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Foramen Magnum: An Osteological Study in Adult Indian Population

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Abstract

Background: The morphology of foramen magnum has a critical role in posterior cranial fossa pathologies and craniovertebral junction disorders. Foramen magnum is of considerable clinical interest as the vital structures traversing it are compromised in several pathologies affecting the posterior cranial fossa.

Aim: The objective of the study is to assess the morphometry of foramen magnum and to determine the antero-posterior diameter, transverse diameter of the foramen magnum and the foramen magnum index.

Material and Methods: The study was conducted on the foramen magna of 200 dry human skulls that were obtained from the Department of Anatomy of a private medical institutions.Skulls with intact foramen magnum were included in the study. The skulls which had partially missing or broken foramen magnum were excluded from the study. The antero-posterior and transverse diameters of foramen magnum were measured with a vernier calipers. The foramen magnum index was calculated. The shape of the foramen magnum was also noted.

Results: The mean antero-posterior and transverse diameter of the foramen magnum was recorded as 33.27 ± 2.1 mm and 27.13 ± 2.4 mm respectively. The average foramen magnum index was observed as 1.2 ± 0.14.The sagittal diameter ranges from the minimum value of 31 mm to maximum value of 38 mm. The transverse diameter ranges from the minimum value of 26 mm to the maximum of 34 mm. The most common shape of foramen magnum observed in our study is oval(30%), followed by egg shaped (21%), round (19%), irregular (13%) and hexagonal (11%).

Conclusion: The present study provides the mean dimensions of foramen magnum in South Indian population which may be used as reference in analyzing the morphological anatomy of posterior cranial fossa.

Keywords: Foramen magnum; Skull; Morphology; Osteology; Foramen magnum Index.

Introduction

The morphology of foramen magnum has a critical role in posterior cranial fossa pathologies and craniovertebral junction disorders. Foramen magnumis of considerable clinical interest as the vital structures traversing it are compromised in several pathologies affecting the posterior cranial fossa.[1, 2]

During radiological assessment, landmarks such as basion which is the midpoint of anterior margin of foramen magnum and opisthion which is the midpoint of posterior margin of foramen magnum are required to assess craniovertebral junction relationships. These landmarks are used to perform basic craniometric measurements while assessing craniovertebral junction anomalies. [2]This study was undertaken to determine the morphometry of foramen magnum in the skulls belonging to south Indian population.

Objectives

1. To study the antero-posterior (sagittal) and transverse diameter of foramen magnum.
2. To determine the foramen magnum index.
3. To study the different shapes of foramen magnum.

Material and Methods

The study was conducted on 200 dry human skulls that were obtained from the Department of Anatomy of a private medical institutions. Skulls with intact foramen magnum were included in the study. The skulls with broken foramen magnum were excluded from the study. The antero-posterior and transverse diameters of foramen magnum were measured with a vernier calipers. The average of the two measurements were taken by the observer to reduce inter-observer bias.

a. The antero-posterior diameter was measured from the midpoint of anterior border (basion) to the midpoint of posterior border (opisthion).
b. The transverse diameter was measured from the point of maximum concavity on the right margin to the maximum concavity on the left margin.
c. The Foramen magnum index was calculated by dividing the anteroposterior diameter by the transverse diameter of the Foramen Magnum.

The different shapes of the foramen magnum are noted. The results were statistically analyzed and P-value< 0.05 is considered significant.

Results

Table 1: Dimensions of Foramen Magnum observed in the study.

Dimensions of Foramen Magnum	Mean	S.D
Anteroposterior Diameter	33.27	2.1
Transverse Diameter	27.13	2.41
Foramen Magnum Index	1.21	0.14

The mean antero-posterior and transverse diameter of the foramen magnum was recorded as 33.27 ± 2.1mm and 27.13 ± 2.4 mm respectively. The average foramen magnum index was calculated as 1.2 ± 0.14. The sagittal diameter ranges from the minimum value of 31 mm to maximum value of 38 mm. The transverse diameter ranges from the minimum value of 26 mm to the maximum of 34 mm.

Table 2: Variants in the shape of the Foramen Magnum.

Variants in shape of the Foramen Magnum	Frequency [Number]
Oval	30%[60]
Egg shaped	21%[42]
Round	19%[38]
Pentagonal	6%[12]
Irregular	13%[26]
Hexagonal	11%[22]

The pictures of different shapes of Foramen Magnum observed in the study are shown below.

Fig. 1: Round Foramen MagnumFigure.

Fig. 2: Hexagonal Foramen MagnumFigure.

Fig. 3: Oval Foramen Magnum.

Discussion

The values of sagittal diameter in the study is similar to the findings of Muthukumar et al, Archana Singh et al, while the results of Chethan et al was slightly lower than our study.[3,4,5] Table 3 shows the comparision of results of our study with previous studies. The sagittal diameter of the foramen magnum is significantly greater than the transverse diameter (P<0.05). This finding agrees with observation that oval foramen magnum is more common than other shapes.

