ORIGINAL RESEARCH PAPER | Medical Science | Volume : 6 | Issue : 9 | September 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Morphometric Study of Nutrient Foramina of Human Radii - in Telangana Region

KEYWORDS: Nutrient foramina, Nutrient arteries, Foraminal index, Radius, growing end.

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ABSTRACT *Present study was to study the number and topographic anatomy of the nutrient foramina in human adult radius bone. The foraminal indexes were also determined.92 dry adult and macerated human radii of unknown sex were selected for study. Total length of the bone and distance of nutrient foramina from its upper end were measured. Number of additional foraminas also noted.Out of 92 human radii, 42 were right sided and 50 were of left side. Single nutrient foramen was present in80 of radii (86.1%) . Double nutrient foramina of the radius were observed in only 8cases (8.6%).no nutrient foramina observed in4 radii (4.3%). 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 and directed upwards, so lower end of the radius is the growing end. In maximal number bones nutrient foramina present on middle 1/3rd of radii.The present study has provided additional information of foraminal index, number 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 and various surgical procedures.*

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 ossification and 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 rapidly.

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 are reconstructed by bone grafting procedures and 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. The importance of preoperative angiography remains important to exclude the possible vascular anomalies in both recipient and donor bones for the microvascular bone 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 number and topographic anatomy of the nutrient foramina in human adult radius bone. The mean length and foramina -lindeces were also determined.

Material And Methods:

Present study was conducted in department of Anatomy, Osmnia Medical College, Hyderabad, Telangana state, India. 92dry adult and macerated human radii of unkown sex and age were selected for study. The bones were cleaned thoroughly. The bones, which had gross pathological deformities, damaged and un-ossified were 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 and distance of nutrient foramina from its upper end were measured with the help of vernier caliper.

The foraminal index was calculated by using the formula: F.I = DNF/L X 100.

(F.I=Foraminal Index, DNF=Distance of nutrient foramen from upper end, L =Length of radius). Aim of the present study is

I. To know the common position of nutrient foramina and its variations from the normal positions.
II. To know the number of nutrient foramina in the shaft of a particular bone.
III. To know the different position of nutrient foramina with reference to the surface of shaft long bone.
IV. To know the direction of nutrient foramina with reference to the growing ends of the bone.

Observations and Results:

Out of 92 human radii, 42 were right sided and 50 were of left side. Results are presented in (table- 1&2). Out of 92 bones80 (86.1%)bones showed single nutrient foramina,8 bones(8.6%) showed double nutrient foramina,4 bones(4.3%) showed no nutrient foramina at all (these bones might get their nourishment from periosteal arter-

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ies).Total numbers of nutrient foramen were 96, of which single nutrient foramen found in 80 bones(80 foramina) and double nutrient foramen found in 8 bones(16 foramina). Most of the nutrient foramen found in the middle 1/3rd, followed by upper 1/3rd but nutrient foramina present in lower 1/3rd is very rare out of 92 bones which have 96 foramina only two additional foramina are present in lower 1/3rd. Most of the additional foraminas are present on middle 1/3rd of the shaft of the radius (figure-1). Most of the foraminas present on anterior surface, followed by interosseous border , anterior border and least number of foraminas present on posterior surface. Nutrient foramina never present on lateral surface of radius , reason could benormally nutrient artery to radius either from the anterior interrosseous or posterior interrosseous arteries. All the nutrient foramen directed upwards i.e. towards elbow. Average length of radius was 23.2cms; average distance of nutrient foramen from the upper end was 8.83 cms (Table-3).

Discussion:

In the present study, we observed single nutrient foramina in 86.1% 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 the radius were observed in only 8 cases (8.6%). 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, out of 96 foramina 74 foramina present at the anterior surface,12 foramina on the interossous border,8 foramina on the anterior border and only 2 foramina on the posterior surface (these two are additional foramina not the main Nutrient Foramina) . The absence of nutrient foramina in the long bones is well known,in the present study also we have 4 radius bones without any Nutrient Foramina.[8,9,10] that means 4 radius bones with 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. Foraminal Index 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.3Lacroix 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 and various surgical intrventions 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 86.1% of radii. Nutrient foramina are located nearer to the upper end as compared to the lower ends and directed towards the upper end of the radius. So lower end of the radius is the growing end. The present study has provided additional information on the foraminal index, number and topography of the nutrient foramina in Radius bones.

Table -1: Distribution of number of Nutrient Foramina in Rt &Lt radius

Side of the bone	Total no of bones	Total no of foramina	No of nutrient foramina		
			0	1	2
Right	42	42	2	38	4(2+2)
Left	50	54	2	42	12(2+2+2+2+2+2)
	92	96	4	80	16

Table -2: Tophographic distribution of Nutrient Foramina in Rt&Lt radius

Side	No of bones	No of foramen	Upper 1/3rd	Middle 1/3rd	Lower 1/3rd	IB	AB	AS	PS
Right	42	42	10	32	-	2	4	34	2
Left	50	54	12	40	2	10	4	40	-
	92	96	22	72	2	12	8	74	2

(IB-Interosseous border, AB- Anteriror border, AS-Anterior surface, PS-Posterior surface)

Table-3 : showing mean values of various parameters

S. no	Mean value of	Right	Left
1	foramen index	35.7	38.65
2	length of radius	23.4 cm	23.0 cm
3	Distance of N.F from upper end	8.81 cm	8.85 cm
4	Range of N.F from upper end	5.8- 11.3 cm	6.5-18.5 cm

Figure-1showing additional foramina along with Main Nutrient Foramina -
A-Right Radius on anterior surface(middle1/3rd) & anterior border(upper1/3rd),
B-Left Radius on anterior surface (middle1/3rd). (above downwards)

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Volume : 6 | Issue : 9 | September 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

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