Original Research Article

Morphological study of nutrient foramina of human radius and their clinical importance

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Abstract

Background: Radius is the lateral bone of forearm. It has anterior, interosseus and posterior surface. Anterior surface bears a nutrient canal at the upper end transmitting nutrient artery. Nutrient artery is the major source of blood supply of long bones mainly during growing period and early phase of ossification.

Aim and objectives: Nutrient foramina is essential for nutrition and growth for long bones and also for survival of osteocytes in some procedures such as bone graft, tumor resection, congenital pseudo-arthrosis, trauma and transplant techniques in orthopaedics. Study of nutrient foramina is important not only in academic purpose but also useful in medico-legal cases in relation to their position.

Materials and methods: Present study was conducted in the department of Anatomy, Indira Gandhi Institute of Medical Sciences, Patna, Bihar. 110 dry adult and macerated human radii were selected for study.

Results: In this study, out of 110 radii, 108 radii had single foramina and 2 radii had double nutrient foramina. Foraminal index was calculated which indicating nutrient foramina was near to the upper end.

Conclusion: Nutrient foramen in radius was near to the upper end, so the lower end of radius is the growing end.

Key words

Radius, Nutrient foramina, Foraminal index.

Introduction

The radius (radius-a ray or spokes of wheel) [1] is the lateral bone of forearm lying by the sides with the ulna. It is pre axial bone of upper limb and corresponds to the tibia of lower limb. It has upper end, lower end and shaft. Its upper end bears a head which is disc shaped and forms only small part of elbow joint. Its lower end is the widest part of bone which forms the main part of wrist [2].

Upper end consist of head, neck and radial tuberosity. Shaft is narrow above and broader below. It possesses 3 surfaces and 3 borders. Surfaces are anterior, posterior and lateral. Borders are anterior, posterior and interosseus.

Anterior surface lies between anterior and interosseus border. It is narrow above and broader below. A nutrient canal present in the upper end of anterior surface which is directed upward [3]. Nutrient artery which is a branch of anterior interosseus artery enters through nutrient canal are the major source of blood supply of bone mainly during growing period and during early phases of ossification. In case of their absence vascularisation occurs through periosteal vessels [4]. Nutrient canal becomes slanted during growth, the direction of slant points towards the ends that has grown least rapidly. This is due to faster longitudinal growth at the growing end. Nutrient foramen is directed towards the elbow in upper limb, while in lower limb, nutrient foramen directed away from knee. This occurs due to one end of bone grow faster than other and generally follows the rule," to the elbow I go, from the knee I flee".

The position of nutrient foramen is variable and may alter during growth phase. Knowledge of positions of nutrient foramen is important in operative procedure to preserve their circulation.

In bone graft, nutrient blood supply is important and it must be preserved to promote the fracture healing.

Aim and objectives

Nutrient foramina are cavity through which nutrient arteries enters. Major blood supply of long bones is mainly derived from nutrient arteries during growing period and during early phases of ossification [3].

Nutrient foramina is essential for nutrition and growth of long bones and it is essential for survival of osteocytes in some procedures such as bone graft, tumor resection, congenital pseudo-arthrosis, trauma and transplant technique in orthopaedics [5].

Study of nutrient foramina is important not only in academic purpose but also useful in medico-legal cases in relation to their position. Information about the location, number and direction of nutrient foramina in human radii are important in many surgical cases like bone graft and internal fixation.

Materials and methods

Present study was conducted in department of anatomy, Indira Gandhi Institute of Medical Sciences, Patna. 110 human radii were collected from Anatomy department, Indira Gandhi Institute of Medical Sciences, Patna and from undergraduate students of Indira Gandhi Institute of Medical Sciences, Patna. Bones were dry and cleaned thoroughly.

The bones which had damaged, gross pathological deformities and unossified bones were excluded.

110 human radii were studied randomly not knowing the age and sex. The nutrient foramina were distinguished by presence of groove leading to foramen. Total length of bone measured with

the help of osteometric table and distance of nutrient foramina from upper end lower end were measured with the help of vernier caliper (**Figure – 1 to 4**).

Figure – 1: Nutrient foramen on anterior and posterior surface.

Figure – 2: Nutrient foramen on lateral surface.

Figure – 3: Distance of nutrient foramen from upper end.

Figure – 4: Distance of nutrient foramen from lower end.

Results

The study was conducted in 110 human radii. Out of 110 human radii, 57 were right side and 53 were left side. 108 radii were single foramina on the anterior surface near upper end directed upwards. Double nutrient foramina were found in only 2 radii. One radius had nutrient foramina on the anterior and posterior surface while the one radius had nutrient foramina on the anterior and lateral surfaces. Mean length were 236.8 mm and 235.4 mm in right and left radii respectively. The mean distance of nutrient foramina from lower end were 152.4 mm and 153.1 mm in right and left radii respectively. Mean distance of nutrient foramina from upper end were 84.4 mm and 82.3 mm in right and left radii respectively. Position of nutrient foramina expressed as percentage of maximum length. The foramina index was calculated by using formula:

I=Du/L X 100
(I=Foraminal index, Du=distance from upper end, L=Length of radiu)

Observation of present study was as per **Table – 1**. Comparison of distance of nutrient foramina from upper and lower end of radius was as per **Graph – 1**.

Table - 1: Observations of present study.