Table 3: Comparision of morphometric data of our study with previous studies.

Authors	Sagittal Diameter		Transverse Diameter	
	Mean	S.D	Mean	S.D
Muthukumar et al[3]	33.3	-	27.9	-
Chethan et al[5]	31.0	2.4	25.2	2.4
Archana S et al[4]	33.79	2.6	28.25	1.83
Suresh et al[6]	34.17	--	28.86	-
Sanjay KR et al[7]	34.36	3.13	28.48	3.97
Present study	33.27	2.10	27.13	2.41

Table 4: Comparision of Foramen Magnum Index of our study with previous studies.

Authors	Mean	S.D
Chetan et al[5]	1.2	0.1
Zdilla et al[8]	1.14	-
Sanjay KR et al[7]	1.23	0.18
Present study	1.21	0.14

The transverse diameter noted in our study is similar to the findings of Muthukumar et al, while the results of Archana et al, Suresh et al, Sanjay KR et al were higher than our findings.[3,4,6,7] The variations in dimensions of foramen magnum noted in the study can be attributed to ethnic variations. Gruber et al observed a positive correlation between the sagittal and transverse diameters of the foramen magnum which is important to estimate the size of foramen magnum in skeletal remains.[9] Also, both the diameters showed poor correlation with femur length indicating foramen magnum cannot be relied on to estimate stature.[9] Both the diameters were reported to show an interindividual variability and both are normally distributed.[9] The foramen magnum is reportedto exhibit sexual dimorphism.[10] Elevated Intracranial pressure may lead to compensation via cerebellar tonsil herniation through the foramen magnum. The anatomy of the foramen magnum may influence the displacement of the herniated tissues.[8] The dimensions of the foramen magnum are critical in the management of anomalies such as craniosynostosis, increased intracranial pressure in Chiari Malformations, etc.

The commonest shape of the foramen magnum in the study was ovoid and the least common type is pentagonal, as shown in Table 5. Muthukumar et al reported that foramen was found to be ovoid when the foramen magnum index was >1.2.[3] The comparision of Foramen Magnum Index obtained in our study with previous studies is shown in Table 4. Several morphological variants of basion tubercles have been described including the tubercular, clubbed, and cup-like type. Presence of basion tubercle may diminish the sagittal diameter of the foramen magnum.[8,11,12,13]

Table 5: Comparision of frequency of variants in Shape of Foramen Magnum of our study with previous studies.

Authors	Population	Number	Oval	Egg shaped	Round	Tetra hedral	Irregular	Penta gonal	Hexagonal
Chethan P et al[5]	Mangalore	53	15.1	18.9	22.6	18.9	15.1	3.8	5.6
Archana Singh et al[4]	Uttar Pradesh	120	33.3	-	13.3	16.6	-	13.3	16.6
Sanjay KR et al[7]	Mangalore	40	22.5	12.5	17.5	12.5	10	12.5	12.5
Suresh et al[14]	Jaipur	62	35.48	19.35	17.74	11.29	4.84	1.61	9.68
Amit Singh Bharti et al[15]	Telangana	40	35	-	32.5	25	-	-	7.5
Present study	Karnataka	200	30	21	19	-	13	6	11

In 20% of the skulls studied the occipital condyle protruded into the foramen magnum.[3] Wide and sagittally inclined occipital condyles, medially protruberant occipital condyles along with a foramen magnum index of more than 1.2 will require much more extensive bony resection to expose lesions ventral to the brainstem.[3]

Chiarimalformationtype I (CM-I) is the displacement of the cerebellar tonsils 5 mm or greater below the foramen magnum radiographically. The size and area of the foramen magnum were significantly smaller in patients with classical CM-I and CM-I occurring with craniosynostosis and significantly larger in patients with CM-II and CM-I occurring with Tethered Cord Syndrome.[16] The anatomic proximity of a foramen magnum mass to the cerebellar tonsils, caudal medulla, lower cranial nerves, rostral spinal cord, and upper cervical nerves results in highly variable symptomatology that is commonly misdiagnosed.[17]

Conclusion

This study attempts to establish a baseline data of morphometric measurements of Foramen magnum in dry skulls belonging to South Indian population which would be valuable to clinicians, neurosurgeons and radiologists.

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A Morphometric Study of Nutrient Foramina in Dry Femur Bones

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Abstract

Background: The nutrient artery of femur usually arises from the second perforating branch of profunda femoris artery. Adequate bone blood flow is an important clinical consideration, particularly during fracture healing, distraction osteogenesis and osteoporosis.

Aim: The objective of the present study was to study the number, location and direction of nutrient foramen in the femur and also to determine the foraminal index of femur.

Material and Methods: The study included 100 femur bones (46 right and 54 left) which were obtained from the department of Anatomy of a private medical institution. The number, location and direction of the nutrient foramina were examined in all the femur bones. The foramen index (FI) was calculated by dividing the distance of the foramen from the proximal end (D) by the total length of the bone (L) and then multiplied by hundred.

