anatomical variation causing globus Pharyngeous and dysphagia [serial online]. Available: URL:http://www.PubMed.com
8. Krichner JC, Krichner JA and Sasaki CT. Anatomic foramina in thyroid cartilage:incidence and implications for the spread of laryngeal cancer. Annals of Oto Rhino Laryngology 1989;98(6):421–25.
9. Jackson C and Jackson CL. Malignant disease of larynx: its treatment by laryngofissure and laryngectomy. American Journal of Surgery 1935;30–33.
10. Monika Jain, Usha Dhall. Morphometry of the thyroid and cricoid cartilages in Adults on CT scan. J Anat Soc of India 2010;59(1):19–23.
11. Lipton RJ, McCaffrey TV, Cahill DR. Sectional anatomy of the Larynx: Implication for the transcutaneous approach to endolaryngeal structures. Ann Otol Rhinol Laryngol 1989;98:141–44.
12. Harrison GA, Tonkin JP. Prolonged (therapeutic) endotracheal intubation. BR J Anaesth 1968;40:241–49.
13. Shin HW, Ahn Y, Sung MW, Kim KH, Kwon TK. Measurement of cross-sectional dimensions of cricoid cartilage: A computed tomographic study. Ann. Otol Rhinol Laryngol 2009 April;118(4):253–8.

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# Is Cadaveric Dissection Still Considered an Indispensible Learning Tool? A Study With 1st M.B.B.S. Students

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**Abstract**

*Background:* Cadaveric dissection is an important experience for every medical student. However a first year student goes through a variety of responses on exposure to cadaveric dissection.

*Aim:* This study was undertaken to note the various attitudes of first year M.B.B.S. student.

*Methods:* Questionnaires were administered to willing candidates out of 250 first M.B.B.S. students to determine attitude of students to cadaveric dissection.

*Result:* 22.14% had recurrent thoughts of the cadaver during the first week of dissection. 5.1% had thoughts about leaving the course in the first week. These thoughts decreased to 0% after 8 weeks of dissection. 85.11% students felt that interaction with Anatomy teachers helped them to emotionally cope with the stress.

*Conclusion:* We conclude that cadaveric dissection is an indispensible learning tool of medical education. Better student staff interaction will help the student cope with stress of first year curriculum.

**Keywords:** Cadaveric dissection; Attitude of students, Gratitude towards cadaver, Emotional help and learning tool.

## Inroduction

Dissection of a Cadaver has been the central part of anatomy learning process. Many consider dissection as a once in a lifetime experience. Since Renaissance period dissection is considered as an important pillar in medical education.[1] However, every medical student goes through a variety of emotions when exposed to human cadaver. Poles apart responses like a deep feeling of gratitude towards the cadaver[2,3] to a shocking feeling of leaving the M.B.B.S. course[1,4] after few days of starting cadaveric dissection have been reported. In the new curriculum with integrated teaching, newer methods like use of dissection videos, virtual dissection, prosected specimens or plastic models as an option for cadaveric dissections are being used.[5] A newly admitted first year student is dealing with sense of pride, excitement and stress of entering the world of Medical education.

### *Aim*

The present study was conducted to determine the attitude of 1st year medical students to cadaver dissection and to determine if students still feel that cadaveric dissection is an indispensible learning tool.

## Materials and Methods

The attitude of 1st year medical students towards cadaveric dissection was tested, before exposure to cadaver, one week after exposure to cadaver and 2 months after starting cadaver dissection.

Standardized and pretested questionnaires prepared in english were administered to willing candidates from 250 1st MBBS students of Dr. D.Y. Patil vidyapeeth and Medical college, Pune. 1st questionnaire was administered immediately before the first class of dissection session. The 2nd questionnaire was administered a week after the first dissecting room experience. The 3rd was 2 months later. The relevant data obtained from questionnaires was captured and analyzed statistically.

## Results

In this Study 59.35% female and 40.65% male students with age ranged between age 16 to 22 has been participated. 69.9% follow a non vegetarian diet while 30.1% are vegetarians. 22.14% students had recurrent thoughts of cadaver and formalin smell even outside college in the first week of dissection. Fear for dissection decreased from 19.9% to 2.55% in two months of dissection. View of student that dissection is an important part of medical course increased from 95.93% to 100%. 5.1% students had thoughts of leaving M.B.B.S. course after first cadaver exposure. 99.14% felt gratitude towards the cadaver after months of dissection which is more than 93.08% response after one week of dissection. 85.11% felt that interaction with anatomy staff helped them emotionally.

**Table 1:** Response to various attitudes

| Attitude | Before start of dissection | After one week of dissection | After 8 weeks of dissection |
|---|---|---|---|
| Fear of cadaver | 19.9% | 15.31% | 2.55% |
| Recurring thoughts about dissection | - | 22.12% | 0% |
| Thoughts about leaving the course | - | 5.1% | 0% |
| Difficulty in eating non-veg food | - | 12.34% | 0% |
| Interaction with anatomy staff helped them emotionally. | 69.51% | - | 85.11% |
| Feeling of gratitude towards the cadaver | - | 93.08% | 99.14% |
| Considering dissection as a indispensible tool | - | 95.93% | 100% |

## Discussion

Mulu and Tegabu[6] in a longitudinal study of Medical students' attitudinal changes towards cadaver dissection, found that the reaction of students towards cadaver varied as the duration of the contact increased. Fear had decreased from 58.5% to 2.7% and nausea from 6.1% to 2% with statistically significant difference ($p < 0.05$). Interest increased from 70.7% to 95.2% and excitement from 42.9% to 57.8% on subsequent exposure to dissection.

Saha et al.[1] studied the attitude of 1st year Medical students in Dissection Hall and found that 100% of them agreed that cadaver dissection was important part of Medical Degree and 96.97% agreed that dissection gave better learning than demonstration on prosected specimen. 96.7% felt gratitude towards the body donors, and 3% stated that they had thought of leaving the training programme following exposure to the cadaver.

Somanath et al.[2] studied the experience of preclinical students in anatomy-Lab and found that 96% males and 97% females agreed that dissection enhanced the skill of thinking in a logical manner. 94% males and 90% females thought that actual hands-on training on cadaver dissection gave better results than demonstration of prosected specimens. 93% males and 96% females admitted that cadaver dissection was ethically acceptable. 86% males and 97% females agreed that cadaver dissection could not be replaced by plastic models and computer assisted training programmes. 100% females and 96% males consider cadaver dissection to be important and indispensable to anatomy learning.

Mishra et al.[7] while studying the attitude of

medical students towards dissection found that majority of students were not found to be mentally prepared about the composition of dissection though they were excited. Students had no idea about body donation though they strongly agreed that dissection would help them in future medical practice.

Oyeyipo and Falana[3] studied the attitude of preclinical students to cadaver dissection in South-West Nigerian Medical School and found that majority (70%) of students found their 1st visit to Dissection hall exciting, 46.7% were upset at the beginning of dissection while 36% showed anxiety and stress immediately before and during dissection. While 76.7% were mentally prepared for dissection 20% were not. 81.7% felt that dissection enhanced their thinking ability and 93.3% felt that dissection provided the best method of learning anatomy. 86.6% and 91.7% felt cadaver dissection was acceptable religiously and culturally respectively.

Dubashi et al.[8] in a study of reactions of Medical students to dissection, found that students experienced positive feelings such as curiosity and interest to learn about the structure of human body and some felt scared, put off by the formalin fumes because of which few were hesitant to dissect the cadaver. Some of these negative feelings influenced their routine activities. Students reported feeling of gratefulness to the people who donated their bodies. Students felt need for pre-education session before the formal dissection.

Vijayabhaskar P et al.[9] studied the emotional impact of cadaveric dissection on first M.B.B.S. students. They used the Appraisal of life events (ALE) scale to measure the amount of impact felt by the student. More loss in ASE scale was reported by vegetarian students. Majority of the students showed a positive response. They considered dissection as a positively significant life experience. The knowledge from theory lectures and tutorial gets elaborated and reinforced during cadaveric dissection. Interaction and assistance by senior students and anatomy staff reduced the stress of dissection significantly. Even 85.11% students in our study state that anatomy staff helped them to emotionally manage the stress. A three dimensional view of human anatomy is given to the students by cadaveric dissection.

Arraez and Aybar[10] in a study with 425 first M.B.B.S. students state that for technical and emotional skill training, cadaveric dissection is an important training tool. The emotional responses to dissection decrease with continual exposure. Students gained better emotional control. Authors say that dissection makes the student learn how to face and adapt to their emotional responses and attitude to deeper thoughts about life and death.

**Table 2:** Comparison with other studies

| Attitude | Mulu & Tegabu[6] | Agnihotri G & Sagoo M[11] | I.P. Oyeyipo & Falana B[3] | Nirmalya Saha et al.[1] | Current study |
|---|---|---|---|---|---|
| Fear of cadaver – before dissection | 64.6% | 30.6% | | | 19.9% |
| After 1 week | 12.9% | | | | 12.31% |
| After 8 weeks | 4.7% | 15.33% | | | 2.55% |
| Recurring thoughts about dissection | | | | 24.2% | 22.12% |
| Thoughts about leaving the course | | | | 4% | 5.1% |
| Difficulty in eating non-veg food | | | | 29.3% | 12.34% |
| Feeling of gratitude towards the cadaver | | | 83.3% | | 99.14% |
| Considering dissection as an indispensible tool | 99% | | 98.3% | | 100% |

## Conclusion

We state that, cadaveric dissection is an indispensible learning tool in Medical education. A three dimensional view of human anatomy is given by cadaveric dissection. On cadaver exposure students demonstrate a variety of responses. Continued dissection exposure for a period of 8 weeks has considerably decreased the negative responses reported in the first week.

A positive response of increase in gratitude for the cadaver is seen. 100% students in this study feel that Cadaveric dissection is an indispensible tool in medical education. First year student is going through a sense of excitement and stress while starting cadaveric dissection. Better student–teacher interactions will help students to emotionally cope with the stress of dissection and academic curriculum.

## References


1. Saha N, Chaudhuri S, Singh M M. Attitude of First Year Medical Students in Dissection Hall. IOSR Journal of Dental And Medical Sciences (IOSR-JDMS). 2015 May;14(5)74–78.
2. Somanath D, Shrivastava S, Rajasekar S. Attitude of First Year Medical Students Towards Dissection. International J. of Healthcare and Biomedical Research, 2015 Jan;03(02):117–21.
3. Oyeyipo IP & Falana BA. Attitude of Preclinical Students To Cadaver Dissection in South West Nigerian Medical School. International Journal of Tropical Medicine. 2012;7(1):1–5.
4. Dempster M, Black A, McCorry N, et al. Appraisal and Consequences of Cadaver Dissection, Med Educ Online 2006;11:16.
5. Haider H Ghazanfar, Sannah S Rashid, Ashraf A Hussain, et al. Cadaveric dissection a thing of the Past? The Insight of Consultants, Fellows, and Residents. Cureus 2018 Apr;10(4):e2418.
6. Mulu A and Tegabu D. Medical Students Attitudinal Changes Towards Cadaver Dissection: A Longitudinal Study. Ethiop J Health Sci 2012 Mar;22(1):51–58.
7. Mishra P, Ksheersagar D, Mishra D. Attitude of First Year Medical Students Towards Dissection. J Cont Med A Dent 2015 Jan-Apr;3(1)45–49.
8. Dubhashi S, Dubhashi U, Singh A, et al. Medical Students React to Cadaveric Dissections. Recent Research in Science and Technology 2011;3(1):135–38.
9. Vijayabhaskar P, Shankar PR, Dubey AK. Emotional impact of cadaver dissection: Asurvey in a medical college in western Nepal. Kathmandu University Medical Journal 2005;3(2,10):143–48.
10. Arraez & Aybar. Dissection as a modulator of emotional attitudes and reactions of future health professionals. Med Educ 2008;42:563–71.
11. Agnihotri G & Sagoo MG. Reactions of first year Indian medical students to the dissection hall experience. NJIRM 2010 Oct-Dec;1(4):4–9.

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# Morphological Study of Pterion in Dry Human Skull

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**Abstract**

*Introduction:* Pterion is irregularly H shape confluence of sutures on norma lateralis. It is an anthropological landmark situated in the floor of temporal fossa. Anterior division of middle meningeal artery is related to and commonly injured in trauma at pterion. Keeping in mind clinical and anthropological importance of pterion study was conducted.

*Aims and Objectives:* To study sutural pattern of pterion based on Murphy's classification. To locate the pterion above zygomatic arch and behind frontozygomatic suture.

*Material and Methods:* 56 dry human skulls of known sex preserved by Anatomy Department, Government medical college Aurangabad were studied for pterion pattern. Location of pterion studied from midpoint of zygomatic arch to midpoint of pterion on both sides and mean is calculated for distance from frontozygomatic suture also. Distance is measured using digital vernier caliper having 0.01 mm accuracy.

*Results:* : Percentage of pattern of pterion in present study is; Sphenoparietal 69.64% Epipteric bone 23.21%, Stellate 4.46% and Frontotemporal 2.68%. Mean distance of pterion in females is 3.8 cm from zygomatic arch and from frontozygomatic suture is 2.91cm. In males it is 3.87 cm and 2.92cm respectively.

*Conclusion:* Sphenoparietal type of pterion is most frequent type of pterion in present study. Sutural pattern and location may vary in two sides in same subjects. Knowledge of morphology and distance of pterion from frontozygomatic suture and zygomatic arch is important for anthropologists, radiologists and neurosurgeons.As skull is thinnest at pterion ,it is useful in pterional approach in neurosurgery.



**Keywords:** Pterion; Zygomatic arch; Sphenoparietal type; Epipteric type.

## Introduction

Pterion is irregularly H shape confluence of sutures on norma lateralis where frontal, parietal, squamous temporal and greater wing of sphenoid meets.

It is an anthropological landmark situated in the floor of temporal fossa. Pterion corresponds to the site of the anterolateral fontanelle of the neonatal skull which closes at third month after birth.[1]

In present project sutural pattern of pterion was studied based on Murphy's classification.[2]

Initially Broca classified pterion into three types namely sphenoparital, frontotemporal, stellate.[3]

Later Murphy in 1956 added fourth type of pterional sutural bone known as epipteric bone.[2]

Pterion is important in surgical approach known as pterional approach in neurosurgery[13], with pterional approach anterior and middle cranial fossa can be operated, also repair of aneurysms of middle cerebral artery, tumors such as olfactory meningioma can be approached, pterional access is of importance in operations on Broca's motor speech area,sphenoid ridge and optic canal.[13]

## Materials and Methods

Fifty-six dry human skulls of known sex preserved by Anatomy Department, government medical

college Aurangabad were studied for pterion pattern. Skull with broken pterion and zygomatic arch were excluded from the study. 56 intact Skulls were classified morphologically into sphenoparietal, frontotemporal, stellate and epipteric types.

1. *Sphenoparital type:* Greater wing of sphenoid articulates with the parital bone.

2. *Frontotemporal type:* Sqamous part of temporal bone articulates with the frontal bone.

3. *Stellate type:* All above said four bones articulate at a single point.

4. *Epipteric type:* Sutural bone is present at the site of pterion.

Types of pterion are shown in figures 1 to 4.

Sphenoparital and frontotemporal types form H shaped sutural pattern.

Location of pterion studied from midpoint of zygomatic arch to midpoint of pterion. On both sides and mean is calculated for distance from frontozygomatic suture also. Distance is measured from posteriormost point of frontozygomatic suture to midpoint of pterion,which is least possible distance.

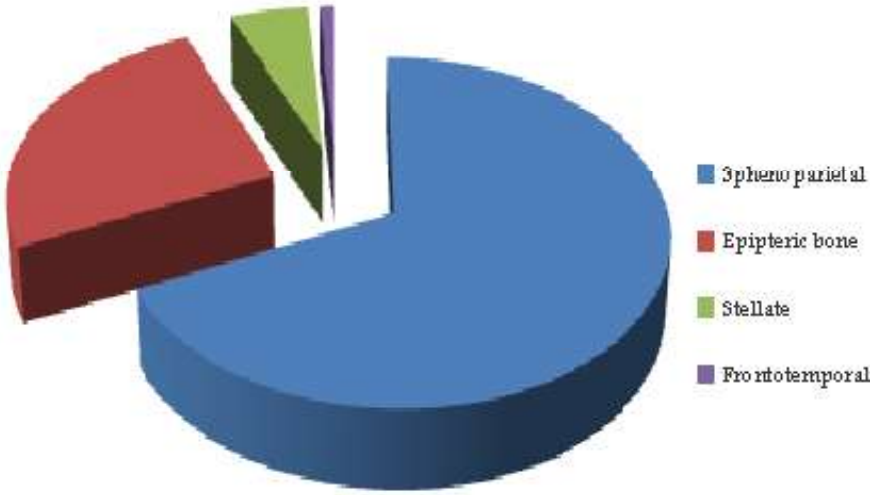
## Results

Percentage of pattern of pterion in present study is as shown in Graph 1.

Sphenoparietal 69.64%, Epipteric bone 23.21%, Stellate 4.46% and Frontotemporal 2.68%.

Mean distance of pterion from zygomatic arch

- In females - 3.8 cm
- In males - 3.87 cm




**Graph 1:** Pie chart showing percentage of pattern of pterion in present study.

**Fig 1:** Stellate type of pterion.

**Fig 2:** Sphenoparital type of pterion.

**Fig 3:** Frontotemporal type pterion.

**Fig 4:** Epipteric type pterion.

Mean distance of pterion from frontozygomatic suture

- In females - 2.91cm.
- In males - 2.92cm.

## Discussion

In present study, 56 skull having 112 sides 78 were sphenoparital, 26 epipteric type, 5 stellate type and 3 of frontotemporal type.

Frontotemporal is predominant in Non-human mammals.[4,5] Location study in different population vary and helps to locate pterion in different populations

In present study and in previous studies[6,7,8,9,10] sphenoparietal is predominant suture pattern.

