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ORIGINAL ARTICLE

MORPHOMETRIC STUDY OF NUTRIENT FORAMINA OF 200 HUMAN RADII IN GUJARAT

Swati Shah[1], Shaista Saiyad[2]

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ABSTRACT: INTRODUCTION: radius is situated on the outer aspect of the forearm. Its anterior surface shows presence of nutrient canal transmitting nutrient artery. Nutrient artery is the major blood supply of long bone mainly during the growing period and early phase of ossification. **AIM AND OBJECTIVES:** Nutrient arterial supply is also essential for survival of osteocytes in procedures such as bone grafts. Location, number and position of nutrient foramen play an important role in academic, clinical as well as surgical cases. **MATERIAL AND METHODS:** This study was conducted in anatomy department, with the aim of Morphometric study of nutrient foramina of human radii. 200 human radii were studied at anatomy departments of SMT.NHLMMC, BJ medical college, Ahmedabad and Govt. Medical College Baroda. Observation and discussion: out of 200 human radii, in 197 radii there was single nutrient foramen on each radius and foraminal index was indicating that its position was near the upper end of radius. **CONCLUSION:** as per results of foraminal index, nutrient foramen in radius was located nearer to the upper end as compared to the lower end pointing towards the elbow. So the lower end of the radius is the growing end.

KEYWORDS: Long bones; nutrient foramina; nutrient arteries; foraminal index.

INTRODUCTION: The Radius (Radius = a ray or spoke of wheel)[1] is situated on the outer aspect of the forearm lying by the side with the ulna. Its upper end is small and forms only a small part of elbow joint. Its lower end is larger and forms chief part of the wrist.[2]

It is slightly curved longitudinally. It has a shaft and 2 ends.

The upper end of radius consists of a head, a neck, and a radial tuberosity. Body of shaft of radius consists of 3 surfaces and 3 borders. Surfaces are anterior, posterior and lateral surfaces. It has anterior, posterior and interosseous borders. Anterior surface lies between the anterior and interosseous borders. It is broader below and narrows above. The upper part of surface presents a nutrient canal which transmits nutrient artery. Nutrient canal is directed upwards in radius.[3]

The major blood supply to long bones occurs through the nutrient arteries which enter through the nutrient foramina. Nutrient foramina are cavities through which the nutrient arteries are conducted. The major blood supply of long bones is derived from nutrient arteries mainly during the growing period and during the early phases of ossification.

During childhood, long bones receive about 80% of the interosseous blood supply from the nutrient arteries, and in case of their absence, the vascularization occurs through the periosteal vessels[4].In bone grafts, the nutrient blood supply is crucial and it should be preserved in order to promote the fracture healing.

Artery development is primarily responsible for the nutrient channels form, rather than the bone development. Most of the nutrient arteries follow the rule, "to the elbow I go, from the knee I flee."[5] They are variable in position.

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AIM AND OBJECTIVES: The major blood supply to long bones occurs through the nutrient arteries which enter through the nutrient foramina. Nutrient foramina are cavities through which the nutrient arteries are conducted. The major blood supply of long bones are derived from nutrient arteries mainly during the growing period and during the early phases of ossification.[3]

Nutrient foramina play an important role in nutrition and growth of bones[6] Nutrient arterial supply is also essential for survival of osteocytes in procedures such as bone grafts, tumor resections, traumas, congenital pseudo arthrosis and in transplant techniques in orthopedics.[7]

The study of nutrient foramina is not only of academic interest but it helps in medico-legal cases in relation to their position. Important information of location, number and direction of nutrient foramina in human radii provides great aid in many surgical and clinical cases like bone grafts and internal fixation devices.

MATERIAL AND METHODS: This study was conducted in anatomy department, with the aim of morphometric study of nutrient foramina of human radii. 200 human radii were collected from anatomy departments of SMT.NHLMMC, BJ medical college and Govt. Medical College Baroda after taking the permission of the concerned head of the departments and authority of the department. Bones were dry and macerated. The bones were cleaned thoroughly.