Results: Majority of the femur bones had singlenutrient foramen (56%) followed by double (44%). Nutrient foramina in all the femur bones were directed upwards. The foraminal index observed in the study is 40.16±9.12.

Conclusion: Single nutrient foramen is more commonly seen along the linea aspera of femur bone. Nutrient foramen is more commonly located in middle third of the femur.

Keywords: Nutrient foramen; Femur; Linea Aspera; Foraminal Index.

Introduction

The nutrient artery of femur usually arises from the second perforating branch of profunda femoris artery. When two nutrient arteries are present, they are derived from first and third perforating branches.[1] Further, a nutrient artery for femur may also arise from fourth perforating artery.[2] The nutrient foramina of femur are directed proximally. They are located on the linea aspera and they vary in number and site.[3] 70% of the total bone blood flow is carried by the nutrient arteries to the diaphyseal cortex and marrow.[4]

Adequate bone blood flow is an important clinical consideration, particularly during fracture healing, distraction osteogenesis, osteoporosis, disuse osteopenia, and bone grafting.[5] This study was undertaken to determine the morphometry and topography of nutrient foramina of femurin the South Indian population.

Aim

The objectives of the present study was

1. To study the number, location and direction of nutrient foramen in the femur.
2. To determine the foraminal index of femur.

Materials and Methods

The study included 100 femur bones (46 right and 54 left) which were obtained from the department

of Anatomy of a private medical institution.

Inclusion criteria: Intact, completely ossified femur bones were included in the study.

Exclusion criteria: Damaged, deformed bones, bones with gross pathological deformities were excluded from the study.

The number, location and direction of the nutrient foramina were examined in all the bones. The foramina were studies with a magnifying lens. A 24 guage needle was used to confirm the patency of the formina. Only diaphyseal nutrient foramina were studied. The number and location of the nutrient foramina with respect to the borders and surfaces were studied. The foramina which were located within 1mm of the border were taken to be lying along the border.

The Femur was divided into 3 equal parts and topographical location of the foramen, whether the foramen was located in upper 1/3rd, middle 1/3rd, lower1/3rd was noted.

The foramen index (FI) was calculated by dividing the distance of the foramen from the proximal end (D) by the total length of the bone (L) and then multiplied by hundred. If more than one foramen is present, the larger foramen was taken into consideration to calculate the Foramen Index. The direction of the nutrient foramen was determined by passing the needle through the foramina.

Results

In the study majority of the femur had single nutrient foramen (56%) followed by double (44%) foraminas as shown in Table 1. Direction of the nutrient foramen in all the femur bones were directed upwards and the foraminal index observed is 40.16±9.12.

Table 1: The distribution of number and location of the nutrient foramina of femur observed in the study.

Number of nutrient foraminas	Number of femur bones		Total
	Right (46)	Left (54)	
Nutrient foramen	25	31	56
Nutrient foramina	21	23	44

Table 2: Location of the nutrient foramen of femur with respect to borders and surfaces observed in the study.

Position of nutrient foramen	Right (n=46)	Left (n=54)	Total
Linea aspera	41	46	87
Posterior surface	5	8	13
Medial surface	-	-	-
Lateral surface	-	-	-

Table 3: Location of the nutrient foramina of femur observed in the study.

Location of foramina in the femur	Present study
Upper 1/3rd	28(28%)
Middle 1/3rd	72(72%)
Lower 1/3rd	0

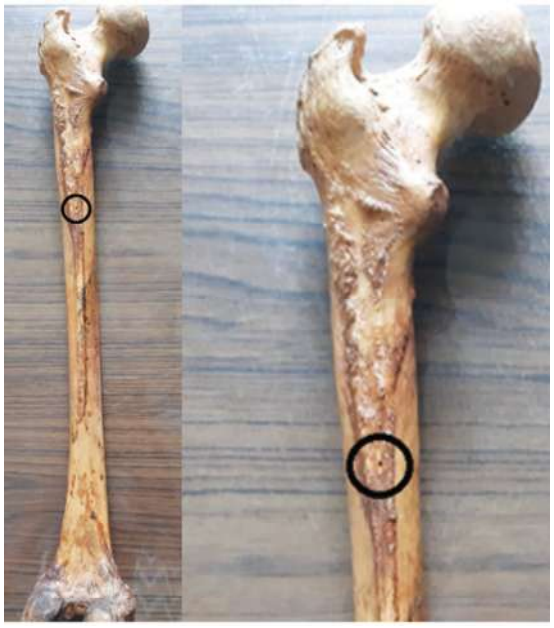

Fig. 1: Femur with single nutrient Foramen on the linea aspera located in upper 1/3rd of the length.Enlarged view of the nutrient foramen is shown in the circled part.

Discussion

The nutrient foramina in the femur bone is directed away from the knee which is the growing end. This is said to be due to one end of limb bones growing faster than the other.[6] The arrangement of the diaphyseal nutrient foramina in the long bones usually follows a definite pattern. There are often two nutrient foramina in the femur. In the femur the nutrient foramina are restricted to the linea aspera or to its immeiate neighborhood in the middle third of the bone.[6]

Table 4: Comparision of the number of nutrient foramina observed in the study with other studies.