Mean	**Right** (n=57)	**Left** (n=53)
Foraminal index	35.64	34.96
Length	236.8	235.4
Distance from upper end	84.4	82.3
Distance from lower end	152.4	153.1
Range of distance from upper end	55-120	52-123
Range of distance from lower end	118-182	112-179

Discussion

The results of the incidence and position of nutrient foramina in long bones are consistant with most of the studies. In my study, number and position of nutrient foremen were studied in radius bone. Nutrient foramina were found on anterior surface and only one in number in most of the radii.

In this study, out of 110 radii, 108 (98.18%) radius bone have single nutrient foramina and may represent only source of blood supply. Thus the area of nutrient foramina distribution must be avoided during surgery. Double nutrient foramina were found in only 2 cases and it represent 1.82% population. The foramen on radius most frequently occurs on anterior surface nearer to anterior or interosseous border and invariably above the middle part pointing upwards. In this study we found nutrient foramina on anterior surface in 108 radii, on the anterior and interosseous surface in 1 radius and on the anterior and posterior surface in 1 radius.

The absence of nutrient foramina in the long bones is well known [6, 7, 8]. In my study we don't find any radii with no nutrient foramina. In case of absence of nutrient foramina long bones are supplied by periosteal artery.

Foramina index calculated in radii in present study was similar with studies on southern Brazillian population [9]. The most important factor which affect nutrient foramina position, are the growth rates at the two ends of the shaft and bone remodelling [10]. Lacroix P [11] suggested that certain anomalous nutrient foramina directions found due to pull of muscle attachments on periosteum. The main blood supply of long bones, nutrient artery are vital during the active growth period and at the early phases of ossification [12].

Nagel A [13] described the risk of intraoperative injury during exposure of nutrient artery. So placed the internal fixation devices with minimum injury nutrient arteries. It is essential to know about the nutrient foramina during surgical procedure to preserve the circulation. This is also important for clinicians who are involved in bone graft surgical procedures.

In this study, the mean foraminal index for left radius was 34.96 and for right radius was 35.64. Similarly it was 35.7 as found by Pariera G.A.M., et al. [9].

The mean distance of nutrient foramina from upper end was 82.3 mm and 84.4 mm in left and right radius respectively.

Similarly the mean distance of nutrient foramina from lower end was 153.1 mm and 152.4 mm in left and right radius respectively. The mean length of left and right radius was 235.4 mm and 236.8 mm respectively.

Conclusion

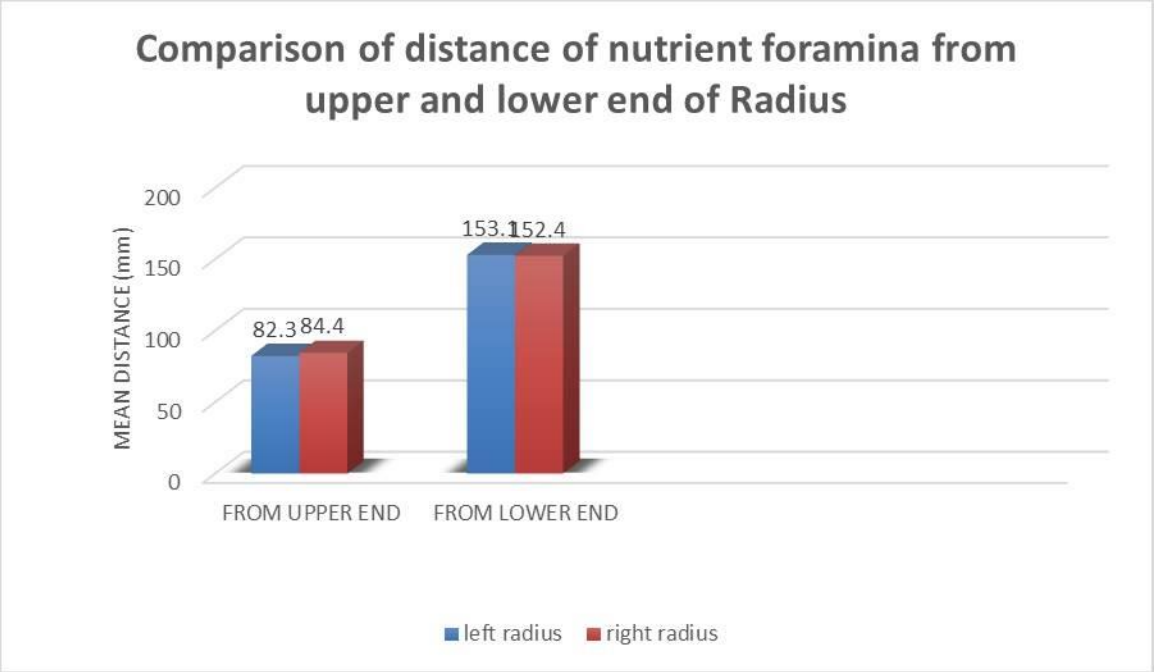
The results of incidence of numbers and position of nutrient foramina are consistent with most of the studies and in most of the bones located on

the anterior surface and upper end which is directed upwards. In this study, single nutrient foramen were found in most of the radii, which indicates the single source of blood supply except in two cases where two nutrient foramina were found.

Mean Foraminal index of radii were measured 34.96 in left and 35.64 in right radii respectively which mean is 35.30, which is similar to that of study done in subjects of Southern Brazil which indicates mean foraminal index was 35.7.

Thus the area where nutrient foramina are located must be avoided during surgery. It helps in surgical procedure and also in the interpretation of radiological images.

Graph – 1: Comparison of distance of nutrient foramina from upper and lower end of radius.



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