In Present study Sphenoparietal type is found in 69.64 % while in study by Oguz et al.[6] it was 88%, by Mwachaka et al.[7] it was 66.7% , by Adejuwaon et al.[8] on Nigerian population it was 86%, by Gupta et al it was 60.95%. Present study is comparable to

**Table 1:** Comparison of present study pterion pattern with previous studies

| Studies | Spheno-parietal | Fronto-temporal | Stellate | Epipteric |
|---|---|---|---|---|
| Oguz et al. (2004)[6] | 88 | 0 | 2 | 10 |
| Mwachaka et al. (2009)(Kenyan)[7] | 66.7 | 15.5 | 11.1 | 6.7 |
| Adejuwon et al. (2013) (Nigerian)[8] | 86 | 8.5 | 5.6 | 0 |
| Sowmya S et al. (2017)[9] | 77 | 17 | 0 | 6 |
| Gupta et al. (2014)[10] | 60.95 | 6.5 | 8.7 | 23.85 |
| Present study (2020) | 69.64 | 2.68 | 4.46 | 23.21 |

Study by Gupta et al. (2014)[10] in which incidence of epipteric was 23.85% and in present study it is 23.21%

Pterional approach is the most popular approach used in neurosurgery.[11] In present study location of pterion studied from midpoint of zygomatic arch to midpoint of pterion. On both sides and mean is also calculated for distance from posterior most point on frontozygomatic suture.

According to study done by Reis BL, et al.[12] sphenopterional point is located on average 21.72 mm posterior and 4.76 mm superior from frontozygomatic suture, over the sphenoidal bone component of the pterion region. They studied 100 adult dry human skull using laser transillumination.

Epipteric bone can be misinterpreted as fracture radiologically.After sphenoparital type epipteric bone is common in Indian population.

Location study in different population vary and helps to locate pterion in different populations.

## Conclusion

Study data may be useful for radiologists and

neurosurgeons and anthropologists. Variation may present in sutural pattern and location in right and left sides in same subjects. Pterion study is also helpful in pterional approach neurosurgeries as anterior division of middle meningeal artery is related internally to pterion to cause epidural haematoma.Racial differences seen in sutural pattern and distances from zygoma and frontozygomatic suture.

## References


1. Standring S, Ellis H, Healy J.C, et al. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 39th edition. London, Elsevier Churchill Livingstone 2005.pp.441–84.
2. Murphy T. The pterion in the Australian aborigine. Am. J. Phys. Anthropol 1956;14(2):225–44.
3. Broca P. Instructions craniologiques et. craniometriques. Mem. Soc Anthrop. Paris 1875;2:1–203.
4. Ashley–Montagu, FM. The tarsian hypothesis and descent of man. J.R. Anthropol. Inst. Great Britain Ireland 1930;60:335–62.
5. Saxena SK, Jain SP, Chowdhary DS. A comparative study of pterion formation and its variations in the skull of Nigerian and Indians. Anthropol Anz 1988;46:75–82.
6. Oguz O, Sanli SG, Bozkir MG, et al. The pterion in Turkish male skulls. Surg. Radiol. Anat 2004;26:220–24.
7. Mwachaka PM, Hassanali J, Odula P. Sutural morphology of pterion and asterion among adult Kenyans. Braz J Morphol Sci 2009:26:4–7.
8. Adejuwon SA, Olopade FE, Bolaji M. Study of the location and morphology of the pterion in adult nigerian skulls. ISRN Anat 2013;2013:403937.
9. Sowmya S, Meenakshi B, Ranganath P. Study of pterion: Its clinical and morphological aspects. Indian Journal of Clinical Anatomy and Physiology 2017;4(2):247–49.
10. Gupta R, Sinha MB, Aggarwal A, et al. Landmarks for keyhole neurosurgical procedures through pterion. Int. J. of Healthcare and biomedical research 2014;2(4):168–75.
11. Yasargil MG, Fox JL, Ray MW. The operative approach to aneurysms of the anterior communicating artery. Advances & Technical standards in neurosurgery 1975;2:113–70.
12. Baltazar Leao Reis, Sebastiao Natanial Silva Gusmao B Sphenopterional Point: Strategic Point for Burr Role Placement in Frontotemporal craniotomies. World Neurosurgery 2017 Sep;105:399–405.
13. Vasudha TK, D'Sa DS, Gowd S. Study Of Morphology Of Pterion And Its Clinical Implications. Int J Anat Res 2017;5(4.3):4674-4678.

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# A Study of Anomalies of Great Vessels of Heart

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**Abstract:**

*Introduction:* Abnormalities of great vessels of heart, especially arch of aorta, are of embryological interest and have already been described in many text books of anatomy. The embryological development of aortic arch is very complex that finally results in the formation of three branches: 1) brachiocephalic trunk 2) left common carotid artery and 3) left subclavian artery. In the present study we have found a case of abnormal aortic arch giving rise to four branches and also ligamentum arteriosum. We also found three more cases of ligamentum arteriosum.

During the foetal life, Ductus arteriosus provides communication between pulmonary and systemic circulations. This normal anatomical structure closes soon after birth and undergoes fibrosis which is termed as ligamentum arteriosum that persists up to 3 months of post natal life.

*Aims and Objectives:* The clinicians and surgeons should be aware of wide range of congenital anomalies of great vessels of heart during the management of such cases. Therefore the present study focuses on reporting of such cases to reduce the risk of iotrogenic injuries.

*Materials and Methods:* We had studied 80 embalmed cadavers for a period of 3 years for the presence of anomalous great vessels of heart.

*Results:* We have found four hearts with anomalous great vessels. One of the hearts had abnormal aortic arch that had given rise to four branches. It also had persistent ligamentum arteriosum. In the other three cases, we found only persistent ligamentum arteriosum.

*Conclusion:* Knowledge of variations in great vessels of heart is important for the practitioners to reduce the disastrous vascular complications.

**Keywords:** Great vessels; Ligamentum arteriosum; anomalies.

## Introduction

The development ofaortic arch is very complex and finally results in the formation of left aortic arch with three branches. They are 1) brachiocephalic trunk 2) left common carotid artery and 3) left subclavian artery. 1–3% of congenital heart diseases account for anomalies of aortic arch. When the arch crosses the right main bronchus, it is called as right aortic arch and further descends to the right side of the spine. This variation does not cause oesophageal compression. But with the presence of both Kommerell's diverticulum and ligamentum arteriosum, oesophagus may get compressed resulting in dysphagia. Patients usually remain asymptomatic till later decades of life as the arteries become tortuous and aneurysmal.[1]

A recent study suggests that only 0.36% of patients with dysphagia had aberrant subclavian arteries.[2] An aberrant right subclavian artery is found in 0.5% of population, whereas aberrant left subclavian artery is found in only 0.06–0.01% of population.[3] The right-sidedaortic arch is a rare congenital malformation occurring during embryologic development. Majority of these cases

present with aberrant left subclavian artery (LSA) which can cause compression of thoracic structures. While this aberrant vessel causes mostly benign symptoms, patients may first present with rupture of a thoracic aneurysm. This thoracic aneurysm is commonly known as Kommerell's diverticulum. Kommerell's diverticulum is a developmental anomaly named after Dr. Kommerell who diagnosed it first. It is a remnant of fourth dorsal aortic arch. The diverticulum may be present on both right and left aortic arches, from which aberrant subclavian artery arise to the contralateral side.[4]

### *Embryological aspects*

The various congenital anomalies of the aortic arch is based on the hypothetical theory of double aortic arch, which was described by Edwards et al.[5] In this hypothetical theory, the ascending aorta divides into Right and Left aortic arches which encircle trachea and esophagus and then unite to form descending aorta. A common carotid artery and subclavian artery arise from each aortic arch. A ductus arteriosus connects the aortic arch and pulmonary artery on each side. Usually, the regression occurs between the origin of right subclavian artery and descending aorta in the Right aortic arch (RAA). Right ductus also undergoes regression. Thus, the normal aortic arch is formed. If the regression occurs between the origin of left subclavian artery (LSCA) and the descending aorta in the left aortic arch, it then becomes an RAA with mirror-image branching. If the interruption takes place between the left carotid artery and the LSCA in the left aortic arch, it will form an RAA with aberrant LSCA.[6] There can be a dilated segment at the proximal part of the aberrant LSCA. It is known as the diverticulum of Kommerell. Thus depending on inappropriate persistence orregression of different segments, different types of aortic arch anomalies occur.[6]

## Materials and Methods

The present studywas conducted on 80 embalmed cadavers, out of which 19 were female and 61 were male, for the period of 3 years from 2015 to 2018 in KAHER's Jawaharlal Medical College, Belagavi, Karnataka. All the 80 cadaveric hearts were observed during the routine dissection hours of MBBS students and presence ofany abnormalities or congenital anomalies of great vessels of heart were noticed.

We found an anomalous heart in a 60 year old male cadaver with the ascending aorta originating from the left ventricle posterior to the commencement of pulmonary artery (Fig. 1). It travels cranially and to the left and became continuous with the arch of aorta. The arch passes posterior to the trachea and oesophagus becoming continuous with the descending thoracic aorta which was on the right side of vertebral column. This anomaly is because of persistence of right fourth aortic arch and regression of left fourth aortic arch.

The right sided aortic arch gave four branches: from right towards the left they were 1) right subclavian artery 2) right common carotid artery 3) left common carotid artery and 4) aberrant left subclavian artery. The aberrant left subclavian artery was arising from a conical dilatation of the proximal portion of its origin from the aorta. This conical dilatation is called as Kommerell's diverticulum which accounts for 1.25% in the present study.

Three more adult male cadavers had only persistent ligamentum arteriosum with no other associated anomalies which accounts for 3.75% (Fig. 2a, b, c).


**Fig. 1:** Anomalous Heart

**Fig 2a, b, c:** Hearts Showing Ligmentum Arteriosum.

## Results

Among 80 dissected cadavers, we got four anomalous hearts. All these were found in adult male cadavers in the age group of 55–70 years. One of hearts (Fig. 1) had right sided arch of aorta giving rise to four branches including aberrant left subclavian artery. The rest of the three hearts had persistent ligamentum arteriosum with no other anomalies (Fig. 2a, b, c).

## Discussion

In 1763, Fioratti and Aglietti first documented a case of right sided aortic arch.[7] This is later classified in 1948 by Edward, in 1963 by Palayew and in 1964 by Steward et al.[8]

According to a study done by Cina CS, et al. in 2009, only 0.1% of adult population was found with Right sided aortic arch which is a very rare congenital anomaly.[9] Half of these cases were associated with aberrant left subclavian artery (0.05–0.1%) which has been found in our case as well. Only about 50 cases of Right sided aortic arch with aberrant left subclavian artery have been found in the previous studies so far.[10]

Right aortic arch (RAA) is divided into two types: mirror-image branching and aberrant left subclavian artery (LSCA).[11] RAA with aberrant LSCA is rarely associated with other congenital heart diseases, which accounts for only about 10%, where as in RAA with mirror-image branching, this risk of association with other congenital heart disease is more than 90%.[12] The most common association is Tetralogy of Fallot. Hastreiter et al. in his study, found that the RAA with mirror-image branching was associated with double-outlet right ventricle in 20%, with truncus arteriosus in 13–15% cases and with Tetralogy of Fallot in 13–34% of cases.[7]

The etiology of right sided arch of aorta is still unknown. A deletion of chromosome 22q11 is said to be associated with 24% incidence of isolated anomalies of laterality of aortic arch.[13]

Right sided aortic arch with aberrant left subclavian artery is rarely associated with other congenital heart diseases and accounts for only 10%.[14]

Jung et al. in 1978 reported five cases of right sided aortic arches with aberrant left subclavian artery and persistent leftligamentum arteriosum.[15]

Kommerell's diverticulum is also called as "remnant diverticulum", "lusoria diverticulum"or "lusoria root". This diverticulum was originally described by Burckhard Friedrich Kommerell in 1936 and is a remnant of left fourth aortic arch.[16]

Two types of aortic arches have been described. In the first type, a vascular ring is formed around the trachea and oesophagus.[17] Bothare enclosedin the ring formed by the right sided aortic arch, and left ligamentum arteriosum. Similar formation has also been found in our study as well. In the other type, both the ductus arteriosus and aorta lie to the right of the trachea without a vascular ring.[14]

Vascular rings are formed by double aortic arches with small, atretic or equal right and left components. The descending thoracic aorta may be left or right sided, and there may be a left, right, or bilateral patent ductus arteriosus, or a ligamentum arteriosum.[18,19]

In the previous studies, it has been reported that right sided aortic arch with aberrant left subclavian artery must always have a ductus arteriosus.[20] Similar findings have been noted in our studies as well. With the presence of ductus arteriosus, a vascular ring is formed which may or may not cause compression of trachea and oesophagus.

## Conclusion

The branching pattern of great vesselsthat are arising from the arch of aorta are of major interest to the cardiologists, cardiothoracic surgeons and clinicians who perform imaging studies and catheter-based techniques to reduce the risk of iotrogenic injuries. It helps them to appreciate these anomalies pre-operatively and can reduce the risk of disastrous vascular complications.

## References

1. Zhao J. et al., Right aortic arch with retroesophageal left ligamentum arteriosum. Tex Heart. Inst. J 2006;33:218–21.
2. De Luca et al. EUS imaging of the arterialusoria: case series and review. Gastrointest. Endosc. 2000;52:670–73.
3. Van Dyke CW, White RD. Congenital abnormalities of the thoracic aorta presenting in the adult. J. Thorac. Imaging 1994;9:230–45.
4. Tanaka A. et al. kommerell's diverticulum in the current era; A comprehensive review. Gen ThoracCardiovasc Surg 2015;63:245–59.
5. Edwards JE. Vascular rings and slings. J.H. Moller, W.A. Neal (Eds.), Fetal, neonatal, and

infant cardiac disease, Appleton & Lange, Norwalk, CT 1990;745–54.

6. Yoo SJ, Min JY, Lee YH, et al. Smallhorn Fetal sonographic diagnosis of aortic arch anomalies. Ultrasound Obstet Gynecol 2003;22:535–46.
7. Hastreiter AR, D'Cruz IA, Cantez T, Namin EP, Licata R. Right-sided aorta. I. Occurrence of right aortic arch in various types of congenital heart disease. II. Right aortic arch, right descending aorta, and associated anomalies. Br Heart J. 1966;28(6):722-739.
8. Garti IJ, Aygen MM, Vidne B, Levy MJ. Right aortic arch with mirror-image branching causing vascular ring. A new classification of the right aortic arch patterns. Br J Radiol. 1973;46(542):115-119.
9. Cina CS, Arena GO, Bruin G, et al. Kommerell's diverticulum and aneurismal right sided aortic arch: A casereport and review of literarture. J. Vasc. Surg 2000;3:1208–14.
10. Yang MH. A Right aortic arch with Kommerell's diverticulum of the aberrant left subclavian artery presenting with syncope. J Chin Med Assoc 2009;72:275–77.
11. P.M. Weinberg Aortic arch anomalies. H.D. Allen, D.J. Driscoll, R.E. Shaddy, T.F. Feltes (Eds.), Moss and Adams' heart disease in infants, children, and adolescents including the fetus and young adult (7th ed.), Lippincott Williams & Wilkins, Philadelphia, PA 2008. pp.730–60.
12. Valletta EA, Pregarz M, Bergamo-Andreis IA, Boner AL. Tracheoesophageal compression due to congenital vascular anomalies (vascular rings) Pediatr Pulmonol 1997;24:93–105.
13. McElhinney DB, Clark BJ 3rd, Weinberg PM, et al. Association of chromosome 22q11 deletion with isolated anomalies of aortic arch laterality and branching. J Am Coll Cardio. 2001;37(8):2114-2119.
14. Achiron R, Rotstein Z, Heggesh J, et al. Anomalies of the fetal aortic arch: a novel sonographic approach to in-utero diagnosis. Ultrasound Obstet Gynecol 2002;20(6):553-557.
15. Jung JY, Almond CH, Saab SB, Lababidi Z. Surgical repair of right aortic arch with aberrant left subclavian artery and left ligamentum arteriosum. J Thorac Cardiovasc Surg 1978;75(2):237-243.
16. Morris CD, Kanter KR, Miller JI Jr. Late-onset dysphagia lusoria. Ann Thorac Surg 2001;71(2):710-712.
17. Chaoui R, McEwing R. Three cross sectional planes for fetal color Doppler echocardiography. Ultrasound. Obstet. Gynecol 2003;21:81–93.
18. Olearchyk AS. Right-sided double aortic arch in an adult. J Card Surg 2004;19(3):248–51. [PubMed]
19. Kouchoukos NT, Blackstone EH, Doty DB, et al. Kirklin/Barratt-Boyes cardiac surgery: morphology, diagnostic criteria, natural history, techniques, results, and indications. 3rd ed. Philadelphia: Churchill Livingstone 2003;1417–24.
20. Stewart JR, Kincaid OW, Titus JL. Right aortic arch: plain film diagnosis and significance. Am J Roentgenol Radium Ther Nucl Med. 1966;97(2):377-389.

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# Correlation Between Stature and Length of Clavicle in Male Population of Central India

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**Abstract**

*Introduction:* Anthropology plays an important role in various medicolegal aspects; apart from determination of Age, Sex and Race of individual, stature is also one of the important parameter of identification various civil and criminal cases. Therefore efforts have been made to determine association between stature and length of clavicle if any.

*Materials and Methods:* The present research was carried out in department of Anatomy JNMC Sawangi (M) Wardha; was conducted on total 50 Male individual of age 17–24. The length was calculated with the help of osteometric callipers for clavicles from anatomical landmarks and stature was calculated in centimetres.

*Conclusion:* From present research it was concluded that the length of clavicle and stature reveals positivecorrelation and the linear relationship between the living stature and length of clavicle of each side was carried out in the form of regression equation.

**Keywords:** Anthropology; Clavicle; Stature; Correlation.

## Introduction

Anthropometry which deals with expressing human form in numbers has been widely used in forensic identification and Anatomy. Identification includes determining sex, age, race and stature of a person. Among these, the sex and stature are the most important[1].