Number	Author	N	Right N (%)	Left N (%)	Total N (%)
Single	Murlimanju et al[7]	86	-	-	47.7%
	Shreshta P et al[8]	151	57 (80.29%)	62 (77.50%)	119 (78.81%)
	Joshi et al[9]	50	-	-	34(68%)
	Abhijit et al[10]	50	10 (40%)	13 (52%)	23 (46%)
	Poornima et al[11]	100	-	-	62(62%)
	Present study	100	25(54%)	31(57%)	56(56%)
Double	Murlimanju et al[7]	86	-	-	44.2%
	Shreshta P et al[8]	151	13 (18.30%)	18 (22.50%)	31 (20.52%)
	Joshi et al[9]	50	-	-	16(32%)
	Abhijit et al [10]	50	15(60%)	11(44%)	26(52%)
	Poornima et al [11]	100	-	-	37(37%)
	Present study	100	21(45.65%)	23(42.59%)	44(44%)

In the study, we observed single nutrient foramen in 56 bones, double nutrient foramen in 44 bones. Our findings are similar to other studies which show that the frequency of occurrence of single nutrient foramen is more than double nutrient foramen as shown in Table 3. In bones having duplicated foramina, both should be treated as main ones, the presence of which is not surprising in view of the length of the bone.[6]

Table 5: Comparision of location of nutrient foramen observed in the present study with other studies.

Location of foramina in the femur	Authors			
	Joshi et al[9]	Roy et al[12]	Abhijit et al[10]	Present study
Upper 1/3rd	9 (18%)	17	12 (16%)	28 (28%)
Middle 1/3rd	41 (82%)	19	63 (84%)	72(72%)
Lower 1/3rd	-	1	0 (0%)	0

Table 6: Comparision of Foraminal Index with other studies.

Authors	Foraminal Index
Murlimanju et al[7]	38.9
Joshi et al[9]	45.58
Abhijit et al[10]	44.13±10.89
Parmar et al[13]	39.3 (± 8.22)
Present study	40.16±9.12

In our study, we noted that the nutrient foramens were located in the middle third of the femur in 72% of the cases and in upper third of the femur in 28% of the cases. Our findings are in concurrence with the results of other studies which show that presence of nutrient foramen in the middle one third of the femur in majority of the cases as shown in Table 5. Table 6 shows the foramen index obtained in our study in comparision with previous studies. The foramen index noted in our study is similar to the findings of previous studies which indicate that the nutrient foramina are more frequent in middle third of the femur.

Several studies have explored the number, course, location of nutrient artery supplying the femur in dry bones, cadavers, plain radiographs, MDCT. Imre et al studied the nutrient canals of the femur using multidetector computed tomography and observed negative correlation between the number of nutrient canals and the canal diameters. Most of the nutrient artery foramina were located in middle third of diaphysis. Imre et al also observed that majority (95%) of the nutrient artery canals were directed upward,some of them directed transversely (3%) and few of them directed downwards (2%).[14]

Henderson et al investigated the change in position of nutrient foramen of femur with age in rats. He observed that femoral nutrient foramen remained constant in position with increasing age, whereas the tibial nutrient foramen moved relatively nearer to the distal end of the shaft. This is due to differences in growth rates at the epiphyseal plates of the femur compensating for the disproportion in the distances of the foramen from the two plates.[15] Unilateral ligation of nutrient artery of the femur provokes an abnormal centripetal blood flow into the compact bone from the vessels in the periosteum.[4]

It has been suggested that the direction of the nutrient foramina is determined by the growing end of the bone. The growing end is supposed to grow at least twice as fast as the other end.[6] Bettina et al studied the cadaveric specimens while trying to determine the safe zones for avoiding perforators in proximal thigh studied. He observed that perforating arteries passed to the back of the thigh at every level between 14.0 and 36.5 cm from the anterior superior iliac spine (16-39% of the leg length). He also observed the high variability in the number and course of the perforating arteries.[16]

Yun et al studied plain radiographs to distinguish nutrient artery canals from fracture lines. They observed that when compared to fracture lines, nutrient artery canals have less radiolucency, small diameter and blunted ends.[17]

Conclusion

In the present study, we observed single nutrient foramen in 56 femur bones, double nutrient foramen in 44 bones. We noted the location of nutrient foramen in the middle third of the femur in 72% of the cases and in upper third of the femur in 28% of the cases. In our study, the foraminal index observed is 40.16±9.12. It was observed that nutrient foramen in all the bones were directed upwards.

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Original Article

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Anatomical Study of Origin of Sinuatrial Nodal Artery in Human Cadaveric Heart Specimens

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Abstract

Background: Sinoatrial Nodal artery is an artery which supplies the Sinoatrial node, the natural pacemaker center of the heart, usually a branch of right coronary artery but also from left coronary artery in variable percentage in different population.

