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MORPHOMETRIC STUDY OF NUTRIENT FORAMINA OF HUMAN RADIUS BONE AND THEIR CLINICAL IMPORTANCE.

Anatomy

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ABSTRACT

Introduction: Nutrient foramen is an opening into the bone shaft, which gives passage to the blood vessels of the medullary cavity of a bone. The major blood supply to the bone is through nutrient arteries, which enter through nutrient foramina. The supply is essential during the growing period and early phases of ossification.

Aim and objectives: Study of relative relationship between the length of bone and distance of nutrient foramen from either ends is useful in calculating the length of a bone from a given fragment, which is important in medico-legal and anthropological work. In free vascular bone grafting, the nutrient blood supply is extremely important and must be preserved to promote fracture repair, a good blood supply being necessary for osteoblast and osteocyte cell survival, as well as facilitating graft healing in the recipient.

Material and methods: Present study was conducted in the department of Anatomy Government Medical College, Jammu. 100 dry adult human radii were selected for the study.

Results: In the present study, out of total radii 52 radii were of right side and 48 were of left side. Out of 52 right side radii, 49 radii had a single nutrient foramen and 3 radii showed absence of any nutrient foramen. Out of 48 left side radii, 46 radii had single nutrient foramen and no nutrient foramen was seen on 2 radii of left side.

KEYWORDS

Radius, Nutrient foramina.

INTRODUCTION

The radius is the lateral bone of forearm. It is the pre-axial bone and corresponds with the tibia of lower limb. The radius presents upper and lower ends, and an intervening shaft **(Datta AK, 2005).**

The Shaft:

It is narrow above and broader below.
It possesses 3 borders, 3 surfaces.

Borders

1)Interosseous (medial) border: It is a sharp border except at upper part. It begins from postero-inferior part of radial tuberosity. At the lower end of it forms the posterior boundary of a small triangular area above ulnar notch of radius. It gives attachment to interosseous membrane in its lower three fourth part.

2)Anterior border: It begins just below antero-lateral part of radial tuberosity and runs down obliquely to lateral side. Its upper and lower parts are sharp.

3)Posterior border: It begins from the postero-inferior part of tuberosity and runs below to end in a dorsal tubercle at the back of lower part. It is prominent in its middle part.

SURFACES:

1)Anterior surface: It lies between anterior and interosseous borders. It presents a nutrient foramen above its middle part, which is directed upwards. The lower end is therefore the growing end of bone. Nutrient artery is a branch of anterior interosseous artery.

2) Posterior surface: It lies between interosseous and posterior borders.

3) Lateral surface: It lies between anterior and posterior borders. This surface is convex and encroaches upon anterior and posterior surfaces in its upper part because of the obliquity of the two borders. There is a rough ridge in the middle part of this surface. It lies opposite the maximum convexity of this surface.

Nutrient foramen is an opening into the bone shaft, which gives passage to the blood vessels of the medullary cavity of a bone. The major blood supply to long bones is through the nutrient arteries, which enter through nutrient foramina. This supply is essential during the growing period and during early phases of ossification **(Lewis OJ, 1956).**

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 J, 1974).**

The vital role of nutrient foramen in growth and nutrition of long bones is well known. The knowledge of position of nutrient foramen is important in surgical procedures like bone grafting and more recently in microsurgical vascularised bone transplantation **(Malukar O & Joshi H, 2011).**

Some pathological bone conditions such as developmental abnormalities, fracture healing or acute hematogenic osteomelitis are clearly related to the vascular system of the bone **(Skawina A & Wyczolkowski M, 1987).**

Study of relative relationship between the length of bone and distance of nutrient foramen from either ends is useful in calculating the length of a long bone from a given fragment, which is important in Medico-legal and anthropological work. An understanding of the location and number of the nutrient foramina in long bones is therefore important for orthopedic surgical procedures such as joint replacement surgery, fracture repair bone grafts and vascularised bone microsurgery as well as medico-legal cases.

AIM AND OBJECTIVES:

The present study is designed on dry human radius to study various morphological features of nutrient foramina.

MATERIAL AND METHODS:

The present study comprised of 100 dried human radii obtained from the department of Anatomy, Government medical college, Jammu. All the radii obtained were without any gross abnormality.

Each radius was labeled from 1 to 100 with suffix 'R' for right and 'L' for left radius bone.