Determination of stature is one of the important factors amongst age, sex and race in various cases, which can be useful for identification in various medicolegal cases.[2] Determination of stature plays significant role in various medicolegal cases. In the field of anatomical, forensic and anthropology measurement of individual body parts plays very a vital role and to assess the various parameters in determination includes height of an individual.[3] Various authors have confirmed correlation between stature and measurements of severalparts of the body which are often represented using linear regression equation derived from them.[1] At present many inherent population differences present among the different population, thus giving rise to the need for different formulae to be derived from different populations.[4] Many authors like Terry, Thieme and Oliver, tried to determine correlation between stature and different bony measurement including clavicle.[5-7] There are very few literature available in India, Singh et al., Jit et al. envisages effort to determine correlation between stature and clavicle length.[8-9]

## Materials and Methods

- The current study was carried out in the department of Anatomy JNMC Sawangi (M) Wardha; was conducted on total 50 Male

individual of age 17–24. The length of the both clavicle was measured by means of a centimeter scale from anatomical landmarks with skin marking pencil and re checked by vernier calliper. Stature was measured in centimeter.

- Participant has been asked to stand barefoot on a plane surface on the ground in upright position and was measured from the vertex to the foot according to the anatomical position and Frankfurt plane. To avoid diurnal variation, Measurements were taken at a set time. Exclusion of participant with obvious deformity or defects.

## Results

A sample of 50 Males were considered, and the measurements were taken randomly using standard tapes.

The data obtained were analyzed statistically using Microsoft Excel software, and the average living stature for an adult male was determined. The linear association between the living stature of individual and length of clavicle of each side was carried out in the form of regression equation. It was clear that the clavicle length showed a positive correlation with the stature.

The mean value of the stature of the individual was found to be 166.42 and the length of the clavicle ($y$) was found to be13.75 and 13.64 for right and left clavicle respectively. The correlation coefficient ($r$) was calculated, and it was found to be significant correlation. The data are shown in (Table 1 and Fig. 1).

**Table 1:** Correlation of height with length of right and left clavicle Pearson's Correlation Coefficient

| | Mean | Std. Deviation | *N* | Correlation *r'* | *p*-value |
|---|---|---|---|---|---|
| Height | 166.42 | 3.78 | 50 | – | – |
| Length of right clavicle | 13.75 | 0.63 | 50 | 0.403 | 0.001, S |
| Length of left clavicle | 13.64 | 0.66 | 50 | 0.389 | 0.0001, S |

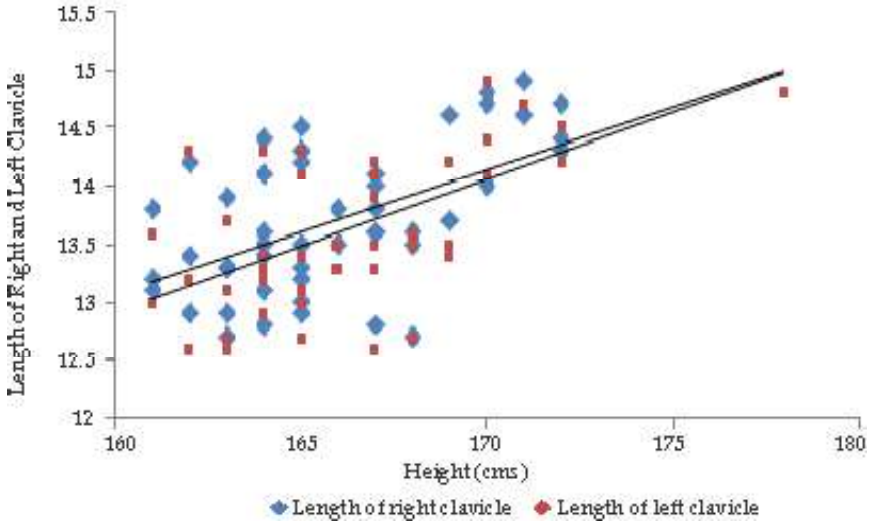


**Fig. 1:** Showing correlation between length of clavicle and height of individual.

## Discussion

Determination of stature from decomposed skeletonised residue is crucial in establishing the individuality of unknown person. Study conducted by Jakhar et al. suggests that there is positive association between the stature and anthropometric dimensions.[10] Study have been conducted by Krishan et al. to estimate height from the human skeleton, they suggested that different methods can be used to estimate the stature from the bone. The simplest and trustworthy method is by regression analysis[11-12].

By using multiplication factor or regression formulae approximate stature of the individual can be determined from different long bones[13]. Nagrale

N, Patond S, found that identification in case of unknown body by using various anthropometric measurements and regression formula was helpful for forensic experts in various medicolegal cases.[14] Similarly Patond S et al. found that determination of the stature from decomposed or skeletonised body and from remains is very crucial in establishing the identity of unknown individuals in various medicolegal cases if one parameter is known, then with the help of regression formula we can find out the remaining parameters.[15]

## Conclusion

From present research it was concluded that the length of clavicle and stature reveals positive correlation and the linear relationship between the living stature and length of clavicle of each side was carried out in the form of regression equation.If the dimension of clavicle is obtained, the stature can be determined, would be useful for forensic experts and anthropologists in various medicolegal cases. The regression formula derived in the study can be used accurately and is reliable for the estimation of stature in a miscellaneous population group.

## Reference


1. Zeybek G, Ergur I. Stature and gender estimation using foot, measurements Forensic Sci Int 2008:181(1–3):54–55.
2. Trotter M, Gleser GC. A re-evaluation of stature based on measurements of stature taken during life and of long bones after death. Am J Phys Anthrop 1958;40:762–67.
3. Chiba M, Terazawa K. Estimation of stature from somatometry of skull. Forensic Sci Int 1998;20:87–92.
4. Lundy J. The mathematical versus anatomical methods of stature estimate from long bones. Am J Forensic Med Pathol 1985;6:73–76.
5. Oliver G. Anthropologic de le clavicle III: La claviculaedu francais. Bull Soc Anthropol 1951;2:121–57.
6. Thieme FP. Sex in Negro skeletons. J Forensic Med 1957;4:72–81.
7. Singh B, Sohal HS. Estimation of stature from the length of clavicle in Punjabis, a preliminary report. Indian J Med Res 1952;40:67–71.
8. Jit I, Singh S. Estimation of stature from clavicles. Indian J Med Res 1956;44:137–55.
9. Saxena SK. A study of correlations and estimation of stature from hand length, hand breadth and sole length. AnthropolAnz 1984;42:271–6.
10. Jakhar JK, Pal V, Paliwal P. Estimation of height from measurements of foot length in Haryana region. J Indian Acad Forensic Med 2010;32:237–41.
11. Krishan K. Anthropometry in Forensic Medicine and Forensic Science- 'Forensic Anthropometry'. Internet J Forensic Sci 2007;2:6.
12. Krishan K, Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian population. J Forensic Legal Med 2007;14:327–32.
13. Rani Y, Naik S. Correlation of stature of adult with the length of clavicle. In J of Ind Acad of Forensic Medicine 2011:33(3):194–196.
14. Nagrale N, Patond S. Estimation of Cephalic Index of Chhattisgarhi Population: An Anthropometric Study from Central India. J of Forensic Med &Toxico 2019:36(1):9–12.
15. Patond S, Nagrale N. Correlation between Stature and Skull Dimensions inthe Population of Central India: A Cross Sectional Study. J of Forensic Med &Toxico 2019:36(1):59–61.

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# Study of Metopism Incidence in Adult Skulls of Karnataka

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**Abstract**

*Background:* The persistence of complete metopic suture is called as metopism. The metopic suture is formed at the meeting of the two halves of the frontal bone, in the midline. The fusion of metopic suture starts normally in the second year of life and within a short duration, gets completely obliterated. The time of the closure of metopic suture varies from one to eight years and it can persist until adult age.

*Aims and Objectives:* To study the incidence of metopism and its clinical importance.

*Materials and Methods:* The present study was carried on 105 dry adult human skulls of both sexes obtained during routine undergraduate teaching. The skulls with complete Metopic suture were selected and studied.

*Results:* In the present study the incidence of complete Metopic suture is 2.85% (out of 105).

*Conclusion:* Awareness of the incidence of persistent metopic suture is important for anatomists, neurosurgeons, radiologists and forensic specialists.

**Keywords**: Adult skull; Metopic suture; Metopism; Frontal bone.

## Introduction

The frontal bone forms the skeleton of forehead, articulating inferiorly with the nasal and zygomatic bones. In the fetal skull, the two halves of the frontal bone are separated by the frontal suture and they remain separate until approximately 6 years of age. In some adults the separation line persists as the metopic suture in the midline of the glabella, the smooth, slightly depressed area between the superciliary arches.[1] The persistent complete metopic suture extending from the nasion to bregma is called metopism.[2] According to Romanes the metopic suture closes by the 5th or 6th year, leaving traces of it on the above and below.[3] According to Hamilton the metopic suture disappears by 7th year.[4] According to Warwick and Williams the metopic suture is usually obliterated by the 8th year.[5] Incidence of metopism has geographical variations, it varies in different regions of India.[6–8] A study by Dixit and Shukla in 1968 on Uttarpradesh skulls found incidence of metopism 2.53%.[12] Another study by Manalgiri et al. in 2010 on central Indian skulls found incidence of metopism 3.95%.[17] Shanta Chandrasekaran (2011) studies showed 5% metopism in Tamilnadu Skulls[18]. Pankaj R et al. (2014) studies found 1.25% metopism in Maharastra.[23] Metopic suture persistence is due to various causes such as abnormal growth of cranial bones, growth interruption, heredity, sexual, hormonal influence, atavism, cranial malformations and hydrocephalus.[9]

The knowledge about metopic suture is important for clinicians as it is easily mistaken as a fracture line of frontal bone or even for the sagittal suture in radiological images.[6,10] It is also important for Paleodemography and Forensic medicine.

### *Aims and Objectives*

The aims and objectives of the present study is to study the incidence of metopism in adult skulls of Karnataka and its clinical importance.

## Materials and Methods

The present study was carried on 105 dry adult human skulls of both sexes obtained from the museum at Department of Anatomy, Vijayanagar Institute of Medical Sciences, Ballari (during 2012–2015). The skulls with complete metopic suture were selected and studied.

## Results and Discussion

In the present study out of 105 dry adult human skulls of both sexes, 3 skulls showed the presence of complete metopic suture. The incidence of the metopism in the present study is 2.85%. Our results differ from other studies done in Karnataka region.[15,20,27] Incidence of metopism in south India ranges from 1.20%–6.25%. The results of present study are approximately similar to the study conducted by Dixit and Shukla (1968) which show 2.53% in Uttar Pradesh,[12] Agarwal et al. (1979) which show 2.66% in Kanpur[8] and Chandrashekaran et al. (1985) show 3.00% each in Maharastrian and South Indian respectively.[13] And also similar to the study conducted by Sharada B Menasinakai et al. in 2019 on Karnataka skulls showed 3% metopism.[28] Das et al. (1973) observed metopism to be 3.31% in Uttar Pradesh[7] and Hussain Saheb S (2010) observed metopism to be 3.20% South Indians.[16] Complete metopic suture incidence reported in Indian adult skulls by various researchers are tabulated in (Table 1).

Minimum incidence of complete metopic suture was reported by Moula P Akbar Basha et al. (2015) in Indian skulls was 1.00%[26] and maximum incidence of complete metopic suture was reported by William F Masih et al. (2013) in Rajasthan (Indian skulls) was 6.50%.[25] Genetics play an important role in causing metopism.[29] The metopic suture closure impairment is common in Apert Syndrome.[30]

**Table 1.** The incidence of complete metopic suture in various geographical regions of India as reported by various researchers

| Study | Race/Region | Percentage |
|---|---|---|
| Rau (1934)[10] | Dravidians of Madras | 4.00 |
| Jit and shah et al. (1948)[6] | Indian (Punjabi) | 5.00 |
| Fakhruddin and Bhalerao (1967)[11] | Indian skulls | 2.00 |
| Dixit and Shukla (1968)[12] | Indian (UP) | 2.53 |
| Das et al. (1973)[7] | Indian( UP) | 3.31 |
| Agarwal et al. (1979)[8] | Indian (Kanpur) | 2.66 |
| Chandrashekaran et al. (1985)[13] | South Indian | 3.00 |
| Anjoo yadav et al. (2007)[14] | Indian skulls | 3.50 |
| Muralimanju B V et al. (2010)[15] | Indian skulls | 1.20 |
| Hussain Saheb S (2010)[16] | South Indian | 3.20 |
| Manalgiri et al. (2010)[17] | Central India | 3.95 |
| Shanta Chandrasekaran (2011)[18] | South India (Salem, Tamil nadu) | 5.00 |
| Gupta R et al. (2012)[19] | Indian (UP) | 5.00 |
| K. Kalyan Chakravarthi[20] | South India n(Manipal-Karnataka, Krishna-Andhra Pradesh) | 6.25 |
| Neelima Pilli et al. (2013)[21] | Indian (Andhra Pradesh) | 5.00 |
| William F Masih et al. (2013)[22] | Indian (Rajasthan) | 6.50 |
| Pankaj R et al. (2014)[23] | Indian (Maharastra) | 1.25 |
| Rubi Saikia (2014)[24] | Indian (Assam) | 3.17 |
| T H Dilipkumar et al. (2014)[25] | Indian (Pondicherry) | 2.00 |
| Moula P. Akbar Basha et al. (2015)[26] | Indian (Andhra Pradesh) | 1.00 |
| Sangeetha V et al. (2018)[27] | South Indian (Karnataka, Tamilnadu) | 5.71 |
| Sharada B Menasinakai et al. (2019)[28] | Indian (Karnataka) | 3.00 |
| Present study (2019) | Indian (Karnataka) | 2.85 |

**Fig. 1:** Showing total number 105 dry adult Human skulls of either sex.

**Fig. 2:** Anterior view-showing complete Metopic suture in 3 dry adult human skulls.


**Fig. 3:** Skull showing; B-Bregma, MS-Metopic suture, F-Frontal suture, G-Glabella.

## Conclusion

The incidence of metopism in the present study is 2.85%. Incidence of metopic suture shows geographical variations after correlating the data available of earlier studies in India. Thus, incidence of metopism is higher in southern India, as can be correlated with other studies. Temperature and genetics appear to be significant factors, though further studies are needed to confirm the same. Knowlegde of the metopic suture is important academically for anatomists, to avoid misdiagnosis as a fracture by radiologists and orthopaedicians and also to the forensic experts while evaluating medico legal cases. The awareness of metopic suture is also important for neurosurgeons while doing frontal craniotomy.

## References

1. Keith L. Moore, Arthur F. Dalley. Clinically oriented anatomy, 4th edition, Lippincott Williams & Wilkins publication: p.834.

2. Bryce TH. Osteology and anthropology in Quain elements ofanatomy. 11th Ed. London 1915;4:177.
3. Romanes GJ. Cunningham' Textbook of Anatomy. 11th Ed. Oxford University, London 1972.pp.133.
4. Hamilton W.J. Textbook of Human Anatomy, Macmillan & Co., London. 2nd edition 1976. pp.60.
5. Warwick R. and Williams P.L. Gray's Anatomy. 36th ed., London; Longmans p.334.
6. Jit I & Shah MA. Incidence of frontal or metopic suture amongst Punjabi adults. Indian. Medical Gazette 1948;83:507.
7. Das AC, Saxena RC, & Beg MAQ. Incidence of metopic suture in U.P. subjects. Journal of the Anatomical Society of India 1973;22:140.
8. Agarwal SK, Malhotra VK and Tiwati SP. Incidence of themetopic suture in adult Indian crania. Acta Anat; 1979;105:p.469–74.
9. Del Sol M, Binvignat O, Bolini PDA, & Prates JC. Metopismo no indivíduo brasileiro. Rev. Paul. Med 1989;107(2):105–07.
10. Rau RK. Skull showing absence of coronal suture. J. Anat. London 1934;69:109–12.
11. Fakhruddin S and Bhalerao UK. Interparietal bone in threepieces, a case report. J of Anat Soc of India 1967;16;146–47.
12. Dixit CS, Shukla PL. Metopicsutures in human crania J. Anat. Soc. India 1968;17:47.
13. Chandrasekhran P. Identification of skull from its suture pattern. Forensic science International 1985;27:205–14.
14. Yadav A, Kumar V, Srivastava RK. Study of metopic suture in the adult human skulls of North India. J. Anat. Soc. India 2010;59(2):232–36.
15. Murlimanju BV, Latha V Prabhu, Mangala M. et al. Median Frontal Sutures – Incidence, Morphology and Their Surgical, Radiological Importance. Turkish Neurosurgery 2011;21(4):489–93.
16. Hussain Saheb S, Mavishettar GF, Thomas ST, et al. Incidence of metopic suture in adult south Indian skulls. J Biomed Sci Res 2010;2:223-6.
17. Manalgiri AS, Satpathi DK, Razvi R, et al. Study of metopismin skulls of central India. Indian Journal of Forensic MedicineToxicology 2010;4(1):74–77.
18. Chandrasekaran S, Shastri D. A Study on Metopic Suture. International Journal of Basic Medical Science 2011;1:379–82.
19. Gupta R, Usman N, Zaidi SHH. A study of Metopic suture inAdult Indian Skulls. National Journal of integrated research inmedicine 2012;3:82–83.
20. Chakravarthi KK, Nelluri V. Morphological study of metopicsuture in adult south Indian skulls. Int J of Med & Health Sci 2012;1(2):23–28.
21. Pilli N, Sunder RR. Persistent metopic suture in various forms in south Indian adult skulls- A study. IJSRP 2013;3(5):1–7.
22. Masih WF, Gupta S, Saraswat PK, et al. Autopsy study of metopic suture incidence in human skulls in western Rajasthan. National Journal of medical research 2013;3(1):63–65.
23. Wadekar PR, Pundge SJ, Fulpatil MP, Pandit SV. Study of incidence of metopic suture in adult skulls. Indian J Basic Appl Med Res. 2014;4(1):277-83.
24. Rubi Saikia. A study on metopic suture in cadaveric skulls of Assamese people. Journal of Evolution of Medical and Dental Sciences 2014;3(44);10910–914.
25. Dilip Kumar TH, Rajasekar SS. Metopic suture and its variations. Indian Journal of Basic and Applied Medical Research 2014;3(4):42–45.
26. Akbar Basha MP, Sugavasi R. Study of metopic suture in south Indian skulls, Int J Res Med Sci 2015 Sep;3(9):2237–39.
27. Sangeetha V, Sundar G. Morphology of metopic suture and its clinical significance in human adult skull, Int J Anat Var 2018;11(2):40–42.
28. Menasinakai SB, Vidya HK, Koti MN. Study of metopic suture, Int J Anat Res 2019;7(2.1):6341–44.
29. Castilho SMA, Oda YJ, Santana GDM: Metopism in adult skulls from Southern Brazil. Int J Morphol 2006:24:61–66.
30. Faro C, Chaoui R, Wegrzyn P, et al. Metopic suture in fetuses with Apert syndrome at 22–27 weeks of gestation. Ultrasound Obstet Gynecol 2006;27:28–33.