Aim: The aim of the study was To establish anatomical origin of sinoatrial Nodal artery , from Right coronary artery or left coronary artery in Indian human cadavers.To observe relation of Sinuatrial nodal artery to the root of Superior Vena cava

Materials and Methods: The study was carried out on 64 formalin fixed Adult Human Cadaveric Heart Specimens of Indian population obtained from department of Anatomy, Sridevi Medical College, Tumkur and Adichunchanagiri Institute of Medical Sciences B. G. Nagara, Karnataka, India. Specimens with gross congenital anomalies were excluded from the study. The coronary arteries were dissected for the origin of sinoatrial Nodal artery.

Results: Out of total 64 cases studied, sinoatrial nodal artery was originating from right coronary artery in 34 (53.12 %) hearts, from left coronary artery in 17 (26.56 %) while in remaining 13 (20.31) hearts SA nodal artery was arising from both right and left coronary arteries. When it is arising from left coronary artery it is a branch of left circumflex artery rather than the main trunk.

Conclusions: The data extracted fromthis study will be helpful for cardiac surgeons during atrial surgical interventions, Radiologists and Anatomists. Further studies are needed in Indian population in relation to SA Nodal Artery. Study of origin and distribution of sinoatrial nodal artery helps cardiologist and cardiac surgeons to understand the ischemic etiology of sinus node diseases and corrective steps needed.

Keywords: Sinoatrial Nodal Artery; Right Coronary Artery; Ischemic; Cadaveric Heart.

Introduction

The sinoatrial nodal artery is anatomically significant, because it is the landmark for the identification of the sinoatrial node (SA node), which is the natural pacemaker of heart. The artery of SA node is an atrial branch distributed to both atria, mainly the right. Origin of the SA nodal artery is highly variable. In most of the cases it is a branch of right coronary artery (RCA), but in 35% cases it may arise from circumflex branch of left coronary artery (LCA). During its course, SA nodal artery (SANA) passes back in the groove between right auricular appendage and aorta. Then it divides into branches around the base of superior vena cava[1].

The artery supplying sinoatrial node mostly arises from the first segment of the right coronary artery, from its initial 1-2 cm. First branch of right coronary artery is Conal artery and second branch of the RCA is Sinoatrial Nodal artery. Sinoatrial Nodal artery also arises from left coronary artery (LCA). When originating from the LCA the artery is most

commonly a branch of the left circumflex artery rather than from the trunk of the artery. Origin of sinoatrial nodal artery from left main trunk has also been reported in few cases. Gray's anatomy describes the artery of the sinoatrial node as anatrial branch, distributed largely to the myocardium of both atria, mainly the right. Accurate identification of coronary arterial branches is important in the interpretation and description of coronary arteries, especially if surgery or angioplasty is considered[2].

The aim of the present study is to assess the normal anatomy and variations of SA nodal artery by studying number, origin, course and relation with superior vena cava.[3]

Materials and Methods

The study was carried out on 64 formalin fixed Adult Human Cadaveric Heart of Indian population obtained from department of Anatomy Shridevi Institute of Medical Sciences and Research Hospital, Tumkur and Adichunchanagiri Institute of Medical Sciences, B G Nagar, Karnataka. The study was conducted for a period of 2 years from 2018 to 2020. Human heart specimens of both sexes between the age of 18 to 80 years were included in the study. Any injured, damaged or pathological heart samples were excluded from the study. The specimens were numbered serially & fixed in 10% formaline for a week. Branches of coronary arteries were dissected in the conventional method after removing the epicardial fatty tissue. The details of origin, course & relation with Superior vena cava were noted.

Results

As shown in Table 01 and Figure 01 Out of 64 heart specimens, the SA nodal artery was arising as a single branch from RCA in 34 specimens (53.12%) as shown in Figure 2, from left circumflex artery in 17 (26.56 %)as shown in Figure 3 and in 13 (20.31%) specimens as shown in Figure 4 SANA was arising both RCA and LCX.

Sino atrial nodal artery was related to posterior aspect of Superior vena cava in all cadaveric heart specimens.

Table 1: Origin of SA Nodal Artery.

Origin of SA nodal artery	RCA	LCA	Both
No of specimens (64)	34	17	13
Percentage	53.12%	26.56%	20.31%

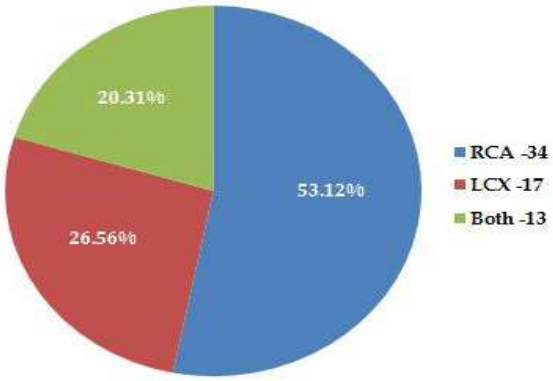

Fig. 1: Origin of SA Nodal Artery (RCA – Right coronary artery, LCX –Circumflex branch of Left coronary artery).