Damaged and unossified bones were excluded. All the bones we studied were fully ossified and intact belonging to the adult persons. After labeling cleaned bones with site number, 200 radii were studied randomly not knowing age and sex and other characteristics of particular subject.
Total length of the radii with the help of the osteometric table and distance of nutrient foramina from its upper end and lower end were measured with the help of Vernier caliper.

OBSERVATION AND DISCUSSION: Most of the nutrient arteries follow the rule, "to the elbow I go, from the knee I flee." they are vary variable in position.[5]

Out of 200 human radii, 95 were right sided and 105 were of left side. The position of nutrient foramen was expressed as a percentage of the maximal length. The foraminal index was calculated by using the formula: I = Du/L X 100. (I=Foraminal Indexed Du=Distance from upper end L =Length of radius).

Mean	
F.I.	35.58
Length	238.5
distance from u.e.	84.22
distance from l.e.	154.28

Table 1

RIGHT SIDED RADII SHOWS THE ABOVE MENTIONED RESULTS:

Mean	
F.I.	36.5
Length	233.32
distance from u.e.	84.7
distance from l.e.	149.47

Table 2

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LEFT SIDED RADII SHOWS THE ABOVE MENTIONED RESULTS: The results on the nutrient foramina incidence and distribution in long bones are consistent with most studies. In this study, nutrient foramina were studied for location and number in radius bone. In most of the radii nutrient foramina were found on the anterior surface and one in number in most of the radii.

In 197 radius bones analyzed in this study have only one NF and may represent the only source of blood supply. I found 2 nutrient foramina only in 3 radii and it represents almost 1.5% of population. In 3 radius bones nutrient foramina were found on other than anterior surface. In 2 bones they were found on interosseous and in 1 bone on the posterior surface.

The analysis on the nutrient foramina distribution indicates that they are located predominantly on the anterior surface in radius. Anterior surface intervenes between the anterior and interosseous borders and is gently curved. Nutrient foramen is located near the middle of the shaft, pointing towards the upper end or elbow.

So the upper end of the radius is the growing end.[3] which corroborates with the results of my study on the localization of NF in the flexor surface of these bones in my study. Of all parameters examined in this study on Subjects from Gujarat, the FI was the one which came closest in comparison with previous studies on the Turkish and Spanish populations and in the bones of southern Brazilian population.[8]

Most of the radius bones analyzed in this study have only one NF and may represent the only source of blood supply. Thus, the areas of NF distribution must be, whenever possible, avoided during surgery. This study recorded data related to the population of Gujarat, providing ethnic data to be used for comparison, in medico-legal cases and may help in surgical procedures and interpretation of radiological images.

This study differ in the observation of number of nutrient foramina on radius because a single NF (100%) and two NF (0.63%) observed in previous studies[9] In 3 radius bones nutrient foramina were found on other than anterior surface. 2 radii shows presence of nutrient foramen on interosseous border and in 1 radius bone nutrient foramen was located on the posterior surface.

As the table shows, the mean foraminal index for left radius was 36.5 mm and for right radius was 35.58 mm.(Table 1) similarly, it was 35.7 as found by Pereira G.A.M. et al.[8]

The mean distance of nutrient foramina from upper end was 84.7 mm and 84.22 mm in left and right radius respectively.

Similarly, the distance from lower end for left and right radius was 149.47 mm and 154.28 mm. It was also seen that the mean length of left radius was 233.32 mm and of right radius was 238.5 mm.

CONCLUSION: The results of incidence of distribution of nutrient foramina in radii are consistent with most studies and indicate that in most of the bones they are located on the anterior surface of the bone. In this study also I found single foramen in most of the bones which may represent a single source of arterial supply, except in 3 cases where two nutrient foramina were located.

Foraminal index in radii measured in my study was 35.58 on right side and on the left side 36.5 Mean is 36.04, which is almost similar to that of the study done in subjects from Southern Brazil, which indicates Mean of foraminal index was 35.7.according these values in radii, nutrient foramina are located nearer to the upper end as compared to the lower ends, so upper end of the radius is the growing end.