*Original Article*

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# Study on the Nutrient Foramen of Long Bones of Lower Limb

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**Abstract**

*Introduction:* The success of any transplant lies in the surgeon's ability to preserve its vascular supply and its rapid reconstruction, especially in free vascularized bone grafts, which preserve viability of osteocytes, act as space filler and introduce a new vascular bed for the reconstruction of defects following trauma, tumour resection, congenital pseudoarthrosis and any cases of difficult non-union bones.

*Aims and Objectives:* The aim of the present study is to: To determine the number and position of the nutrient foramina in the upper and lower limb long bones. To determine the location and direction of nutrient canal. To determine whether the nutrient foramina obey the general rule that is directed away from the growing end of long bone.

*Material and Methods:* The present study is carried out on 150 human cleaned and dried bones of the Upper limb. The samples were taken from Narayana Medical College, Chinthareddypalem, Nellore, Andhra Pradesh. The long bones included for the study was as follows: Femur– 50, Tibia– 50, Fibula– 50. All the bones that were taken for the study were normal and had no pathological changes were present. The age and the sex of the bone were unknown. In all these bones after determining the side of bone, the "Nutrient Foramen" were studied in regards with. (1) The number of foramina on the shaft of the bone. (2) Surface on which it was located. (3) Direction from growing end. (4) Location in relation with length of the shaft.

*Observation and Results:* Total 150 long bones of Lower limb of right and left side of unknown age and sex were taken for the study. The parameters studied were depending on the number of nutrient foramina, direction of foramina and their distribution at various levels. The results and observations of the study are presented as tables.

*Conclusion:* Importance of nutrient foramen is relevant to fracture treatment. Combined periosteal and medullary blood supply to the bone cortex helps to explain the success of nailing of long bones fractures particularly in the weight bearing like femur and tibia uses of vascularised fibula bone in bony defects due to trauma. Currently, the detailed study of blood supply to long bone is a determining factor for the success of newer techniques and resection in orthopedics.

**Keywords**: Nutrient foramina; Nutrient artery; Humerus; Radius; Ulna bones.

## Introduction

The nutrient artery is the principal source of the blood to along bone particularly during its growth period in the embryo and fetus as well as during early phases of ossification (Lewis, 1956; Patake & Mysorekar, 1977; Forriol Campos et al., 1987;)[5,16,22] during childhood, long bones receive about 80% of the interosseous blood supply from the nutrient arteries, and in the case of their absence, the vascularisation occurs through the periosteal vessels (Trueta, 1953).[25] Because the artery of the shaft of the long bone is largest it is called the "Nutrient Artery". Nutrient canal typically becomes slanted during the growth, the direction

of slant from surface to marrow cavity point towards the end that has grown least rapidly. This is due to greater longitudinal growth at the faster growing end, hence the derivation of the axiom that foramina "seek the elbow and flee from the knee". Bones are structures that adapt to their mechanical environment, and from the fetal age adapt to a naturally occurring holes. The holes or nutrient foramina, allow blood vessel to pass through the bone cortex (Gotzen et al., 2003).[6] The cavities conducting the blood vessels and peripheral nerves on the surface of shaft of long bones are called as "Nutrient Foramen". The role of nutrient foramen is evident from the term "Nutrient" itself. The nutrient foramina has been studied in the past by Berard (1835), Schwalbe (1876), Langer (1876).[1,23,15]

The location of nutrient foramen is important in longitudinal stress fractures, as they can either initiate from the nutrient foramina or the supero medial aspect: longitudinal stress fractures are more commonly associated with tibia, but occasionally occur in femur, fibula and patella (Craig et al., 2003).[3] Clinical fracture of a long bone is usually accompanied by the rupture of the nutrient artery with variable disruption of the peripheral vessels associated with periosteal detachment. Following fracture the ruptured nutrient artery and the periosteal vessels, together with those in the adjacent soft tissue, start bleeding (Trueta, 1974).[25] An understanding of the location and the number of the nutrient foramina in long bones is, therefore important in orthopedic surgical procedures such as joint replacement therapy, fracture repair bone grafts and vascularised bone microsurgery as well as medico legal cases (Trueta, 1974; Longia et al., 1980; Guo, 1981; Forril Campos et al., 1978).[5,17,25]

Detailed data on the blood supply to long bones and the association with the areas of bone supplied has been, and continues to be, a major factor in the development of new transplantation and resection techniques in orthopedics (Kirschner et al., 1998).[12] However, there is still a need for a greater understanding of the location and number of nutrient foramen in bones such as Femur, Tibia and Fibula. By defining this restricted area of "Nutrient Artery" entering into the nutrient canal, surgeons can void that during surgical operations and thereby prevent damage to nutrient artery and minimize or lessen the chances of non–union of fracture of the bone.

### *Aim and Objectives*

The aim of the present study is to:

1. To determine the number and position of the nutrient foramina in the lower limb long bones.
2. To determine the location and direction of nutrient canal.
3. To determine whether the nutrient foramina obey the general rule that is directed away from the growing end of long bone.

## Materials and Methods

The present study is carried out on 150 human cleaned and dried bones of the Lower limb. The samples were taken from Narayana Medical College, Chinthareddypalem, Nellore and Sri Venkata Padmavathi Medical college (SVIMS) of Andhra Pradesh. The long bones included for the study was as follows:

Femur – 50,

Tibia – 50,

Fibula – 50.

All the bones that were taken for the study were normal and no pathological changes were present. The age and the sex of the bone were unknown. In all these bones after determining the side of bone, the "Nutrient Foramen" were studied in regards with

1. The number of foramina on the shaft of the bone.
2. Surface on which it was located.
3. Direction from growing end.
4. Location in relation with length of the shaft.

Nutrient foramina were distinguished by the presence of a well marked groove leading to the foramen, and by a well marked often slightly raised edge of the foramen at the commencement of the canal. In doubtful cases a dissecting microscope was used to locate the foramen. For direction of canal fine stiff wire was passed through the foramen to confirm its direction. The size of nutrient foramen was determined by using hypodermic needle No. 20 & 24. (Hidustan Syringes and Dispovan Pvt. Ltd.).

- Large foramen –accepted the No. 20 needle.
- Medium foramen –accepted only the No. 24 needle.
- Small foramen –did not take No. 24 needle.

When more than one foramen was present, the larger one was considered Dominant (DF), and

nutrient foramina smaller than a size 24 hypodermic needle were considered as being secondary nutrient foramina (SF)

*Femur:* The distance between the superior aspect of the head of the femur and the distal aspect of the medial condyle.

*Tibia:* The distance between the superior margin of the medial condyle and the distal aspect of medial malleolus

*Fibula:* The distance between the apex of the head of the fibula and the distal aspect of the lateral malleolus.

All measurements were taken to the nearest 0.1 mm using a digital vernier caliper. The results were analyzed and tabulated using the Statistical Package for the Social Sciences (SPSS) 8.0 windows. The range, mean and standard deviation of Foramina Index were determined.

## Observation and Results

Total 150 long bones of Lower limb of right and left side of unknown age and sex were taken for the study. The parameters studied were depending on the number of nutrient foramina, direction of foramina and their distribution at various levels. The observations of the study are presented as tables.

## Discussion

In this study, (52%) of the femora examined possessed double nutrient foramina, While ( 46%) had only one nutrient foramen and (2%) had triple nutrient foramen. Many authors stated that the majority of femora studied had double nutrient foramina (Mysorekar, 1967);[20] (Forriol Campos et al., 1987);[5] (Nagel, 1993);[21] (Gumusburun et al., 1994);[8] (Collipal, 2007),[2] while others reported the presence of a single foramen in most specimens (Lutken, 1950);[18] (Laing, 1953);[14] (Longia et al., 1980);[17] (Sendemir and Cimen, 1991);[24] (Emi Kizilkanat et al., 2007)[4]. Three nutrient foramina were observed in a small number of femora (2.19–10.7%) by many authors (Lutken, 1950);[18] (Longia et al., 1980);[17] (Forriol Campos et al., 1987);[5] (Nagel, 1993);[21] (Gumusburun et al., 1994);[7] (Collipal, 2007),[2] others confirmed the absence of nutrient foramina in some femora (Mysorekar, 1967);[20] (Gumusburun et al., 1994).[8]

In this study, the whole series of tibiae examined had a single nutrient foramen (100%). Previous studies reported the presence of a single nutrient foramen in at least 90% of the tibiae. But, in contradiction with the present results, they also reported the presence of double nutrient foramina in some of the tibiae (Mysorekar, 1967).[20] In the fibulae studied, (88%) of the bones presented a single nutrient foramen, while (10%) of the bones possessed double nutrient foramina, and (2%) of the bones had absence of nutrient foramina. Similar data had been reported by Mysorekar (1967),[20] Longia et al. (1980),[17] Guo (1981),[10] Mckee et al. (1984),[19] Forriol Campos et al. (1987)[5] and Sendemir and Cimen (1991),[24] while Mckee et al. (1984)[19] reported fibulae with three nutrient foramina. On the other hand, Mysorekar (1967),[20] Mckee et al. (1984),[19] Gumusburun et al. (1994)[8] and Kizilkanat et al. (2007)[13] reported fibulae with no nutrient foramina. (Table 1).

**Table 1:** Number of nutrient foramina observed in the long bones of lower limb

| Bone | Number of Bone | Number of Foramina | Percentage (%) |
|---|---|---|---|
| Femur | 23 | 1 | 46 |
| | 26 | 2 | 52 |
| | 1 | 3 | 2 |
| | – | 0 | – |
| Tiba | 50 | 1 | 100 |
| | – | 2 | – |
| | – | 3 | – |
| | – | 0 | – |
| Fibula | 44 | 1 | 88 |
| | 5 | 2 | 10 |
| | – | 3 | – |
| | 1 | 0 | |

### *Position of Nutrient Foramina*

In the present study, most of the nutrient foramina of the femur bone (68%) were located along the linea aspera and a narrow slip along it. These were coinciding with the finding of Lutken (1950)[18] and Longia et al., (1980)[17] who stated that most of the nutrient foramina are concentrated on the linea aspera. In this single foramina were 19 and are dominant foramina, two nutrient foramina had 25 dominant and 7 secondary foramina, three nutrient foramina had 1 dominant and 1 secondary foramina. On the posterior surface only 1% that were double dominant nutrient foramina. On the lateral surface 4% were seen out of which single dominant was 1 and double secondary foramina were two. On the medial aspect the foramina accounted to 27% out of which single dominant foramina are 3 and two secondary foramina are 17. Interesting feature is that all are situated in the proximal 2/3rd, with no foramina detected in the distal third of the femur. These results were in accordance with those of Laing (1953),[14] Mysorekar (1967).[20] However, these findings did not coincide with that of Lutken (1950)[18] and Forriol Campos et al. (1987)[5] who stated that the nutrient foramina are nearer to the hip joint. All these finding are tabulated in Table 2 and photographed in (Fig. 1).

**Table 2:** Position and number of dominant (DF) and secondary (SF) nutrient formina observed in the Femur

| Position | Total Number of Foramina | % | Number of Foramina | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Single | | Two | | Three | |
| | | | DF | SF | DF | SF | DF | SF |
| Linea aspera | 53 | 68 | 19 | – | 25 | 7 | 1 | 1 |
| Posterior surface | 1 | 1 | – | – | 1 | – | – | – |
| Lateral surface | 03 | 4 | 1 | – | – | 2 | – | – |
| Medial surface | 21 | 27 | 3 | – | – | 17 | – | 1 |


**Fig. 1:** A photograph of the posterior surface of right femora shaft showing double nutrient foramina (NF).Both foramina are directed upwards as shown by the needles inserted.

In the present study, most of the nutrient foramina in the tibiae were in the proximal third 88%. Nutrient foramina were located in the middle third in the rest of the tibiae examined (12%). 94% of the foramina were on posterior surface out of which 47 were single dominant foramina. On the lateral surface 6% of the foramina were seen out of which 3 were dominant single nutrient foramina. There were no foramina in the distal third. Similarly, many authors reported the presence of the majority of nutrient foramina in the proximal third of the tibia (Mysorekar, 1967; Longia et al., 1980; Gumusburn et al., 1994; Collipal et al., 2007).[2,8,17,20]. The rate of healing of a fracture is related to the vascular supply of the bone. In the present series, most of the nutrient foramina of the fibula were situated in the middle third of the bone (94.4%). The above findings are tabulate in Table 3 and photographed in (Fig. 2).

**Table 3:** Position and number of dominant (DF) and secondary (SF) nutrient formina observed in the Tibia

| Position | Total Number of Foramina | % | Number of Foramina | | | |
|---|---|---|---|---|---|---|
| | | | Single | | Two | |
| | | | DF | SF | DF | SF |
| Posterior surface | 47 | 94 | 47 | – | – | – |
| Lateral surface | 3 | 6 | 3 | – | – | – |


**Fig. 2:** A photograph of the posterior surface of right tibiae showing a single nutrient foramen (NF). The foramen is located in the proximal third (Type 1) and is directed downward.

The single fibula nutrient foramina (1.9%) were located in the distal third of the bone, while 3.7% had nutrient foramen in the upper third. These results were in agreement with most of the previous studies (Mysorekar, 1967; Mckee et al., 1984; Forriol Campos et al., 1987; Sendemir and Cimen, 1991; Gumusburun et al., 1994; Collipal et al., 2007).[2,5,8,19,20,24] On other hand, Guo (1981)[10] reported that the majority of foramina were located in the proximal third of the fibula.

In this study, 75.9% of the fibular foramina were located on the posterior surface of which 66.66% of foramina were on the medial crest and 75.9% on the posterior surface and remaining 24.1% on the medial surface. On the posterior surface 41% were seen in which dominant foramina were single and 35 in number whereas two nutrient foramina had 2 dominant and four secondary. On the medial surface 24.1% single dominant were 9 and double dominant were 3 and secondary were 1 (Table 4 and Fig. 3). Similarly, Mysorekar (1967)[20] reported that 56% of nutrient foramina were located on the medial crest while 33% lied on the posterior surface of fibula. However, some authors observed more nutrient foramina on the posterior surface compared to those on the medial crest (Mckee et al., 1984; Forriol Campos et al., 1987; Gumusburun et al., 1994; Kizilkanat et al., 2007; Collipal et al., 2007).[2,5,8,13,19] Others, (Sendemir and Cimen, 1991)[24] reported that the majority of foramina were on the medial surface of the fibula. Knowing the variations in the distribution of the nutrient foramina is important preoperatively, especially regarding the fibula used in bone grafting.

**Table 4:** Position and number of dominant (DF) and secondary (SF) nutrient formina observed in the Fibula

| Position | Total Number of Foramina | % | Number of Foramina | | | |
|---|---|---|---|---|---|---|
| | | | Single | | Two | |
| | | | DF | SF | DF | SF |
| Posterior surface | 41 | 75.9 | 35 | – | 2 | 4 |
| Midial surface | 13 | 24.1 | 9 | – | 3 | 1 |

**Fig. 3:** A photograph of right fibulae showing single nutrient foramina (NF) on the posterior surface of the shaft. Foramen is located in the middle third (Type 2); the foramen is directed downward as shown by the needle iserted.

The present study proved that most of the nutrient foramina were observed to lie on the flexor surface of the bones. Thus, the femur, tibia and fibula, they were located on the posterior surface. Kizilkanat et al. (2007)[13] stated that the position of the nutrient foramina was directly related to the requirements of a continuous blood supply to specific aspects of each bone, for example where there were major muscle attachments. It might be that, being more bulky, stronger and more active, flexors need more blood supply compared to extensors of limbs.

**Table 5:** Position and direction of nutrient foramina in the long bones of lower limeb.

| Bone | Position | | |
|---|---|---|---|
| | Type 1 | Type 2 | Type 3 |
| Femur | 3 (3.8%) | 75 (96.2%) | 0 |
| Tibia | 44 (88%) | 6 (12%) | 0 |
| Fibula | 2 (3.7%) | 51 (94.4%) | 1 (1.9%) |

### *Size of Nutrient Foramina*

The present results showed that, with the exception of the femur in which most of the foramina studied were dominant, all long bones of lower limb possessed a majority of secondary nutrient foramina. These results were in agreement with those of Longia et al. (1980)[17] who reported that about two third of the nutrient foramina were secondary. The present results contradicted with those of kizilkanat et al. (2007)[13] who stated that most foramina were of the dominant type. They added that wherever a single nutrient foramen was observed, it was always dominant. This was the case in the present study. Sendemir and Cimen (1991)[24] stated that there was no femur without a dominant nutrient foramen. Such statement was applicable in the present study.

### *Direction of Nutrient Foramina*

Hughes (1952)[11] stated that anomalous canals were found frequently in the femur, which might be the cause of the latter findings. The present study confirmed the previous reports suggesting that the nutrient foramina in the tibiae 1 was directed towards the growing end and remaining all were away from the growing end. (Mysorekar, 1967);[20] (Hughes, 1952).[11] On the other hand, Longia et al. (1980)[17] observed nutrient foramina directed towards the knee in 3.5% of tibiae examined.

Regarding the fibula, the direction of 3 nutrient foramina was directed towards the growing end, while 46 foramina were directed away from the growing end. In accordance with the present results, Longia et al. (1980)[17] reported nutrient foramina having a proximal direction in 9.5% of

fibula examined. Mysorekar (1967)[20] added that variations, in the direction of nutrient foramina were found only in the fibula.