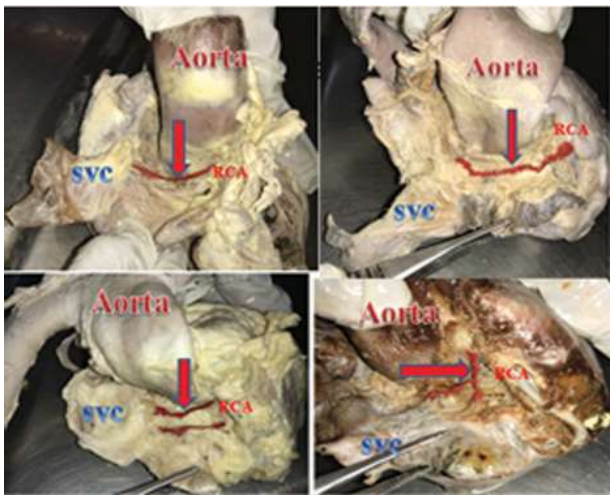

Fig. 2: SA Nodal artery arising from Right coronary artery.

Fig. 3: SA Nodal artery arising from Circumflex branch of Left coronary artery.

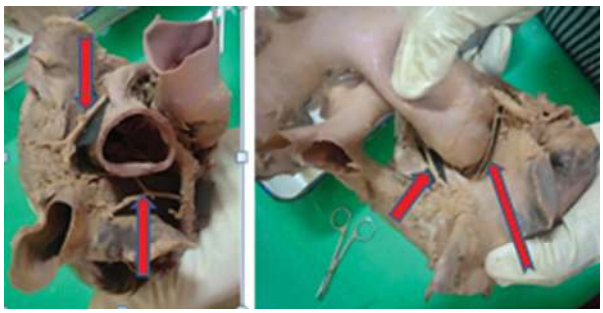

Fig. 4: SA Nodal artery arising from both right coronary and Circumflex branch of Left coronary artery.

Table 2: Comparision of percentage wise arterial distribution pattern of Sino atrial nodal artery origin.

SI. No	Author	Year	Sample size	RCA (%)	LCA (%)	Both (%)
1	Denis Berdajs (3)	2003	50	66	34	-
2	Anjali S Sabnis (4)	2012	110	90	10	-
3	Vidyasha-mbhava Pare (5)	2017	60	57	25	17
4	Mitchell Lee Milanuk (6)	2017	60	76.7	18.3	?
5	Priti Sinha (2)	2018	50	78	21.27	
6	Rekha Sinha (7)	2018	50	76	16	-
7	Lakshmi Prabha R (8)	2019	55	64	34	2
8	Present study	2020	64	53.12	26.56	20.31

Discussion

The present study of sinoatrial nodal artery in Indian cadaveric hearts, 34 out of 64 hearts (53.12%) received SA nodal artery from the right coronary artery,17 out of 64 hearts (26.56 %) from the left coronary artery and 13 out of 64 hearts (20.31%) from both right coronary artery, Circumflex branch of Left coronary artery.[4] When SA nodal artery was a branch of the left coronary, it arised most commonly from the circumflex branch of the left coronary artery andnot from the main trunk of the artery.[5] Thus a constant pattern of blood supply to the SA nodecomparable with that given in literature and other published reports was observed. Similar observations noted by a study done by Vidya shambhava Pare during 2017 where they have found in SA nodal artery arising from right coronary in 57% population, from circumflex branch of Left coronary in 25% population and from both right and left coronary in 17% population, which is almost near to values observed in the present study.[6] When we compare with remaining studies incidence of SA nodal artery arising from right coronary is higher in all studies and incidence of SA nodal artey arising from circumflex branch of left coronary is lower than the present study (2,3,4,6,7) as shown in Table - 02.

Gray'sanatomy states that the artery of the sino atrialnode is an atrial branch, distributed largely to the myocardium of both atria, mainly the right.[7] Its origin is variable; it came from the circumflex branch of the left coronary in 35% and from right coronary artery in 65% cases (1). Snell's anatomy has a similar view, stating that the artery of the sino atrial node supplies the node and the right and left atria and in 35% of individualsit arises from the left coronary artery.[9]

In cases of dual origin of SANA, the most common pattern was one branch arising from RCA and the other from LCx. Such dual supply would prevent ischaemia in vaso-occlusive disease of one of the coronary arteries.[8] When a single artery supplies the SA node, there is more chance of ischaemia leading to sick sinus syndrome.[10]

Conclusion

Origin and distribution of Sinoatrial nodal artery helps Cardiologist and Cardiac surgeons to understand the ischemic etiology of sinus node diseases. The SA node is the pacemaker of the heart situated at the junction of the superior vena cavaand the right atrium. The present study of Indian human cadaveric hearts the blood supply to SA node was from the sinoatrial nodal branch of the right coronary artery in 53.12% of cases, from the left coronary artery in 26.56% of cases from both in 20.31% of cases. In cases in which the SA node is supplied by the left coronary artery it is most often a branch of the circumflex artery rather than from the main trunk. SA nodal artery was related to posterior aspect of superior Vena cava irrespective of its source of origin.

