Original article

Morphometric study of nutrient foramina of human radii and their surgical importance

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Abstract:

Present investigation was to study the topographic anatomy and morphology of the nutrient foramina in human adult upper limb radius bone. The foraminal indexes were also determined.109 dry adult and macerated human radii were selected for study.Total length of the bone 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 sliding vernier caliper. Out of 109 human radii, 58 were right sided and 51 were of left side.Single nutrient foramen was present in 98.17% of radii. Double nutrient foramina of the radius were observed in only 2 cases (1.8%).In most of the bones, nutrient foramina are located on the anterior surface of the bone. 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.The present study has provided additional information on the foraminal index, morphology and topography of the nutrient foramina in Radius bones. The anatomical data of this subject is enlightening to the clinician for procedures of bone grafting.

Key words: Nutrient foramina, Nutrient arteries, Foraminal index, Radius

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Introduction:

Radius (a forearm bone) lies by the side of ulna on outer side of forearm. The upper part of bone presents a nutrient canal which transmits nutrient artery. Nutrient canal is directed upwards in radius.[1] Nutrient arteries which enters through the nutrient foramina are major source of blood supply of long bones mainly during the growing period and during the early phases of ossificationand in case of their absence, the vascularization occurs through the periosteal vessels.[2] Nutrient canal (through which nutrient artery enters the shaft) typically become slanted during growth, the direction of slant from surface to marrow cavity points

towards the end that has grown least rapidly. This is due to greater longitudinal growth at the faster growing end.

Nutrient foramen are directed towards elbow in upper limb (directed towards lower end of humerus and upper ends of radius and ulna),while in lower limb nutrient foramen is directed away from knee(that is, upper end for femur and lower ends of tibia and fibula) This is said to be due to one end of limb bones growing faster than the other and generally follows the rule, "to the elbow I go, from the knee I flee."

Their positions in mammalian bones are variable and may alter during the growth phase. The topographical knowledge of these nutrient foramina is useful in operative procedures to preserve the circulation.[3-5]Their probable role in few cases of vascular necrosis is pointed out.[6]

Bony defects as a consequence of traumatic injuries, tumor resection procedures, pseudoarthrosis are reconstructed by bone grafting proceduresand the preferred modality is free vascularized bone graft.Ideal bone graft for the free transfer should include endosteal and periosteal blood supply with good anastomosis.[5]

The importance of preoperative angiography remains important to exclude the possible vascular anomalies in both recipient and donor bones for the microvascularbone transfers.[7-8]Though there are few reports available on the morphology of nutrient foramina of the lower limbs, the upper limb foramina were rarely studied. The aim of the present investigation was to study the topographic anatomy and morphology ofthe nutrient foramina in human adult upper limb radius bone. The foraminalindexes were also determined.

Material and methods:

Present study was conducted in department of anatomy, HIMS, HIHT University, Jolly grant, Dehradun, Uttarakhand, India. 109dry adult and macerated human radii were selected for study. The bones were cleaned thoroughly. The bones, which had gross pathological deformities, damaged and unossifiedwere excluded from the study.

The 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.

Total length of the bone 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 sliding vernier caliper.

Results:

Out of 109 human radii, 58 were right sided and 51 were of left side. Results are presented in table 1.

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).

Table 1: Observations of Present study.

Mean	Right (n=58)	Left (n=51)
Foraminal index	35.32	34.21
Length	237.4	234.68
Distance from upper end	83.84	80.26
Distance from lower end	153.58	151.92
Range of distance from upper end	52 -121	53 - 124
Range of distance from lower end	116 – 185	110 – 181

Discussion

In the present study, we observed single nutrient foramina in 98.17% of radii. 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. Double nutrient foramina of theradius were observed in only 2 cases (1.8%).The radius has its foramen invariably above the middle part, towards the upper end. The foramen most frequently occurs on the anterior surface nearer to anterior or interosseous border. In the present study, 77.98%of the radius had the foramen at the anterior surface.

The absence of nutrient foramina in the long bones is well known.[4,9,10] In the present study, we did not found any radii with the absence of the nutrient foramina.

It was reported that in case the nutrient foramen is absent, the bone is likely to be supplied by periosteal arteries.

ForaminalIndex calculated in present study was found comparable with studies on southern Brazilian population.[11]

The well-known factors, which may affect nutrient foramen position, are the growth rates at the two ends of the shaft and bone remodeling.[3]Lacroix P[12]suggested that the pull of muscle attachments on periosteum explained certain anomalous nutrient foramina directions. Nutrient arteries, which are the main blood supply to long bones, are particularly vital during the active growth period and at the early phases of ossification.[13]

Nagel A[14] described the risks for intraoperative injury during exposure of the nutrient artery. Some suggestions were also offered for placing the internal fixation devices with minimal injury nutrient arteries. It was described that the knowledge about these foramina is useful in the surgical procedures to preserve the circulation. The findings are important for the clinicians who are involved in bone graft surgical procedures and are enlightening to the clinical anatomists and morphologists.

Conclusion:

In most of the bones, nutrient foramina are located on the anterior surface of the bone. Single nutrient foramina were observed in 98.17% of 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.

The present study has provided additional information on the foraminal index, morphology and topography of the nutrient foramina in Radius bones. The anatomical data of this subject is enlightening to the clinician for procedures of bone grafting.

Fig 1: Nutrient foramen of radius.

Fig 2: Distance of Nutrient foramen on radius from upper end.

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