### *Obliquity of Nutrient Foramina*

In all long bones of lower limbs examined, there were no changes in the Obliquity of the foramen whether it was in the centre of the bone or nearer the ends. Such results were in agreement with those of Mysorekar (1967).[20] Many theories had been put forward to account for the generally constant direction of the canals, and also the anomalously directed ones. Among these were the 'Periosteal slip' theory of Schwalbe (1876),[23] the vascular theory of Hughes (1952)[11] and the muscular theory of Lacorix P (1950)[22] the 'vascular theory' appeared to offer the most comprehensive explanation but, instead of only one theory explaining the anomalous foramina, all factors may be appropriately and proportionately responsible in individual bones.

## Conclusion

The present study was undertaken to study the nutrient foramina of the lower limb long bone. The study material consisted of 150 long bones; each bone was studied for the number, position, size, direction & obliquity of their nutrient foramina. With the exception of femur, majority of nutrient foramina of all bones were single in number and were secondary in size. Most of the nutrient foramina were concentrated in the middle third of the bone with exception of tibia and ulna in which the nutrient foramina were predominantly observed in the proximal third. Nutrient foramina were mostly located on the posterior surface of the shaft of bones of lower limb. The direction of nutrient foramina followed the growing end theory, with variations in the direction observed in some tibia and fibulae. The results of the present study confirmed previous findings regarding the number and position of nutrient foramina of long bones of the limbs and provided clinical information concerning the nutrient foramina which could be useful as reference for surgical procedures. Accordingly, a well understanding of the characteristic morphological features of the nutrient foramina by orthopedic surgeons is recommended. Exact position of the distribution of the nutrient foramina in bone diaphysis is important to avoid damage to the nutrient vessels during surgical procedure.

## References


1. Berard A. Memoire sur le rapport qui existe entre la direction des condits nourriciers des os longs et l'ordre suivant lequel les epiphysis see soudent au corps de l'os. Archives generales de medicine. 1835;7:176–183.
2. Collipal E, Vargas R, Parra X, et al. Diaphyseal nutrient foramina in the femur, tibia and fibula bones. Int. J. Morphol 2007;25(2):305–08.
3. Craig JG, Widman D, van Holsbeeck M. Longitudinal stress fracture: Patterns of edema and the importance of the nutrient foramen. Skeletal Radiol 2003;32:22–27.
4. Kizilkanata E, Boyana N, Ozsahina ET, et al. A study of the nutrient foramina in human long bones. Surg. Radiol. Anat 1987;9:251–55.
5. Gotzen N, Cross ., Ifju P, et al. Understanding stress concentration about a nutrient foramen. J. Biomech 2003;36:1511–21.
6. Gumusburun E, Adiguzel E, Erdil H, et al. A study of the nutrient foramina in the shaft of the fibula. Okajimas Folia Anat. Jpn 1996;73(2–3):125–28.
7. Gumusburun E, Yucel F, Ozkan Y, et al. A study of the nutrient foramina of lower limb long bones. Surg. Radiol. Anat 1994;16:409–12.
8. Guo F. Fibular blood supply. Chin. Med. J. 1981;94:396–400.
9. Guo F. Observation of the blood supply to the fibula. Arch. Orthop. Traumat. Surg 1981;98:147–51.
10. Hughes H. The factors determining the direction of the canal for the nutrient artery in the long bones of mammals and birds. Acta anat 1952;15:261–80.
11. Kirschner MH, Menck J, Hennerbichler A, et al. Importance of arterial blood supply to the femur and tibia for transplantation of vascularized femoral diaphyses and knee joints. World J. Surg 1998;2:845–52.
12. Kizikanat E, Boyan N, Ozsahin ET, et al. Location number and clinical significance of nutrient foramina in human long bones. Ann Anat 2007;189:87–95.
13. Laing PG. The blood supply of the femoral shaft. J. Bone Jt. Surg 1953;35:462–66.
14. Langer K. (1876). Uber das Gefässsystem der Röhrenknochen, mit Beitragen zur Kenntnis des Baues und der Entwicklung des Knochengewebes. Denkschr. Akad. Wiss. Wien 36:1–40.
15. Lewis OJ. The blood supply of developing long bones with special reference to the metaphyses.

J. Bone Jt. Surg 1956;38:928–33.

16. Longia GS, Ajmani M., Saxena SK, et al. Study of diaphyseal nutrient foramina in human long bones. Acta Anat. (Basel) 1980;107:399–406.
17. Lutken P. Investigation into the position of the nutrient foramina and the direction of the vessel canals in the shafts of the humerus and femur in man. Acta anat 1950;9:57–68.
18. McKee NH, Haw P, Vettese T. Anatomic study of the nutrient foramen in the shaft of the fibula. Clin. Orthop. Rel. Res 1984;184:141–44.
19. Mysorekar VR. Diaphysial nutrient foramina in human long bones. J Anat 1967;101:813–22.
20. Nagel A. The clinical significance of the nutrient artery. Orthop. Rev 1993;22:557–61.
21. Patake SM, Mysorekar VR. Diaphysial nutrient foramina in human metacarpals and metatarsals. J. Anat 1977;124:299–304.
22. Schwalbe G. Uber die Ernährungskanäle und das knochenwachstum. Zeitschr F. Anat. U. Entwgesch 1:307–52.
23. Sendemir E, Cimen A. Nutrient foramina in the shafts of lower limb long bones: situation and number. Surg. Radiol. Anat 1991;13:105–08.
24. Trueta J. Blood supply and the rate of healing of tibial fractures. Clin. Orthop. Rel. Res 1974;105:11–26.

*Original Article*

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# Dorsalispedis Artery and its Anatomical Variations in A Cadaveric Study

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**Abstract**

*Introduction:* In the lower limb, Dorsalispedis artery is the main artery for blood supply to the food and nowe have come to know that there exists many anatomical variations in the dorsalispedis. Still, there is limited anatomical evidence available regarding the branches of the dorsalispedis artery, which occur at the point at which they cross the ankle joint.

*Objectives:* The objective of the study was to study the anatomical variations in the dorsalispedis artery of foot

*Materials and Methods:* We conducted our study in the department of anatomy in a tertiary medical college and dissected a total of 25 cadaveric feet to explore the course of the dorsalispedis artery while paying attention to the branching pattern at the joint line.

*Results:* After careful dissection, we found that Fourteen of the twenty five feet had a branch of the dorsalispedis artery that crossed the level of the ankle joint. Out of these, nine were lateral, four medial and one bilateral. Eleven of the fourteen specimens had one branch at, or just before, the level of the joint. Two specimens had two branches and one had three branches crossing the ankle, which were all in the same direction.

*Conclusions:* We came to the conclusion that there is a high rate of branching of the dorsalispedis artery at the level of the ankle joint.

**Keywords:** Dorsalispedis artery, Anatomical variations.

## Introduction

In the lower limb, the dorsalispedis artery carries oxygenated blood to the dorsal surface of the foot. It's located 1/3 from medial malleolus. It arises at the anterior aspect of the ankle joint and is a continuation of anterior tibial artery. It ends at the proximal part of the first intermetatarsal space, where it bifurcates into two branches, the first dorsal metatarsal artery and the deep plantar artery. The dorsalispedis communicates with the plantar blood supply of the foot through the deep plantar artery. Through it's course, it is accompanied by a deep vein, the dorsalispedis vein.

The pulse of thedorsalispedis artery can be palpated readily lateral to the extensor halluces longustendon (or medially to the extensor digitorumlongustendon) on the dorsal surface of the foot, distal to the dorsal most prominence of the navicular bonewhich serves as a reliable landmark for palpation.[1] It is often checked bythe surgeons, when assessing whether a given patient has peripheral vascular disease. It is absent, unilaterally or bilaterally, in 2–3% of young healthy individuals.[2]

The dorsalispedis artery has been known to have a variable origin in the foot, course and branching pattern.[3,4] as also an abnormal branching pattern in 16% of 50 dissected cadaveric specimens.[3]

This abnormal branching may cause a complication called as a pseudoaneurysm which may occur in arthroscopic procedures. Fortunately, the incidence of pseudoaneurysm during ankle arthroscopy is only around 0.008%.[5] One study reported a single vascular complication from 1,305 procedures.[6] This studyaimed to identify the anatomical variation of the dorsalispedis artery at the level of the ankle joint by describing the frequency and direction of branches crossing the ankle joint.

## Materials and Methods

This was an observational study carried out in the dissection hall in the department of anatomy in a new tertiary teaching hospital in central india. All dissection was carried out on formalin-preserved cadavers within an approved facility and according to guidance laid out in the Human Tissue Authority Code of Practice.[7]

We had placed marker probes at the level of the ankle joint medially and laterally before commencing dissection. We then carefully dissected the Cadaveric feet to expose the course of the dorsalispedis artery and its branches. The branching pattern of the artery at the joint line was recorded. We then photographed each ankle to show the joint line and the dorsalispedis artery. We also recorded the presence of branches from the main arterial trunk at the level of the joint and its direction and number of branches.

## Results

In our observational study we studied a total of 25 cadaveric feet anddorsalispedis artery was identified in all of the specimens. The main finding of this study was the huge variation in the location of the dorsalispedis artery branches crossing the ankle joint. Of the cadavers studied, 56% (14 of 25) showed a branch that crossed the ankle joint in addition to the main arterial trunk. Of these 14 cases, 9 had a branch that was lateral, 4 had a medial branch and one case had bilateral branches (Tables 1-3).

**Table 1:** Showing the distribution of the branches of the dorsalispedis artery at the level of the anke joint

| Branch of dorsalispedis artery | Total | Percentage (*N* = 25) |
|---|---|---|
| Crossing ankle joint | 14 | 56 |
| Not crossing the ankle joint | 11 | 44 |

**Table 2:** Showing direction of the dorsalispedis artery that had crossed the ankle joint

| Direction of the dorsalispedis artery after crossing | Number | Percentage (*N* = 14) |
|---|---|---|
| Lateral | 9 | 64.3 |
| Medial | 4 | 28.6 |
| Bilateral | 1 | 7.1 |

**Table 3:** Showing number of the dorsalispedis artery that had crossed the ankle joint

| Number of the dorsalispedis artery that had crossed the ankle joint | Number | Percentage (*N* = 14) |
|---|---|---|
| One | 11 | 78.6 |
| Two | 2 | 14.2 |
| Three | 1 | 7.1 |

## Discussion

In the lower limb, Dosalispedis artery is the main blood supply of foot and its anatomic variations especially in itsbranching may result in possible complications like pseudoaneurysms which may occur during orthopedic procedures. If we carefully study the applied anatomy of the dorsalispedis artery we see that in orthopedic procedures like arthroscopy, about half of all aneurysms that occur around the foot and ankle do so at the dorsalispedis artery.[5] in contrast to other studies, abnormal

branching patterns of the dorsalispedis artery at the level of the ankle joint occurred in the majority of patients in our study.

In one of the cadaveric study[8] it was demonstrated that the antero-central portal is comparatively low risk for damaging the superficial peronealnerve. However, in this study where 20 ankles were studied, 90% of instruments in the anterocentral portal touched the dorsalispedis artery and in one case there was a laceration of the deep peroneal nerve.[8] while another cadaveric study of 92 feet specimens classified the neurovascular bundle at the dorsum of the foot into four types.[3] Thus it was necessary to emphasize the importance of being aware of the anatomical variation of the trunk of the dorsalispedis artery in relation to the deep peroneal nerve for portal placement.[3]

In our study as we have demonstrated such variability in branches crossing the ankle joint, we cannot recommend a specific portal over the conventional anterolateral portal in preventing vascular damage.[8]

Also, Studies by Vijayalakshmi et al. found that the dorsalispedis artery ran a 'normal course' (definition set out by the paper itself) in only 56% of cases, with five other major variations in course.[4] Typically, it was found as a continuation of the anterior tibial artery but has been noted to arise from the peroneal artery. Only 16% showed more branches crossing the ankle joint.[3] The findings of our study are in contrast with this, as we have demonstrated abnormal branching in the majority of specimens we examined.

Our study advocatesthat the operating surgeon be aware of this anatomical variations in the dorsalispedis artery so as to avoid the possible complicatons

## Conclusion

We have concluded that there are high rates of branching of the dorsalispedis artery at the level of the ankle joint and this has not been specifically investigated or described in previous literature.

## References

1. Mowlavi A, Whiteman J, Wilhelmi BJ, et al. Dorsalispedis artery pulse using a landmark. Postgraduate Medical Journal 2002;78(926): 746–7.
2. Robertson GS, Ristic CD, Bullen BR et al. The incidence of congenitally absent foot pulses. Annals of the Royal College of Surgeons of England 1990;72(2):99–100.
3. Rajanigandha V, Rajalakshmi R, et al. Relationship between the deep peroneal nerve and dorsalispedis artery in the foot: A cadaveric study. ClinAnat 2008;(7):705–12.
4. Vijayalakshmi S, Raghunath G, Shenoy V. Anatomical study of dorsalispedis artery and its clinical correlations. J ClinDiagn Res 2011;(2):287–90.
5. Yu JL, Ho E, Wines AP. Pseudoaneurysms around the foot and ankle: Case report and literature review. Foot Ankle Surg 2003;(3):194–98.
6. Zengerink M, van Dijk C. N. Complications in ankle arthroscopy. Knee Surg Sports Traumatol Arthrosc 2012;(8):1420–31.
7. Human Tissue Authority Code of Practice 4: Anatomical Examination Version 14.0. London: HTA; 2014.
8. Williams JC, Roberts JW, Yoo BJ. Dorsalis pedis artery pseudoaneurysm after Lisfranc surgery. J Orthop Trauma 2010;24(11):e98-e101.

*Original Article*

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# A Morphometric Study of Bicipital Groove in Humerus and its Clinical Importance

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**Abstract**

*Introduction:* The Bicipital groove (BG) remains controversial regarding its morphology. The primary objective of this study was to elucidate the detailed gross morphology of BG in an adult Indian population.

*Method:* 124 unpaired dry humeri (58 right side and 66 left) were studied and measured for various parameter such as length, width and depth of the bicipital using digital vernier caliper in anatomy laboratory of our institution. The data were expressed in mean ± SD and statistically compared between right and left sides of bicipital groove.

*Results:* The mean length, width and depth of the bicipital groove were 85.50 ± 4.84 mm, 7.5 ± 2.0 mm and 4.6 ± 1.8 mm, respectively. There was no statistically significant difference in these parameters between the left and right sides. A supratubercular ridge of Meyer was seen in 27% of the humeri.

*Conclusion:* Morphometric knowledge of BG is significant in functional and clinical setup for better understanding of wide range of movements in upper extremities and it's predispose dislocation of tendon of biceps.

**Keywords:** Bicipital groove; Intertubercular sulcus; Morphometry; Supratubercular ridge.

## Introduction

Bicipital groove (BG) is an indentation on the anterior aspect of proximal part of humerus between the lesser and greater tubercles which allows tendon of long head of biceps brachi muscle enveloped in synovial sheath and ascending branch of anterior circumflex humeral artery to pass through it.[1] The BG is converted into a canal by the fibrous band called transverse humeral ligament which extends between lesser and greater tubercle of the humerus. The transverse humeral ligament provides stability and effective functioning of long head of biceps muscle and prevents subluxation of the tendon.[2] The supratubercular ridge is a bony prominence that is continuous with the lesser tubercle and it allows gradual change in the direction of tendon of long head of biceps by elevating and forcing it laterally.[3] Related to the functional significance of structures in BG, it is an important landmark for replacement of prosthesis of shoulder and the knowledge of its morphometry is essential for the selection of prosthetic design, size and position.[4] Any alteration in the morphometry of bicipital groove can affect the functions of neighboring structures leading to several pathological conditions.[5] In the present study, the morphometry of BG was examined in relation to its length, width, depth, length of the medial and lateral walls of the BG and the presence of supratubercular ridge in south Indian population.

## Materials and Methods

The study was carried out in 124 adult humeri (58 right and 66 left) from the Department of Anatomy, Kannur Medical College, Kannur, between May 2018 and September 2019. Bones with external deformities were excluded from the study. The length, width, depth were accurately measured by using digital vernier caliper. All the parameters were measured by two observers to ensure accuracy and the average was taken. Data were presented in Mean ± SD. Statistical significance is performed using independent *t*-test. Data were analysed using SPSS 15.0 Programme (SPSS Inc, Chicago, Illinos, USA).

The following parameters were measured in this study.

1. The length of the BG was measured from the point between the tubercles to the end of the medial lip of the BG.
2. The depth of the BG was measured between the greater and lesser tubercles. The width of the BG was measured between the midpoint of the medial and lateral lips.
3. The length of the medial and lateral walls was measured from the tubercles to the respective lips of the BG. Supratubercular ridge is a bony prominence extending from the lesser tubercle. and is found in few humeri in the present study (Table1 and Fig. 1).

## Results

The mean length, width and depth of the BG were 85.50 ± 4.84 mm, 7.5 ± 2.0 mm and 4.6 ± 1.8 mm respectively. Data were analyzed between the sides and the detailed values are presented in Table 1. The mean length of the Lateral lip of BG was longer than the medial lip ($p$ = 0.04). Other than this, no parameters showed statistically significant differences ($p$ > 0.05) between the right and left sides. A supratubercular ridge of Meyer (Fig. 1) was identified in 27%.