Thus knowing the variations in the blood supply of SA node and study of origin and distribution of sinoatrial nodal artery helps cardiologist and cardiac surgeons to understand the is chemicetiology of sinus node diseases and corrective steps needed.

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Original Article

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Estimation of Stature from Ring Finger Length: A Quantitative Appraisal amidst Young Indian Population

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Abstract

Estimation of stature or height of a person is subject to variations during life due to muscular relaxation and elasticity of intervertebral discs but could be still valuable in identification. Stature estimation from dismembered body parts can be done based on the ratio of the body part concerned, in relation to the entire body. Many previous studies insisted that regression equation for stature estimation from various body measurements should be population specific. Since there is a need to develop a separate regression equation for estimation of stature from ring finger length for a particular population. So, the present study is undertaken with the aim, to determine correlation between ring finger length and stature of a person and to develop regression equation to estimate stature from ring finger length for both the sexes separately. The present study was carried in the Department of Forensic Medicine and Toxicology, ESIC Medical College, Kalburagi in collaboration with Department of Anatomy, AIIMS Rajkot. Total 140 students (70 males and 70 females) from ESIC Medical College, Kalburgi were randomly selected for the study. Preliminary data like age, sex and address were noted. Height, length of both right and left ring finger length of each student were measured. In the present study, stature shows good positive correlation coefficient with ring finger lengths. For males, Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.405 and 0.334 respectively which show moderate degree positive correlation. Similarly, for females Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.515 and 0.629 respectively which shows high degree positive correlation.

Keywords: Stature; Height; Ring Finger length; Regression equation; correlation coefficient.

Introduction

Estimation of stature or height of a person is subject to variations during life due to muscular relaxation and elasticity of intervertebral discs but could be still valuable in identification. Stature estimation from dismembered body parts can be done based on the ratio of the body part concerned, in relation to the entire body[1]. Identification of a dead victim often helps the police to trace the victim's movement, to know the background. If victim's identity is not known, it becomes difficult for the police to solve the crime. The identification of the dead body and corpus delicti is important before sentence is passed in murder trials[2]. Among identification data's stature along with age and sex are considered as primary characteristics of identification[2]. Many studies have established the relationship between stature and hand anthropometry[3-8]. Several authors have offered regression equations based on the length of long bones; however, it is well known that formulae that apply to one population do not always give accurate results for other populations. Pearson stated that a regression formula derived for one population should be applied to other groups with caution[9]. Many previous studies insisted that regression equation for stature estimation from

various body measurements should be population specific. Since there is a need to develop a separate regression equation for estimation of stature from ring finger length for a particular population. So, the present study "**Estimation of Stature from Ring Finger Length**" is taken with the aim,

a. To determine correlation between ring finger length and stature of a person.
b. To develop regression equation to estimate stature from ring finger length for both sexes separately.

Materials and Methods

The present study was carried in the department of Forensic Medicine and Toxicology, ESIC Medical College, Kalaburagi. Total 140 students (70 males and 70 females) from ESIC Medical College, Kalaburagi were randomly selected for the study. Preliminary data like age, sex and address were noted. Height, length of both right and left ring finger length of each student was measured during the time period of 2.00 pm to 4.00 pm to eliminate diurnal variation of height and by the same observer, using the same instrument to avoid personal error in methodology.

Inclusion criteria: Students aged between 18 and 25 years. This age group was chosen because the growth of an individual ceases by this age and there is no age-related loss in body height at this age.

Exclusion criteria: Subjects possessing injuries or deformities in the ring finger of the hand, history of skeletal injuries, and who are on any form of hormonal medications were excluded from the studies.

Method used for taking finger length: The length of the ring finger (RFL) of the left and right hand of each subject were measured with the aid of manual Vernier caliper, from the tip of the digit to the ventral proximal crease, where there was a band of crease at the base of the digit, the most proximal crease was used.

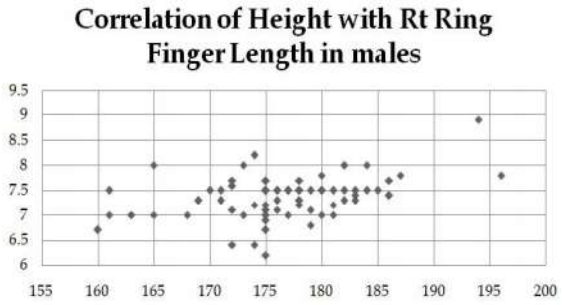
Method used for taking stature (height): Stature was estimated from vertex to the floor with feet axis parallel and head in Frankfort plane.