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Thus, the areas where nutrient foramen is located must be, whenever possible, avoided during surgery. It helps in surgical procedures and in the interpretation of radiological images.

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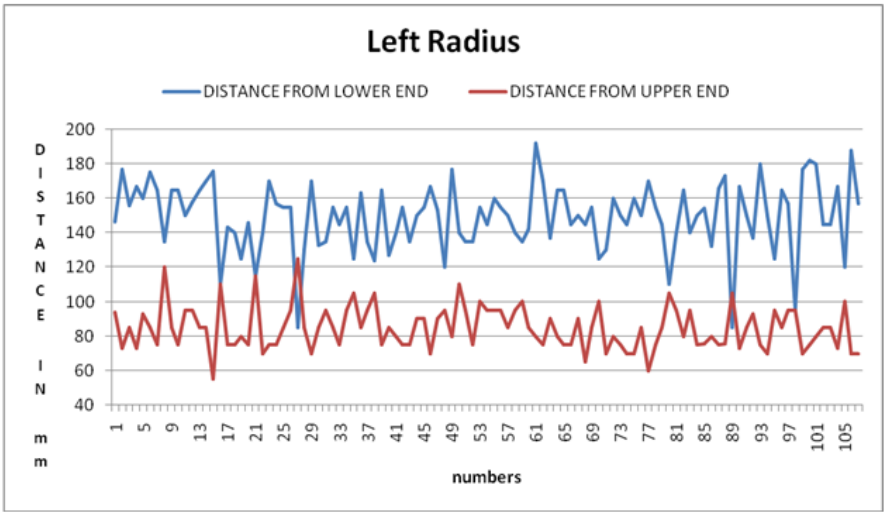
Mean	Left (n=107)	Right (n=93)
Foraminal index	36.5	35.58
Length	233.32	238.5
Distance from upper end	84.7	84.22
Distance from lower end	149.47	154.28
Range of distance from upper end	55 - 125	55 -125
Range of distance from lower end	85 – 192	105 – 210

Table 3: information about means for both sides



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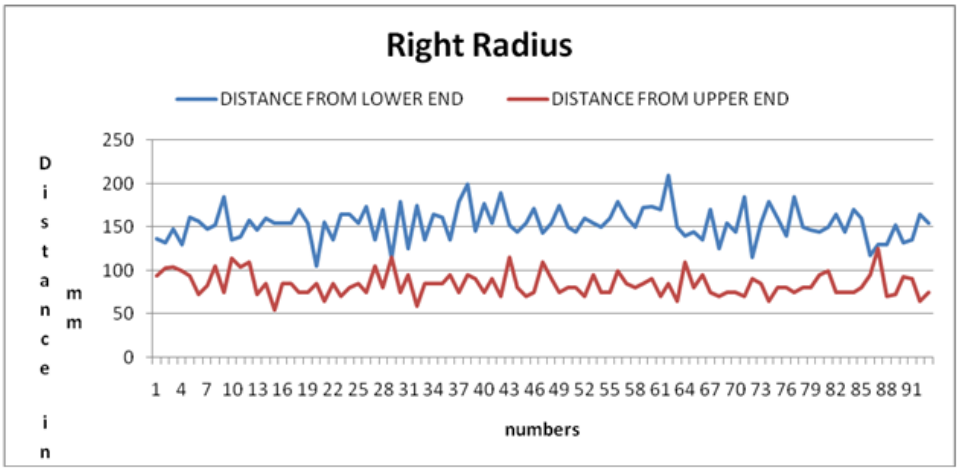

2 nutrient foramina on radius shown by circles

Nutrient foramen on anterior surface of radius

Distance of Nutrient foramen on radius from upper end

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AUTHORS:

1. Swati Shah
2. Shaista Saiyad

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anatomy, Smt. NHL Municipal Medical College, Ahmedabad.
2. Assistant Professor, Department of Physiology, Smt. NHL Municipal Medical College, Ahmedabad.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Swati Shah,
B/1, Sharanam, Shantikunj Bung.,
Shantikunj Society, Paldi,
Ahmedabad.
Email: swatidharmeshshah@gmail.com

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