**Table 1:** Comparison of Measurements of Right and Left Humeri ($n$ = 124)

| Parameter (mm) | Mean ±SD | | $p$ value |
|---|---|---|---|
| | Right side | Left side | |
| Length of BG | 84.79 ± 5.84 mm | 87.33 ± 6.40 mm | 0.53 |
| Width of BG | 6.84 ± 1.01 mm* | 7.74 ± 1.96 mm | 0.48 |
| Depth of BG | 4.21 ± 0.58 mm* | 5.01 ± 1.05 mm | 0.45 |
| Length of the medial wall | 24.22 ± 1.02 mm | 23.31 ± 2.21 mm | 0.37 |
| Length of the lateral wall | 32.05 ± 2.21 mm | 31.12 ± 0.24 mm | 0.04* |

Values are mean ± SD, Statistical significance (independent *t*-test). *: $p$< 0.05

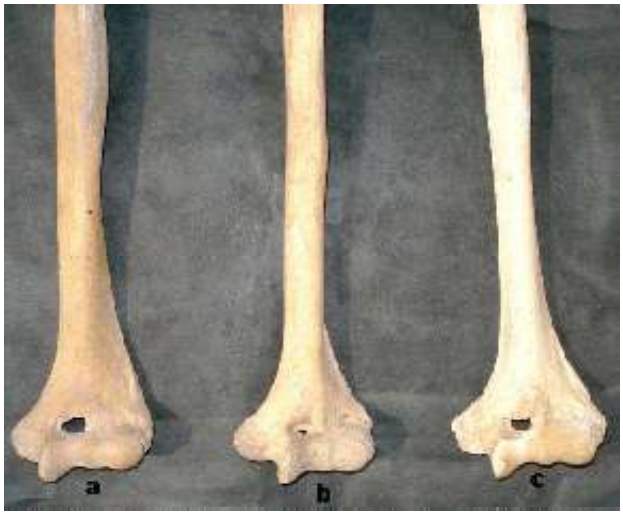


**Fig. 1:** Upper end of the humerus showing measurements of bicipital groove. (STR: supratubercular ridge of Meyer).

## Discussion

The tendon of the long head of the biceps plays an important role in maintaining integrity of the shoulder joint. Subluxation and dislocations of the biceps tendon are more common in people with a shallow bicipital groove.[6] A shallow bicipital groove associated supratubercular ridge of Meyer predisposes a patient to bicipital disease.[7,8] The variation in the morphology of the BG affects the biomechanics of the biceps tendon, and implicated in the development of bicipital tendinitis[8] Any Anatomic variations in the groove could give rise to sliding of the biceps brachii muscle tendon[9] is a subject clinical interest but still there is limited data available in it. In a morphometric study by Rajani S et al.[8] reported the length of the medial wall was 23±4 mm on the right side and 24 ± 5mm on the left side and the length of the lateral wall was 31 ± 6 mm on the right side and 31 ± 5 mm on the left side which is similar to the present study. According to reports the incidence of subluxation and dislocation of tendon of biceps is common when the BG is shallow.[10] The instability of biceps tendon may be also attributed to the lengths of medial and lateral walls, presence of supratubercular ridge.[11] The reports on length, width and depth of BG of several studies are presented in (Table 1 and Fig. 1).

In general most of the persons (approx. 90–95%) are right handed preference to do the work. Thereof, pressure of long head of the biceps tendon is higher on the right side than on the left, which may be subjected to morphometric changes in BG.[12]. Vettivel et al. observed that the mean width of the BG was greater on the right humeri than the left and the mean depths of the BG on right and left sides were same on both sides.[5] But the present study showed no significant differences between the right and left humeri ($p > 0.05$).

Wafae et al., reported the average length of the groove was 80.1 mm and mean width of 10.1 mm and depth was 4.0 mm which is higher than the other study population.[13] Similar study by Pfahler et al., and Robertson et al., reported sex differences in the morphometry of BG.[14] Studies on Indian population reported that in right side BG mean length (86 ± 10.1 mm) and width (8.3 ± 2.4 mm) whereas on left side (83.3 ± 11.5 mm) and (8.7 ± 2.2 mm) respectively.[15] Our finding was similar to the previous studies.

Cone et al., defined the supratubercular ridge as a bony ridge extending proximally from the lesser tubercle more than one-half of the distance to the humeral head[16] and reported its prevalence to 48% of all specimens and 46% of all patients in their study. The authors through radiographic interpretations concluded that the supratubercular ridges are not pathologically significant. But contrarily Hitchcock and Bechtol demonstrated definite correlation between the supratubercular ridge and tendonitis.[17] Vettivel et al., found this ridge in 88% on the right side and 57% on the left side[5] and interpretated that higher incidence of supratubercular ridge on the right side will prevent medial displacement of biceps tendon. Sangeeta gupta et al., observed 42% incidence of supratubercular ridge in North Indian population but their findings were not statistically significant.[18] Murlimanju et al., reported supratubercular ridge in 38.1% of the humeri in their study.[15] In our study we found a lower incidence of 27% supratubercular ridge on the right side and 15% on the left side. This may probably be due to ethnic variation and it needs to be substantiated with comparison with different population.

## Conclusion

Our study reported the width of the BG and the incidence of supratubercular ridge is less when compared to other studies in western population. However it's on par with other Indian studies.

## References

1. Gray's Anatomy. In: Standring S, ed. The Anatomical Basis of Clinical Practice. 39th ed., Spain: Churchill Livingstone 2006:823–32.
2. Rajan YS, Kumar SK. Morphometric Study on Bicipital Groove among South Indian Population. J Clin Diagn Res 2016;10(7):AC01–AC3.
3. Hitchcock HH, Bechtol CO. Painful shoulder. J Bone Joint Surg (Am) 1948;30:262–73.
4. Booth RE, Marvel JP. Differential diagnosis of shoulder pain. Orthop Clin North Am 1975;6:353–79.
5. Vettivel S, Indrasingh I, Chandi G, et al. Variations in the intertubercular sulcus of the humerus related to handedness. J Anat. 1992;180(2):321–26.
6. Robertson DD, Yuan J, Bigliani LU, Flatow EL, Yamaguchi K. Three-dimensional analysis of the proximal part of the humerus: Relevance to arthroplasty. J Bone Joint Surg. 2000;82(11):1594–602.

7. Yoo JC, Iyyampillai G, Park D, et al. The influence of bicipital groove morphology on the stability of the long head of the biceps tendon. J Orthop Surg (Hong Kong) 2017 May-Aug;25(2):23094.
8. Rajani S, Man S. Review of bicipital groove morphology and its analysis in north Indian population. ISRN Anat 2013;2013:243780.
9. Boileau P, Ahrens PM, Hatzidakis AM. Entrapment of the long head of the biceps tendon: the hourglass biceps: A cause of pain and locking of the shoulder. J Shoulder Elbow Surg 2004;13(3):249–57.
10. Mark Levinsohn E, Santelli ED. Bicipital groove dysplasia and medial dislocation of the biceps brachii tendon. Skeletal Radiology 1991;20(6):419–23.
11. Baumann B, Genning K, Böhm D, et al. Arthroscopic prevalence of pulley lesions in 1007 consecutive patients. J Shoulder Elbow Surg 2008;17(1):14–20.
12. Gückel C, Nidecker A. MR arthrographic findings in tenosynovitis of the long bicipital tendon of the shoulder. Skeletal Radiology 1998;27(1):7–12.
13. Wafae N, Atencio Santamaría LE, Vitor L, et al. Morphometry of the human bicipital groove (sulcus intertubercularis) J Shoulder Elbow Surg 2010;19(1):65–68.
14. Pfahler M, Branner S, Refior HJ. The role of the bicipital groove in tendopathy of the long biceps tendon. J Shoulder Elbow Surg 1999;8(5):419–24.
15. Murlimanju B. V., Prabhu L. V., Pai M. M., et al. Anthropometric study of the bicipital groove in indians and its clinical implications. Chang Gung Med J 2012;35(2).
16. Cone RO, Danzig L, Resnick D, et al. The bicipital groove: Radiographic, anatomic, and pathologic study. AJR Am J Roentgenol 1983;141(4):781–88.
17. Hitchcock HH, Bechtol CO. Painful shoulder observations on the role of the tendon of the long head of the biceps brachii in its causation. J Bone Joint Surg 1948;30(2):263–73.
18. Gupta S, Naqshi BF, Shah AB. Variations in the bicipital groove in north Indian population: Amorphological and morphometric study and review of literature Int J Health Sci Res 2015;5(9):220–26.

*Original Article*

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# Morphometric Analysis of Supraorbital Notch and Foramen with it's Clinical Relevance

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**Abstract**

*Introduction:* The supraorbital margin is interrupted at it's lateral two third and medical third by the supraorbital notch/foramen. The supraorbital notch/ foramen transmits the supraorbital artery, vein and nerve. The surgeon should have knowledge of precise location and difference in prevalance of SON/SOF in order to reduce the risks while performing clinical procedures.

*Materials and Methods:* In the present study 112 skulls were studied. Each skull was examined at it's supraorbital margin on both sides for presence of SON/SOF. The prevalance of bilateral, unilateral SON/SOF was calculated, presence of accessory SOF and shape of SOF were also noted. The distance of SON/SOF from nasal midline, Frontozygomatic suture, Infraorbital foramen was calculated by using digital vernier calliper in millimeters.

*Results:* The present study concluded that the frequency of occurrence of SON (66.07%) was more than that of SOF (33.92%). Bilateral SON we're found in 51.78% and bilateral SOF were found in 17.85% of skulls. Unilateral presence of SON/SOF were noted in 34 skulls. 14.28% of cases showed presence of accessory SOF. The average distance between nasal midline, FZS, IOF and SON/SOF was 22.39–22.40 mm, 30.89–30.53 mm, 39.27-39.45 mm respectively on right and left side.

***Conclusion:*** The present study provides detail information regarding prevalance of SON/SOF and it's exact position by calculating theaverage distance between SON/SOF from nasal midline, frontozygomatic suture, infraorbital foramen. This data is very essential during various diagnostic, therapeutic, anaesthetic and surgical procedures.

**Keywords:** Supraorbital nerve; Supraorbital notch; Supraorbital foramen; Skulls.

## Introduction

The orbital opening is approximately quadrangular in shape. Upper, supraorbital margin of each orbit is entirely formed by the frontal bone, interrupted at the junction of its sharp lateral two-thirds and rounded medial third by the supraorbital notch or foramen.[1] The supraorbital nerve is the larger terminal branch of frontal nerve. This branch continues in the line of the parent stem. The nerve passes through the supraorbital notch or foramen and turns upwards into the forehead. Normally It divides into two in the scalp, but if this occurs in the orbit, the larger lateral part occupies the supraorbital notch.[2]

The supraorbital nerve supplies the mucous membrane lining the frontal sinus, skin and conjunctiva covering the upper eyelid and skin over the forehead and scalp. The supraorbital nerve ascends on the forehead with the supraorbital artery and divides into medial and lateral branches which supplies skin of scalp as far as lambdoid suture. These branches runs deep to frontal belly of occipitofrontalis. The medial branch perforates the muscle to reach the skin, while the lateral

Pierce's the epicranial aponeurosis.[1] In 25% of cases the supraorbital notch is cross by periosteal ligament which become ossified converting the supraorbital notch into Foramen.[3] The periosteal ligament crossing supraorbital notch is referred as supraorbital ligament by the Duke et al.[4]

The supraorbital nerve block is given in the region of SON/SOF during different procedures like, cosmetic facial corrections, supraorbital neuralgia, forehead and brow lift surgeries. For precise and effective supraorbital nerve block exact location of supraorbital nerve is mandatory.[5]

## Materials and Methods

The present study was carried out by using 112 adult dry human skulls of unknown age and gender. The samples were collected from the department of Anatomy, government medical college Aurangabad during the year 2019. The skulls with gross abnormalities were excluded from the study to avoid any kind of bias in the study. Each skull was examined carefully at it's supraorbital margins on both sides for the presence of supraorbital notch or foramen. The presence of unilateral or bilateral supraorbital notch/foramen was carefully observed and noted down for further calculations. The distance between nasal midline and supraorbital notch/foramen was measured. The distance between frontozygomatic suture and supraorbital notch/foramen, also the distance from infraorbital foramen and supraorbital notch/foramen were measured using digital verniercalliper. The obtained data was properly recorded, analysed and tabulated.

## Results

In the present study 112 adult dry human skull of unknown gender were analysed bilaterally at both the orbits from government medical college Aurangabad. The findings of present study were summarized and tabulated in (Table 1 and Table 2). The frequency of occurrence of supraorbital notch (66.07%) was much more than that of supraorbital foramen (33.92%). Out of 112 skulls studied 20 skulls (17.85%) shows presence of bilateral supraorbital foramen (Fig. 2) whereas 58 skulls (51.78%) shows presence of bilateral supraorbital notches (Fig. 2). The unilateral presence of supraorbital foramen (i.e. supraorbital notch on other side) was noted in 34 skulls (Fig. 3). The supraorbital foramen present on right side only was found in 14 skulls (12.5%). The supraorbital foramen on left side only was found in 20 skulls (17.85%) out of total 112 skulls studied. The accessory supraorbital foramen was found in 16 skull (14.28%). The oval shaped supraorbital foramen were noted in 19.64% and rounded shape in 13.39% of cases.

The mean distance between nasal midline and SON/SOF was 22.39 ± 2.58 mm on right side and 22.40 ± 2.40mm on left side (Fig. 4). The mean distance between frontozygomatic (FZS) suture and SON/SOF was 30.89 ± 5.78 mm on right side and 30.53 ± 5.89 mm on left side (Fig. 5). The average distance from SON/SOF to infraorbital foramen was 39.27 ± 2.47 mm and 39.45 ± 2.31 mm on right and left side respectively (Fig. 6). These morphometric measurements and statistical analysis of mean distance of SON/SOF from nasal midline, Frontozygomatic Suture and Infraorbital foramen were tabulated in Table 2. The statistical analysis was done, the difference between right and left sides was analyzed by application of paired *t*-test. The results shows that comparison between two sides was not significant statistically in all parameters.

**Table 1**: Findings of present study showing prevalance of SOF/SON.

| Sr. No. | Prevalance of SOF/SON in present study | Number of skulls | Percentage |
|---|---|---|---|
| 1 | Total prevalance of Supraorbital notch | 148 (orbits) | 66.07 |
| 2 | Total prevalance of Supraorbital foramen | 76 (orbits) | 33.92 |
| 3 | Bilateral supraorbital foramen | 20 | 17.85 |
| 4 | Bilateral Supraorbital notch | 58 | 51.78 |
| 5 | Supraorbital foramen on Right side | 14 | 12.5 |
| 6 | Supraorbital foramen on Left side | 20 | 17.85 |
| 7 | No. of accessory foramina's | 16 | 14.28 |

**Table 2:** Morphometric measurements and statistical analysis of SON/SOF

| Sr. No. | Parameters | Mean distance (*R* + *L*) Mean + SD *N* = 224 | Right side Mean ± SD (*N* = 112) | Left side Mean ± SD (*N* = 112) | Paired *t*-test | *p*-value |
|---|---|---|---|---|---|---|
| 1 | Distance between nasal midline and SON/SOF | 22.39 ± 2.58 | 22.39 ± 2.74 | 22.40 ± 2.40 | $t = 0.055$ | $p > 0.05^{NS}$ |
| 2 | Distance between SON/SOF and FZS | 30.71 ± 5.84 | 30.89 ± 5.78 | 30.53 ± 5.89 | $t = 0.247$ | $p > 0.05^{NS}$ |
| 3 | Distance between Infraorbital foramen and SON/SOF | 39.36 ± 2.39 | 39.27 ± 2.47 | 39.45 ± 2.31 | $t = 0.269$ | $p > 0.05^{NS}$ |


**Fig. 1:** Bilateral Supraorbital notch.


**Fig. 2:** Bilateral Supraorbital Foramen.


**Fig. 3:** Unilateral Supraorbital Foramen on right side.

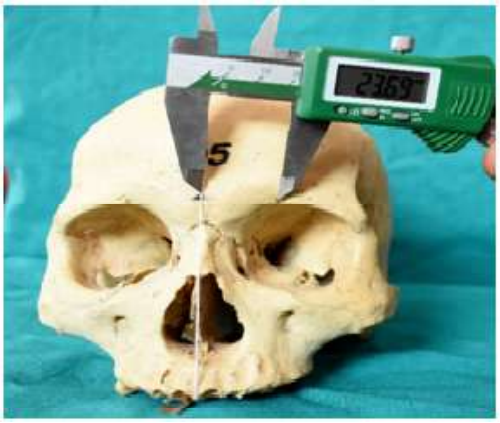

**Fig. 4:** Measurement of distance between nasal midline and SON/SOF.

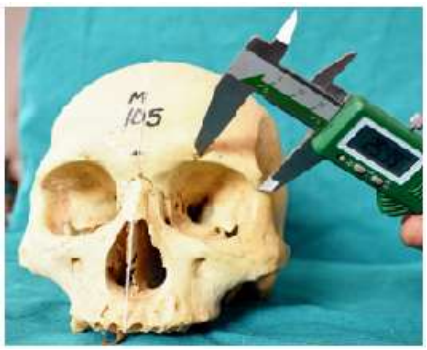


**Fig. 5:** Measurements of distance between FZS and SON/SOF.

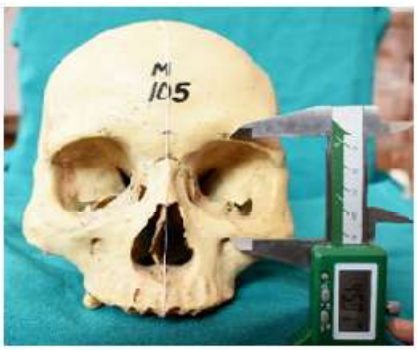


**Fig. 6:** Measurement of distance between IOF & SOF/SON.

## Discussion

In the present study out of 112 skulls studied 66.07% of orbits shows presence of supraorbital notch (SON) which exceeds than the total prevalence of supraorbital foramen (SOF) which was 33.92%, these findings of present study were found to be consistent with the Apinhasmit et al.[6] which shows prevalence of SON and SOF of about 66.5% and 33.5% respectively. Chung MS[7] reportedthat the frequency of SON (69.9%) was more than that of SOF (28.9%) in Korean population, which shows lower prevalance of SOF than present study.

The findings of Dodo[8] showing prevalence of SOF was 39.4%, 44.6%, 46.8% in north, west and east india respectively which were much more than present study. The prevalance of SON/SOF shows variations in different populations. Webster et al.[9] concluded that frequency of prevalence of SON (61.57%) was higher than SOF (38.43%). The frequency of bilateral SON was 49.07% and bilateral SOF was 25.93%, whereas unilateral SOF was present in 12.5% of cases. These findings of Webster et al. didn't match with findings of present study.

Apinhasmit et al.[6] reported the prevalance of bilateral SON (50%) and bilateral SOF (17%) with unilateral SON/SOF in about 16.5% of cases. These findings of Apinhasmit et al. were consistent with the findings of present study. The present study shows presence of bilateral SON in 51.78%, bilateral SOF in 17.85% and unilateral SON/SOF in 14.28% of cases. Cheng et al.[10] given the total prevalence of SOF of about 45.9% and SON about 54.1%, which shows wide variation with the present study.