Observations

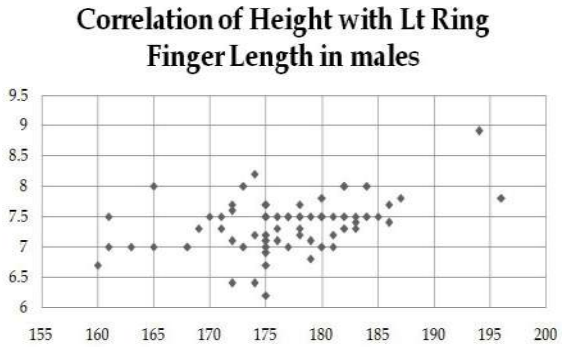
The statistical data which are extracted from calculation are tabulated in Table-1, Table-2, Table-3 & Table-4.

Table 1: Shows Average, Standard Deviation and Median for Height, Right Ring Finger and Left Ring Finger Length.

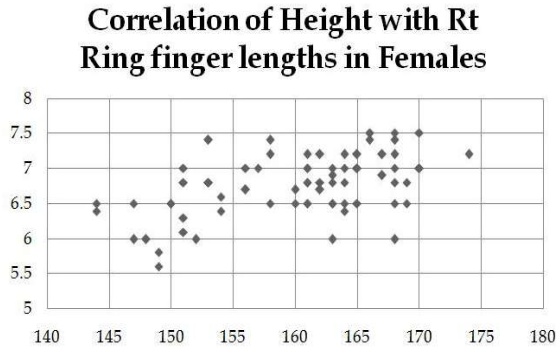
All in centi-meters	Average		Standard Deviation		Median	
	M	F	M	F	M	F
Height	176.66	160.21	6.69	7.22	176.66	162.0
Rt. Ring Finger Length	7.38	6.77	0.429	0.435	7.5	6.8
Lt. Ring Finger Length	7.37	6.76	0.429	0.407	7.5	6.8



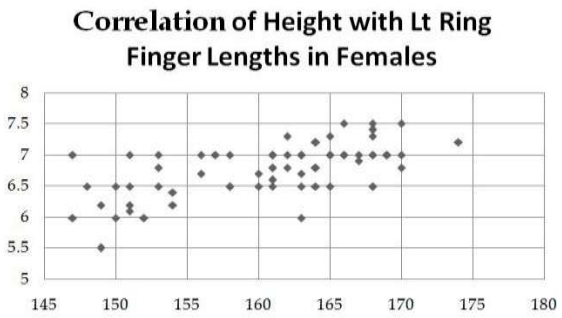
Graph 1: Scatter diagram showing Correlation of Height with Right Ring Finger Length in Males.



Graph 2: Scatter diagram showing Correlation of Height with Left Ring Finger Length in Males.



Graph 3: Scatter diagram showing Correlation of Height with Right Ring Finger Length in Females.



Graph 4: Scatter diagram showing Correlation of Height with Left Ring Finger Length in Females.

Table 2: Shows Correlation co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length separately for male and female.

Type of Correlation	Male	Female
Correlation of Height with Right Ring Finger length	0.405	0.515
Correlation of Height with Left Ring Finger length	0.334	0.629

For males, Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.405 and 0.334 respectively which show moderate degree positive correlation.

Similarly, for females Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.515 and 0.629 respectively which shows high degree positive correlation.

Table 3: Regression Formulae developed for stature estimation is shown in Table.

Participants	Regression Equation
Males	Height = 59.96 + 15.81X Right Ring Finger Length
	Height = 52.81 + 16.80X Left Ring Finger Length
Females	Height = 37.7 + 18.12X Right Ring Finger Length
	Height = 1.8 + 23.96X Left Ring Finger Length

Standard Error	Male	Female
Right Ring Finger length	6.215	6.286
Left Ring Finger length	6.215	5.699

Discussion

In the present study stature shows good positive correlation coefficient with ring finger lengths. For males, Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.405 and 0.334 respectively which show moderate degree positive correlation.

Similarly, for females Correlation Co-efficient of Height with Right Ring Finger Length and Left Ring Finger Length are 0.515 and 0.629 respectively which shows high degree positive correlation10. Whereas in a study done by Sharma R. and Dhattarwal S.K., shows correlation coefficient between height and RFL+0.30 in male and +0.15 in female. In male it shows moderate degree of correlation whereas in female it shows less degree of correlation.[11] In a study conducted by suseelamma et. al. also showed positive correlation in case of RFL with the stature in the genders.[12] Tyagi et al studied the subjects from Delhi and found positive correlation between stature and Ring & Index finger lengths and have suggested that index finger was best for the prediction of stature in both males and females.[13] Rastogi et al estimated stature from middle finger and noted a positive correlation that ranged from 0.504 to 0.696 between middle finger length and stature while studying the north and south Indian population.[14] According to study conducted by Bardale R. V., et. al., amongst males, correlation was higher between the ring finger length and stature (right hand r = 0.546 and left-hand r = 0.572). In females, correlation was higher between index finger and stature (right hand r = 0.618 and left-hand r = 0.612).[15]

Conclusion

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

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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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