The nutrient foramina were distinguished by the presence of groove leading to foramen and its number was noted. Direction of nutrient foramen was examined whether towards upper end or lower end. The position of nutrient foramen was noted in relation to the surface or borders of the bone and also location was noted. Total length of the bone was measured with the help of osteometric board and its distance from upper and lower end of the bone was measured with the help of sliding vernier caliper.

RESULTS: Out of 52 right sided radii, 49 showed presence of a single

nutrient foramen and 3 radii had absent nutrient foramen.

Out of 48 left side radii, 46 radii showed presence of a single nutrient foramen, absence of nutrient foramen was seen on 2 radii bones.

Radius was divided into three equal parts, upper 1/3rd, middle 1/3rd and lower 1/3rd, and the location of nutrient foramen was noted . On right sided radii, 36.5% nutrient foramina were located in upper 1/3rd and 57.6% were located in middle 1/3rd, while no nutrient foramen was located in lower 1/3rd of the bone. Among left sided radii, 37.5% foramina were situated in upper 1/3rd and 58.3% were seen on middle 1/3rd , while no nutrient foramina was located on lower 1/3rd of the bone. All nutrient foramina were directed towards upper end of the bone.

Position of nutrient foramina in relation to the surface of the bone were noted. On right sided radii, out of 52 bones, 37 nutrient foramina were located on anterior surface, 8 on interosseous border and 4 on posterior surface of the bones. Among left sided radii, 38 bones showed location of nutrient foramina on anterior surface, 4 on interosseous border and 4 on posterior surface of the bone.

Mean length of radius on right and left side radii were 239.6mm and 238mm respectively. The mean distance of nutrient foramina from lower end of the bone was 157.2mm and 153.3mm on right and left radii respectively. Mean distance of nutrient foramen from upper end of the bone was 84.5mm and 84.4mm on right and left side, respectively.

Table: showing comparison of mean distance of nutrient foramina from the upper and lower end of the radius with foraminal index.

Mean	Right (n=52)	Left (n=48)
Length of radius	239.6mm	238mm
Distance of nutrient foramina from upper end	84.5mm	84.4mm
Distance of nutrient foramina from lower end	157.2mm	153.3mm
Foraminal index	35.27	35.46

DISCUSSION

Nutrient Foramen: Location, number and position of nutrient foramen plays an important role in academic, clinical as well as surgical cases like bone grafts and internal fixation device The mean number of nutrient foramen in the present study is in accordance with the studies done on nutrient foramen by Gopalakrishna K et al, 2014 and Patel SM & Vora RK, 2015. In the present study most of the radii (95%) showed presence of a single nutrient foramen, which is in agreement with previous studies done by many authors. The incidence of the absence of nutrient foramen in present study (5%) is in consonance with the findings of Gopalakrishna K et al, 2014 who also found absence of nutrient foramen in 5.17% of the bones. In bones where nutrient foramen is absent, periosteal vessels become sole source of the blood supply. However, none of the radii in the present study showed presence of two nutrient foramina.

The distribution of nutrient foramen in the present study is in accordance with the study done by Gopalakrishna K et al, 2014. Maximum number of nutrient foramina were located on middle 1/3rd of the bone which is in concordance with similar studies done in the past by Vinay G and Kumar SA (2015), Roul B and Goyal M (2015). None of the studies including the present study showed the presence of nutrient foramina in the lower 1/3rd of the radii.

In the present study, maximum number of nutrient foramina were located on the anterior surface of the bone. The present study is in consonance with the studies done by Gopalakrishna K et al, 2014 and Mysorekar VR et al, 1967. Majority of the studies showed presence of nutrient foramina on the anterior surface of the radii.

In the present study, the distance of nutrient foramen from upper end is less, as compared to the lower end of the bone. That is, the nutrient foramen is located in upper part of the bone.

In the present study the direction of nutrient foramina was found to be towards the upper end of the bone which is in consonance with the previous studies done and follows the general rule “Towards the elbow I go, and away from the knee I flee”.

CONCLUSION

In the present study, single nutrient foramina was recorded in 95 bones and 5 bones showed absence of nutrient foramen. Maximum nutrient of nutrient foramina were located the anterior surface of the bone. The direction of all nutrient foramina were towards the upper end of the bone. Maximum number of nutrient foramina were located on middle 1/3rd of the shaft and mean distance of nutrient foramen from upper end was less than the distance from the lower end of the bone.

The present provides additional information regarding topography and morphology of nutrient foramina on radius bone, which is useful for clinicians in various procedures.

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