The presence of accessory supraorbital foramen is a common finding. A minor twig of supraorbital nerve traverse through it, which results in incomplete analgesia and anaesthesia following injection in nerve at SON/SOF. The prevalence of accessory SOF in present study was 14.28%. The frequency of accessory SOF reported by Berry[11] was 50% and by Saylam[12] was 21.2%. In the present study out of total SOF studied 19.64% were oval in shape and 13.39% were rounded in shape.

The present study reported the mean distance between the nasal midline and SON/SOF was 22.39 ± 2.74mm on right side and 22.40 ± 2.40 mm on left side. The average distance from nasal midline ad SON/SOF reported by Cheng et al., Apinhasmit, Webster et al. were 24.56 mm, 25.14 mm, 32.02 mm respectively, these findings were higher than the present study. The mean distance between FZS and SON/SOF was 30.89 ± 5.78 mm on right side and 30.53 ± 5.89 mm on left side in the present study. Smith et al.[13] Liu et al.[14] studied the distance between FZS and SON/SOF which was 26.2 mm & 20.55 mm respectively and found to be much less than present study.

The distance between SON/SOF and infraorbital foramen also shows wide racial variations. Thai population studied by Apinhasmit showed that the average distance of IOF from SON/SOF was 44.95 ± 2.96 mm on right side and 42.52 ± 3.89 mm on left side. Korean population studied by Chung et al.[7] reported that the average distance between IOF and SON/SOF was 45.6 mm, these findings of Thai & Korean population are quite higher than present study which shows average distance between IOF and SON/SOF was about 39.27 ± 2.47 mm on right side and 39.45 ± 2.31 mm on left side respectively.

## Conclusion

Wide variations of SON/SOF were present in different populations. The prevalence of SON exceeds than that of SOF, other variations like unilateral SOF, accessory SOF were also common. The precise and exact location of SON/SOF is very essential for different therapeutic, diagnostic, anaesthetic and surgical procedures in order to reduce the relative risk during these clinical procedures.

### *Abbrevations*

**SON –** Supraorbital Notch

**SOF –** Supraorbital Foramen

**FZS –** FrontozygomaticSuture

**IOF –** Infraorbital Foramen

## References

1. Standering S, Ellis H, Healy JC, et al. Ed's. Gray's Anatomy: The Anatomical basis of clinical practice. 39th Edition, Elsevier, Churchill Livingstone, London 2005.pp.511–13.
2. Romanes GJ. Cunningham's Textbook of Anatomy, Head, Neck and Face, 15th ed. London, Oxford University Press 1972.p.106.
3. Hollenshed W.H. Anatomy for surgeons. Vol I. Hoeber Harper, New York & London 1966.
4. Duke Elder SS. System of ophthalmology. Volume II. Henry Kimpton, London 1961.
5. Evan RW, Pareja JA. Supraorbital neuralgia. Headache. J Head Face Pain 2009;492:278–81.

6. Apinhasmit W, Chompoopong S, Methathrathip D, et al. Supraorbital Notch/Foramen, Infraorbital foramen and mental Foramen in Thais: anthropometric measurements and surgical relevance. J Med Assoc Thais 2006 May;89(5):675–82.
7. Chung MS. Locational relationship of the supraorbital notch/Foramen and infraorbital and mental foramina in Koreans. Actaanatomica 1995;154(2):162–66.
8. Dodo Y. Supraorbital Foramen and hypoglossal canal bridging the two most suggestive nonmetric cranial traits in discriminating major racial grouping of man. J Anthropology Soc Nippon 1987;95:19–35.
9. Webster RC, Gaunt JM, Hamdan, et al. Supraorbital and supratrochlear notches and foramina: Anatomical variations and surgical relevance. Laryngoscope 1986;96(3):311–5.
10. Cheng AC, Yuen HK, Lucas PW, et al. Characterization and localization of the supraorbital and frontal exits of the supraorbital nerve in Chinese: An anatomic study. Ophthalmology plastic Reconstruction surgery 2006 May- June;22(3):208–13.
11. Berry AC. Factors affecting the incidence of non-material skeletal variants. J Anat 1975 Dec; 120(pt 3):519–35.
12. Saylam C, Over MA, Ozck C et al. Anatomical variations of the frontal and supraorbital transcranial passages. J Craniofacial. Surg 2003;14(1):10–2.
13. Smith JD, Surek CC, Cortex EA, Withdrawn. Localization of the supraorbital, infraorbital and mental foramina using palpable bony landmarks. Clin Anat 2010 may;23(4):495.
14. Liu DN, GueJL, Luo Q, et al. Location of supraorbital foramen/notch and infraorbital foramen with reference to soft and hard tissue landmarks. J Craniofac Surg 2011 Jan;22(1): 293–96.

*Case Report*

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# A Case Report on Excessive Elongation of Styloid Process

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**Abstract**

During retrieving of skull bone from a known male cadaver of 44 years, excessive elongated styloid process was observed on both the sides of skull. The length of styloid process was same on both the sides i.e. 4.4 cm. It was concavo-convex and pointed. It was directed anteriorly, inferiorly and medially. Excessive elongated styloid process may create pressure on facial nerve and external and or internal carotid artery which causes pain in cervicofacial region and sometimes it is asymptomatic. Surgical resection of styloid process is required if elongated styloid process is associated with severe symptoms.

**Keywords:** Styloid process; Long styloid process; Eagle's syndrome; Cervicofacial pain.

## Introduction

Styloid process (SP) is pointed bony process of temporal bone which is derived from dorsal part of Reichert's cartilage of second arch or hyoid arch. It is slender, pointed and projects anteroinferiorly from the inferior aspect of temporal bone. It is almost straight, it can show curvature, an anteromedial concavity being most common. SP lies anterior and medial to the mastoid process and stylomastoid foramen lies between the mastoid and styloid process. The length of SP varies from few millimetres to few centimetres to an average of 2.5 cm.[1]

The proximal part of SP is called as tympanohyal which is ensheathed anterolaterally by tympanic plate. The distal part of SP is called as stylohyal part where muscles and ligaments are attached. These parts are united by cartilage which undergoes ossification often as late as middle age.[2] SP carries clinical significance as it has important relations with muscles, nerve and vessels. SP is related to parotid gland laterally and is separated from beginning of internal jugular vein by the attachment of stylopharyngeus. Facial nerve crosses SP at the base and external carotid artery crosses SP at its tip.[1] Internal jugular vein, accessory, vagus, and glossopharyngeal nerves, internal carotid artery, sympathetic chain are located medial to the process[3] while the occipital artery and hypoglossal nerve run along its lateral side and also found is the posterior belly of the digastric muscle.[4] Attachment of muscles like styloglossus, stylopharyngeus, stylohyoid and ligaments like stylohyoid, stylomandibular to SP forms styloid apparatus. Through these structures, the styloid process facilitates the movement of the tongue, pharynx, larynx, hyoid bone and mandible.[4] Excessive elongation of styloid process may create compressive effect on nearby neurovascular structures and lead to cervicofacial pain. It may be useful to do assessment of the length of styloid process in case of cervicofacial pain to find out the cause of pain.

## Case Report

Bilateral excessive elongated and pointed SP was observed during retrieval of skull bone of 44 years of male cadaver. The length of SP was 4.4 cm and it was directed anteriorly, inferiorly and medially with curvature.


**Fig. 1:** Photograph shows excessive elongated bilateral presence of SP.

## Discussion

Styloid process is bony prolongation starts from temporal bone and present on anteromedial aspect of stylomastoid foramen. Five structures consist of three muscles and two ligaments constitute styloid apparatus. Styloglossus, stylopharyngeus and stylohyoid muscles play role in mastication and deglutition. Stylomandibular ligament is thickening of deep cervical facia and connects tip of SP and angle of mandible while the stylohyoid ligament's proximal attachment lies at the apex of the styloid process, while the distal end of the ligament attaches to the lesser cornu of the hyoid. Both ligaments facilitate the movement of the tongue, pharynx, larynx, hyoid bone, and mandible.[5,6]

SP shows variations in the length, angulation and other morphological features. The reported normal length of SP ranges from 20–32 mm.[7] This varies from person to person, males to females and even from side to side in the same person.[8–11] Wide literature about length of SP shows variations in the length of SP, it ranges from 23 to 36 mm, 42 mm for women under age of 35 years and 49 mm for men over 35 years,[12] mean length of SP was found to be 3.7 mm on right side and 3.8 mm on left side,[13] in males on right side is 25.78, on left side is 22.69 and in females on right side is 25.8 and on left side 22.75 mm.[14] Average length of SP was 2 to 3 cm[10,15–17] 1.52 to 4.77 cm,[18] 2.51 to 6.11 cm.[19] The normal SP was approximately 2.5 cm in length and any process longer than 2.5 cm might be considered to be elongated which was found in 4% of the patients.[20] When length of SP is more than 30 mm then it is considered as elongation.[21] When symptoms are associated with elongated SP then it is termed as Eagle syndrome.[22] Incidence of elongation of SP is around 4–7%; only 4% of the patients with elongation of SP show the symptoms.[23,24] In the present study the length of SP is 44 mm which is excessively elongated and same on both the sides.

SP length is not related to age, gender[25,26] but significant co-relation was seen between serum calcium concentration and length of SP, longer the SP higher the serum calcium concentration was found.[25] Association of dental status and SP length was evaluated.[11,25] Muscle tension from occlusal disarrangements and changes in both bones' height in partially or completely edentulous patients can be probable factor in the incidence of a co-relation between no of teeth present in the mouth and SP length.[11]

Cause of elongation of SP is not clearly understood. It may be related to complete or partial calcification of stylohyoid ligament or abnormal ossification of stylohyoid ligament.

The styloid process originates as a part of Reichert's cartilage, which forms from the second pharyngeal arch during embryological development.[27] Reichert's cartilage divides into four parts, the tympanohyal part, the stylohyal part, the ceratohyal part, and the hypohyal part. The tympanohyal part develops antenatally, attaches to the petrous portion of the temporal bone, and gives rise to the base of the styloid process which is ensheathed by the vaginal process of the tympanic part. The stylohyal part appears post-natally, and it gives rise to the shaft of the styloid process and the proximal portion of the stylohyoid ligament. The stylohyal part might unite with the tympanohyal after puberty, but in some cases they never do. The ceratohyal and its fibrous sheath regress, giving rise to the stylohyoid ligament. The hypohyal part gives rise to the lesser cornu of the hyoid bone.[28,29] The stylohyal part might unite with the tympanohyal after puberty. If the stylohyal part successfully fuses with the tympanohyal part and the stylohyal aspect ossifies, it results in a long styloid process.[28] In the current case excessive elongation of SP may be because of ossified stylohyoid ligament. We could not elicit the history of pain in the cervicofacial region as we received the cadaver with cause of death as cardiac arrest.

Elongated SP may go unnoticed or it is incidental finding if it is not associated with symptoms of cervicofacial pain. If it is associated with symptoms then surgical resection of SP is required for better outcome.

## References

1. Standring S, External and middle ear; In: with associated, Standring Seditor; Gray's Anatomy: The anatomical basis of clinical practice. 40th ed. Elsevier Churchill Livingstone 2008.p.617.

2. Strauss M, Zohar Y, Laurian N. Elongated styloid process syndrome: Intraoral versus external approach for styloid surgery. Laryngoscope 1985:95:976–79.
3. Palesy P, et al. The involvement of the styloid process in head and neck pain: A preliminary study. J Oral Rehabil 2000:27;275–87.
4. Abdulaziz K. Abuhaimed; Reinier Alvarez; Ritesh G. Menezes. Anatomy, Head and Neck, Styloid Process. Treasure Island (FL): Stat Pearls Publishing; 2019 Jan https:// www. ncbi. nim. nih. gov/ books/ NBK540975
5. Vadgaonkar R, Murlimanju BV, Prabhu LV, et al. Morphological study of styloid process of the temporal bone and its clinical implications. Anat Cell Biol 2015 Sep;48(3):195–200.
6. Piagkou M, Anagnostopoulou S, Kouladouros K, et al. Eagle's syndrome: A review of the literature. Clin Anat 2009 Jul;22(5):545–58.
7. Guldane M. Evaluation of styloid process morphology and calcification types in both genders with different ages and dental status, J Istand Univ Fac Dent 2017;51(2):29–36.
8. More CB, Asrani MK. Evaluation of the styloid process on digital panoramic radiographs. The Indian J Radiol Imaging 2010;20(4):261–65.
9. Langlais RP, Miles DA, Van Dis ML. Elongated and mineralized stylohyoid ligament complex: A proposed classification and report of a case of Eagle's syndrome. Oral Surg Oral Med Oral Pathol 1986;61(5):527-32.
10. Ferrario VF, Sigurta D, Daddona A, et al. Calcification of the stylohyoid ligament: incidence and morphoquantitative evaluations. Oral Surgery Oral Med Oral Pathol 1990;69(4):524–29.
11. Ghafari R, Hosseini B, Shirani AM, et al. Relationship between the elongated styloid process in panoramic radiographs and some of the general health conditions in patients over 40 years of age in the Iranian population. Dental Res J 2012;9(Suppl 1):S52–56.
12. Jung T. Elongated styloid process:when is it really elongated? Dentomaxillofac Radiol 2004;33(2):119–24.
13. Sridevi K, Mahesh N, Krishnaveni B et al. Evaluation of the styloid process and its anatomical variations: A digital panoramic study with systematic review, J Int Soc Perv Community Dent 2019;9(3):256–62.
14. Balcioglu HA. Length of the styloid process and anatomical implications for Eagle's syndrome, Folia Morphol 2009;68(4):265–70.
15. Kaufman SM, Elzay RP, Irish EF. Styloid process variation. Radiologic and clinical study. Arch Otolaryngol 1970;91(5):460-463.
16. Chandler JR. Anatomical variations of the stylohyoid complex and their cilical significance. Laryngoscope 1977;87:1692–1701.
17. Zaki HS, Greco CM, Rudy TE, Kubinski JA. Elongated styloid process in a temporomandibular disorder sample: prevalence and treatment outcome. J Prosthet Dent 1996;75(4):399-405.
18. Moffat DA, Ramsden RT, Shaw HJ. The styloid process syndrome: aetiological factors and surgical management. J Laryngol Otol 1977;91(4):279-294.
19. Ceylan A, Köybaşioğlu A, Celenk F, Yilmaz O, Uslu S. Surgical treatment of elongated styloid process: experience of 61 cases. Skull Base 2008;18(5):289-295.
20. Eagle WW. Elongated styloid process: Further observations and new syndrome. Arch Otolaryngol 1948;47:630–40.
21. Keur JJ, Campbell JP, McCarthy JF, et al. The clinical significance of the elongated styloid process. Oral Surg Oral Med Oral Pathol 1986;61(4):399–404.
22. Eagle WW. Symptomatic elongated styloid process: Report of two cases of styloid processcarotid artery syndrome with operation. Arch Otolaryngol 1949;49(5):490–503.
23. Prasad KC, Kamath MP, Reddy KJ, Raju K, Agarwal S. Elongated styloid process (Eagle's syndrome): a clinical study. J Oral Maxillofac Surg 2002;60(2):171-175.
24. Chourdia V. Elongated styloid process (Eagle's syndrome) and severe headache, Journal of otolaryngology and head and neck surgery 2002;54(3):238–41.
25. Okabe S, Morimoto Y, Ansai T, et al. Clinical significance and variation of the advanced calcified stylohyoid complex detected by panoramic radiographs among 80-year-old subjects. Dentomaxillofac Radiol. 2006;35(3):191-199.
26. Mac Donald- Jankowski D. Calcification of the stylohyoid complex in Londoners and Hong Kong Chinese, Dentomaxillofac Radiol 2001;30(1):35–39.
27. Lavine MH, Stoopack JC, Jerrold TL. Calcification of the stylohyoid ligament. Oral Surg. Oral Med. Oral Pathol 1968 Jan;25(1): 55–8.
28. Piagkou M, Anagnostopoulou S, Kouladouros K, et al. Eagle's syndrome: A review of the literature. Clin Anat 2009 Jul;22(5):545–58.
29. Patil S, Ghosh S, Vasudeva N. Morphometric study of the styloid process of temporal bone. J Clin Diagn Res 2014 Sep;8(9):AC04–6.

*Case Report*

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# Primary Amenorrhoea with Imperforate Hymen: A Case Report

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**Abstract**

Imperforate hymen is a rare condition, most commonly diagnosed among obstructive anomaly, with a incidence of less than 1%. It is an isolated anomaly that is seen due to failure of canalisation of urogenital sinus. It presents with primary amenorrhea, cyclical abdominal pains and may be with urine retention and it is observed at the age of puberty in girls. We present a case of 13 year old girl with imperforate hymen underwent hymenoplasty under general anesthesia for Hematocolpose and Hematometra, presented with abdominal pains on and off and tenesmus. On follow up the girl had started with normal menstruation.

**Keywords**: Hymenoplasty; Imperforate Hymen; Primary Amenorrhoea.

## Case Report

Hymen is an incomplete mucous fold that closes the cavity of vagina near external orifice of the vagina. Hymen may present in various shapes like annular, crescentic or cribriform.[1] Imperforate hymen, is the most common female genital tract malformation.[2] It occurs rarely and has a prevalence rate of 0.014–0.1%.[3,4] Mostly pubertal girls present this anomaly.[5]

A 13 year old girl came for consultation to Gynaecologist with complaints of abdominal pain periodically since one year. She also complained of associated constipation and retention of urine. She was completely alright before one year. Since then she started getting crampy pain in lower abdominal region which were cyclic in nature. The pain was lasting for six to seven days of every month. The severity of pain went on increasing by each month and it became more severe since last two months and also the lower part of the abdomen was increasing in size. She also presented with the history of constipation and difficult micturition. She had no history of nausea, vomiting and fever. She did not give any positive history regarding onset of menstrual cycle but she had growth of pubic hairs and breast buds had also developed that were confirming the onset of puberty. The patient had no history of any vaginal discharge and any sexual activity. There was no history of similar complaints in any family members.

On physical examination, the signs of secondary sexual characteristics like pubic hair and mammary gland buds were well developed. On examination of cardiovascular system nothing abnormality was found. On per abdominal examination, lower abdomen was distended and there was tenderness on pressure. Perineal examination showed bulging bluish hymen and imperforate membrane was seen.

There were no other major abnormalities of external genitalia observed.

An Ultra Sonography of abdomen and pelvis was done which showed partially distended urinary

bladder with normal wall thickness. The size, shape and outline of uterus was normal. The size was 6 × 2.9 cm. Endometrium showed hypoechoic collection with internal echoes noted in it, Myometrium was normal. Cervical canal showed collection in it, e/o collection in cul de sac.

Vagina showed hypoechoic collection in it with internal echoes noted in it measuring about 9.9 × 5.5 cm. All findings from Ultrasonography were suggestive of Hematometrocolpos (Fig. 1). Both the ovaries were normal. Aorta and Inferior Vena Cava were normal. Both the adrenals were normal. There were no evidence of Ascitis or enlarged lymph nodes. Bowels appeared normal.


**Fig. 1:** Hypoechoic collection in cervical canal and uterus.

### *Treatment*

Patient was given general anaethesia. Hymenoplasty was carried out. The patient was taken in theatre and an X-shaped incision of the hymen was made under anesthesia and approximately 1000 milliliters of thick chocolate coloured blood was drained. The edges of the hymen were turned outward and sutured by Vicryl 2/0 sutures. Local analgesic cream and prophylactic oral antibiotics were given to patient. She made uneventful recovery and was doing well at 1 month. She was however lost to follow-up after that.

## Discussion

Lui et al.[6] revealed the average age of presentation is 12 years and range is 10-15 years. Liang et al.[7] stated mean age presentation of imperforate hymen as 13.2 years and range 11–16 years. The patient with imperforate hymen presents with following signs and symptoms;

I. Amenorrhea, may be primary due to accumulation of blood in the vaginal cavity obstructed by imperforate hymen[5] or secondary that may occur after spontaneous closure of previously perforate hymen. The later mainly occurs in micro perforate or stenosed hymen following surgical or sexual trauma where initial light periods will be experienced but continuous stenosis leads to complete obstruction and amenorrhoea.[8]

II. Periodic pains in lower abdominal region or pelvic region on and off (up to 60%)[3,5,9] due to continued distension of the vagina and uterus by accumulating menstrual blood and low back pain (38–40%)[5] which is a referred pain after irritation of the sacral plexus and nerve roots by the distended vagina and uterus.

III. Obstruction

   1. Obstruction of Urinary outflow and its complications (58%).[6] Acute retention of urine[8,6,12] is caused by pressure on the bladder by the distended uterus that causes angulation at the neck of bladder and stricture of the urethra.[10]
   2. Vaginal outflow obstruction which is seen as a bluish bulge at the introitus.[11]
   3. In chronic cases intestinal obstruction leading to constipation (20–27%)[6] and tenesmus[11] also seen.

IV. Mass per abdomen due to distended uterus and vagina with accumulated menstrual blood.[5]

V. Accumulation of blood in uterus leads to the development of endometriosis and it can be confirmed with the help of laparoscopy while performing hymenoplasty.

Vulvar distension differentiates imperforate hymen from transverse vaginal septum 1 Imperforate hymen can be usually diagnosed clinically which can be confirmed by ultrasonography. Hymenoplasty is the choice of treatment under general anesthesia. An X-shaped incision at 2-, 4-, 8-, and 10-o'clock positions is used due to which risk of risk of injury to urethra is reduced. Incision should be in quadrants of hymen and the mucosal margins are approximated with fine delayed-absorbable suture.[12] The outcome of surgical hymenotomy is good and the recurrences are rare.[7]

### *Teaching Point*

We can suspect Imperforate Hymen in absence of menstrual cycle in pubertal girls presented with periodical abdominal pains. In such cases a complete gynaecological history, examination and investigations may prevent serious complications due to delay in diagnosis.

## References


1. Vishram Singh, Text book of Abdomen and Lower limb, 2nd edi. Elsevier publication Female genital organs, p.276.
2. Nagai K, Murakami Y, Nagatani K, et al. Life-threatening acute renal failure due to imperforate hymen in an infant. Pediatr Int 2012;54(2):280-282.
3. Eksioglu AS, Maden HA, Gokce Cinar G, et al. Imperforate hymen causing bilateral hydroureteronephrosis in an infant with bicornuate uterus. Urology Case. Reports. 2012;2012:102683. Epub 2012 Jun 7.
4. Basaran M, Usal D, Aydemir C. Hymen sparing surgery for imperforate hymen: case reports and review of literature. J Pediatr Adolesc Gynecol 2009;22(4):e61-e64.
5. Dane C, Dane B, Erginbas M, Cetin A. Imperforate hymen-a rare cause of abdominal pain: two cases and review of the literature. J Pediatr Adolesc Gynecol 2007;20(4):245-247.
6. Lui CT, Chan TWT, Fung HT et al. A retrospective study on imperforate hymen and hematocolpos in a regional hospital. Hong Kong J emerg med. 2010;17(5):435–40.
7. Liang CC, Chang SD, Soong YK. Long-term follow-up of women who underwent surgical correction for imperforate hymen. Arch Gynecol Obstet 2003;269(1):5-8.
8. Khan ZA. Imperforate hymen: A rare case of secondary amenorrhoea. J Obstet Gynecol 2011;31(1):91–2.
9. Ercan CM, Karasahin KE, Alanbay I, et al. Imperforate hymen causing hematocolpos and acute urinary retention in an adolescent girl. Taiwan J Obstet Gynecol 2011;50(1):118-120.
10. Abu-Ghanem S, Novoa R, Kaneti J, Rosenberg E. Recurrent urinary retention due to imperforate hymen after hymenotomy failure: a rare case report and review of the literature. Urology 2011;78(1):180-182.
11. Anselm OO, Ezegwui UH. Imperforate hymen presenting as acute urinary retention in a 14-year old Nigerian girl. J Surg Tech case Rep 2010;2(2):84–86.
12. Dominguez CE, Rock JA, Ira R. et al, Surgical conditions of the Vagina and Urethra. In: Rock JA, eds. TeLinde's Operative Gynaecology. 10th ed. New Delhi: Wolters Kluwer Health/ Lippincott Williams & Wilkins 2008:508–11.

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# An Additional Head of Biceps Femoris: A Case Report

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**Abstract**

*Background:* Anatomists and clinicians need to be aware about existence of muscle variation. The biceps femoris is the muscle of thigh having two heads.

*Methods and Material:* During cadaveric dissection we got the muscle variation. The biceps femoris muscle shows variations in its origin bilaterally. Both right and left limbs were carefully and cleanly dissected.

*Results:* In the upper portion of muscle, few fibers was diverged & directed medially, downwards and inferiorly, and joined with distal fibers of semitendinosus muscle. The length of these fibers was 8.2 cm on right and 7.6 cm on left side. Hence the muscle fibers diverging from long head of biceps femoris muscle, they look like additional head of biceps femoris.

*Conclusions:* These fibers merges with semitendinosus, they may give strain in posterior compartment, compress sciatic nerve & strengthen semitendinosus muscle. These fibers may create misconceptions to clinicians and diagnostic experts.

**Keyword:** Biceps femoris; Variation; Additional head.

## Introduction

Muscle variations routinely come across during dissection as well as in clinical practice, so both anatomists and clinicians need to be aware of their existence. The biceps femoris is the muscle of posterior compartment of thigh. It has two heads; the long head originates from lower and inner impression on the posterior side of ischial tuberosity. This is the common origin with the semitendinosus muscle, and from the lower part of sacrotuberous ligament. The short head arises from linea aspera laterally. Both heads of biceps femoris is joined together and inserted on the head of fibula laterally and small tendinous slip inserted on the lateral condyle of the tibia. The tibial part of sciatic nerve innervates the long head of biceps femoris and common peroneal nerve innervates to the short head.[1,10]

The long head of biceps femoris is the component of hamstring muscles along with semitendinosus, semimembranosus, and adductor magnus muscle.[2,3] All the hamstrings crosses the hip joint cranially and knee joint caudally, so the action of these muscles is flexion of knee joint and extension of the hip joint partially. Along with this they also help in internal and external rotation of the hip joint.[5,6]

Hamstring muscles are involved mainly in locomotion hence forth injuries of the muscles are common in many sports and usual activities life. The anatomical variations of biceps femoris are rare or if present it may affect normal functions like gliding and flexibility. The information about variations of the biceps femoris is required to avoid diagnostic misconceptions of surgeons, physiotherapists and radiologists.[1]

The variations mainly arise by genetical inheritance or may be due to developmental

deformities. Most of these are not harmful and some of these may affect body systems severally.

The common variations of biceps femoris are the short head may be absent, additional heads may arise from the ischial tuberosity, the linea aspera, the medial supracondylar ridge of the femur etc. The insertion may be on iliotibial tract and gastrocnemius.[10]

In year 2017–2018, at the time of 1st year MBBS student's regular cadaveric dissection, muscle variation was found. The biceps femoris muscle showed variations in its origin bilaterally. All the structures were preserved like attachments of muscle, its relations and neurovascular supply. Other structures were normal except biceps femoris in the posterior compartment of thigh. Later the biceps femoris muscle was carefully examined. Both the lower limbs were preserved in 10% formalin.

## Case Report

The case was found in department of Anatomy, D.Y. Patil Medical College, Kolhapur at the time of regular cadaveric dissection. Out of total 15 cadavers, a 48 years male cadaver showed variation of biceps femoris muscle bilaterally. The long head of biceps femoris normally originates from ischial tuberosity and is inserted on the head of fibula. We found that some muscle fibers were diverging from long head of biceps femoris and located in between biceps femoris and semitendinosus muscle. A variation was found in the upper region of popliteal fossa (Fig. 1,2). The existence of additional muscle fibers between long head of biceps femoris and semitendinosus is mentioned rarely in our literature. The region was carefully dissected and cleaned without damage to any structure. In this case, the long head of biceps femoris was originated and inserted normally but in the proximal portion of muscle some fibers were diverged their normal course. These abnormal muscle fibers were directed downward, medially and inferiorly. Inferiorly these muscle fibers were merged with the distal fibers of semitendinosus as they coursed medially. On measuring the length of right side muscle fibers was 8.2 cm. (Fig. 1) and of left side was 7.6 cm. (Fig. 2) these muscle fibers look like additional head of biceps femoris. The right and left lower limbs of cadaver showed same variation. After dissecting whole limb no any other variation was found. The biceps femoris was examined carefully and photographed. As these variations are rare we preserved these limbs in 10% formalin.

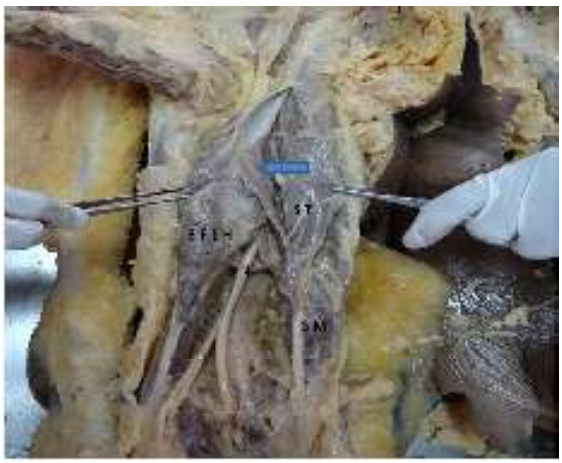


**Fig. 1:** An additional head of biceps femoris showed by arrow of left lower limb.
SM- Semimembranosus
ST-Semitendinosus
SN- Sciatic Nerve
BFLH- Long head of biceps femoris


**Fig. 2:** An additional head of biceps femoris showed by arrow of right lower limb.
SM- Semimembranosus
ST-Semitendinosus
SN- Sciatic Nerve
BFLH- Long head of biceps femoris

## Discussion

The structure and function of hamstrings muscle have been studied for long time which provides full information about anatomy of hamstrings muscles. The biceps femoris is the important component of the hamstrings muscle. Different variations of hamstrings muscle explained

in a review of literature. e.g. an accessory semimembranosus muscle,[11] Hypoblastic or absent semimembranosus,[12] Duplicated semimembranosus,[13] common proximal tendon of three muscles,[14] separate distal short head of biceps brachi insertion and separate proximal long head of biceps brachi.[3,4]

The abnormal muscle bundle originated from long head of biceps femoris in the right lower limb of adult male cadaver was described by Cetkin M. et al. The origin was normal but some fibers formed another tendon, runs medially in between biceps femoris and semitendinosus. It measures about 86.32 × 5.47 mm.[2] The present study is similar to Cetkin M. et al. But we found bilateral presence of anomalous muscle.

This type of variation may affect normal actions of biceps femoris muscle. The slip of muscle attached to semitendinosus, so it may strengthen it. It crosses the sciatic nerve; there may be chance of compression and a mysterious pain in lower limb. In clinical practice this type of muscular variations produces confusion to diagnose.[7,11]

A muscular anomaly was identified between long head of biceps and semitendinosus muscle by Chakravarti.[4] It was originated from the long head of biceps and merges with semitendinosus muscle. It was 6.5 cm in length and 3.5 cm in width. He considered that it may be the third head of biceps femoris.

An anomaly in the insertion of the biceps femoris tendon that has never been described in the literature was described by Fritsch and Mhaskar. They found a hypertrophic insertion on the tibia and an atrophic insertion on the fibula, which was successfully managed by otoplasty of the fibular head and by changing the route of biceps femoris surgically.[5]

The anatomy and relations of muscle was described by Renata La Rocca Vieira, by using MRI of the distal biceps femoris. A variation present in this part may be resulted in entrapment neuropathy of common peroneal nerve.[9]

In myogenesis when a muscle precursor enters, to divide the limb buds into dorsal and ventral part. After that both the parts again divides into three compartments and proximal–distal axis. The continuous migration of muscle precursor results in the formation of specific muscle. Anomaly found in present study may be defect in continuous moving of muscle precursor during development.[16]

## Conclusion

We found a part of muscle fibers originates from long head of biceps and merges with semitendinosus bilaterally. The importance of this finding is it gives strain to the muscles of posterior compartment and compression of sciatic nerve. Hence the muscle fibers were merged with semitendinosus may strengthen it. This muscle strap may create confusion in examination of CT and MRI scans and while performing surgery. Hence to avoid complexity during diagnosis and treatment, it is necessary to cognizant of such variations.[15]

## Acknowledgement

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***Conflict of Interest:*** None

## References

1. Gupta RK, Bhagwat SS. An anomalous muscle in the region of the popliteal fossa: A case report. J. Anat. Soc. India 2006;55(2):65–68.
2. Cetkin M, Yoruk MD, Golpinar M, et al. An Anomalous Muscular Bundle Connecting Biceps Femoris to Semitendinosus. MOJ Anat & Physiol 2017;4(3):00137. DOI: 10.15406/mojap 2017.04.00137
3. Feucht MJ, Plath JE, Seppel G, et al. Gross anatomical and dimensional characteristics of the proximal hamstring origin. Knee Surg Sports Traumatol Arthrosc 2015;23(9):2576–82.
4. Chakravarthi K. Unusual unilateral multiple muscular variations of back of thigh. Ann Med Health Sci Res 2013;3(Suppl 1):S1–S2.
5. Fritsch BA, Mhaskar V. Anomalous Biceps Femoris Tendon Insertion Leading to a Snapping Knee in a Young Male. Knee Surg Relat Res. 2017;29(2):144-149.
6. Sato K, Nimura A, Yamaguchi K, et al. Anatomical study of the proximal origin of hamstring muscles. J Orthop Sci 2012;17(5):614–18.
7. Sinav A, Gümüşalan Y, Arifoğlu Y, et al. Accessory muscular bundles arising from biceps femoris muscle. KaibogakuZasshi 1995;70(3):245–47.
8. Bang JH, Gil YC, Yang HJ, et al. Multiple

muscular variations in the neck, upper extremity, and lower extremity biased toward the left side of a single cadaver. J Korean Med Sci 2015;30(4):502–05.

9. Vieira RL, Rosenberg ZS, Kiprovski K. MRI of the distal biceps femoris muscle: normal anatomy, variants, and association with common peroneal entrapment neuropathy. AJR Am J Roentgenol 2007;189(3):549-555.
10. Gray H. Muscle and fascia, In: Gray H, ed. Gray's anatomy, 15th ed. New York, NY: Bounty Books 1977.pp.57–59.
11. Sneath RS. The insertion of the biceps femoris. J Anat 1955;89:550–53.
12. Stoane JM, Gordon DH. MRI of an accessory semimembranosus muscle. J Comput Assist Tomogr 1995;19(1):161–62.
13. Peterson JE, Currarino G. Unilateral absence of thigh muscles confirmed by CT scan. Pediatr Radiol 1981;11(3):157–59.
14. Cattrysse E, Barbaix E, Janssens V, et al. Observation of a supernumerary hamstring muscle: a state of the art on its incidence and clinical relevance. Morphologie 2002;86(274):17–21.
15. Markee JE, Logue JT Jr, Williams M, et al. Two-joint muscles of the thigh. J Bone Joint Surg Am 1955;37(1):125–42.
16. Schnorrer F, Dickson BJ. Muscle building; mechanisms of myotube guidance and attachment site selection. Dev Cell 2004;7(1): 9–20.

# Erratum

## "A Morphometric Study of Normal Parietal and Coronal Suture's Width in Indian Infant Population by CT Imaging"

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The original published version of this Article contained errors in the title mentioned. In the title the word **Parietal** was mistakenly written in place of **Sagittal**, Now title of article readed as

**"A Morphometric Study of Normal Sagittal and Coronal Suture's Width in Indian Infant Population by CT Imaging"**

**Now we can cite this article as:**

Wasim Hiroli, Saurabh Prakash Kulkarni, Arun Kasote. A Morphometric Study of Normal Sagittal and Coronal Suture's Width in Indian Infant Population by CT Imaging. Indian J Anat. 2019;8(4):275–281.

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[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.

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[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.

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

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[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.

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[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.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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