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Anatomy

VARIATIONS IN NUTRIENT FORAMINA OF RADIUS AND IT'S SURGICAL IMPORTANCE

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ABSTRACT The anterior interosseous artery is the principal nutrient artery of the radius, and preservation of its blood supply is essential in trauma, such as crush injuries, falls, and accidents, to prevent complications including malunion, non-union, and avascular necrosis. Detailed knowledge of the number, location, and distribution of nutrient foramina is important for orthopaedic procedures like fracture repair, bone grafting, and microsurgical interventions. **Objective:** To determine the number of nutrient foramina, identify their surface, and assess their position along the radius. **Materials and Methods:** 72 dry adult radii from the Department of Anatomy at MGM Medical College were studied. Only intact bones were included; damaged, fractured, unossified, or paediatric bones were excluded. Total bone length was measured using a Hepburn Osteometric board from the proximal aspect of the radial head to the distal tip of the styloid process. The number, surface location, and distances from proximal and distal ends of each foramen were recorded. The foraminal index (FI) was calculated to standardize foramen position relative to total bone length. **Results:** Among the 72 radii, 86.12% exhibited a single nutrient foramen, while 13.88% had no identifiable foramen. Most foramina (66.12%) were located on the middle third of the bone, and 82.25% were on the anterior surface. Variations in number and position were observed. **Conclusion:** The study provides data on the number, surface location, and foraminal index of nutrient foramina in the radius among the Maharashtra population. This information aids surgeons in planning orthopaedic procedures, including bone resections, grafting, and transplantation, by preserving the vascular supply and minimizing post-surgical complications.

KEYWORDS : Nutrient Foramen, Nutrient Artery, Radius, Foraminal Index

INTRODUCTION

Long bones receive their blood supply primarily from the nutrient, periosteal, metaphyseal, and epiphyseal arteries, with the nutrient artery being the main source of vascularization for the diaphysis during growth and repair.[1,2,3,4,5.]

The radius, a vital bone of the forearm, plays a central role in precise movements and manual labour, highlighting its functional importance in daily activities.

The nutrient artery of the radius is usually a branch of the anterior interosseous artery. It enters the bone through the nutrient foramen.[4,6] In some cases, however, it arises from the posterior interosseous artery.[4,8] When the nutrient foramen is absent, periosteal vessels predominantly maintain the bone's blood supply, ensuring its viability.[1,5,7,8]

Clinically, the radius is commonly fractured along with the ulna. It is frequently involved in orthopaedic interventions, including fracture fixation, bone grafting, and microsurgical procedures.[1,3,5,9] Preservation of its vascular supply is crucial for proper fracture healing and for preventing complications such as delayed union or non-union.[1,3,7] Therefore, detailed knowledge of the number, location, and surface distribution of nutrient foramina is essential for surgical planning and successful clinical outcomes.

Aim

To study anatomical variations in nutrient foramina of radius.

Objectives

- To find out the number of nutrient foramen.
- To identify the surface of nutrient foramina.
- To determine the position or zone of nutrient foramen along the radius

MATERIAL AND METHODS

This study was conducted in the department of Anatomy, MGM Medical College, Chhatrapati Sambhajinagar. After the approval of the Institutional Research and Ethics Committee, 72 radii were taken for the study, irrespective of their side. Damaged or fractured bones, unossified bones, bones with healed fractures, and bones from foetuses or children were excluded from the study.

The following instruments were used for calculation of various parameters of radius.

1) Hepburn Osteometric board,
2) Vernier calliper,
3) Hand lens,
4) Thread,
5) Scale,
6) Probe[1,9]

Parameters

Total length of bone was calculated from the proximal-most aspect of head to distal most point of styloid process. Diaphyseal nutrient foramen was identified, number of nutrient foramen was noted. The distance of nutrient foramen from proximal end was measured using Vernier calliper.

Surface and position of the nutrient foramen was documented. The foraminal index (FI) was calculated using the formula[10]:

$$FI = \frac{\text{Distance from the proximal end to the nutrient foramen}}{\text{Total bone length (TL)}} \times 100$$

And depending on Foraminal index, Radius was divided into different zone, for the position of nutrient foremen as follows –

Zone I (Upper 1/3rd of shaft) = FI < 33.33.
Zone II (Middle 1/3rd of shaft) = FI 33.33 - 66.66.
Zone III (Lower 1/3rd of shaft) = FI > 66.66.

This standardises the position of nutrient foramen from the values of foraminal index in radii of different lengths.The variations observed in the nutrient foramina of radius were also recorded. Data entry was done in Microsoft Excel systematically. Statistical Analysis of data was done by entry in Microsoft Excel and analysed using SPSS version 25.0th.

Observation

1. Number of Nutrient Foramen

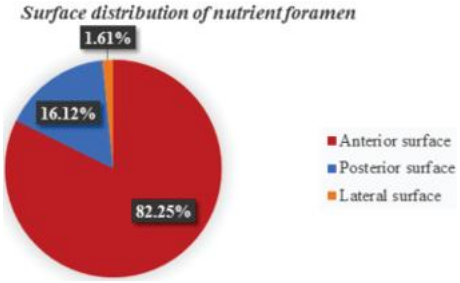
Out of 72 radii, 86.12% radii showed a single nutrient foramen, and 13.88% radii showed absence of nutrient foramen.

2. Surface of Nutrient Foramen.

Table 1: Surface Distribution of Nutrient Foramina in the Radius

Surface	Anterior surface	Posterior surface	Lateral surface
Radius (62)	82.25% (51)	16.12% (10)	1.61% (1)

Table no. 1 shows that out of 62 radii, (82.25%) are having nutrient foramina on anterior surface, fewer (16.12%) on the posterior, and very few (1.61%) on the lateral surface, indicating the anterior surface as the primary site. Graphical representation is given below in graph no. 1



Graph 1: Surface Distribution of Nutrient Foramen

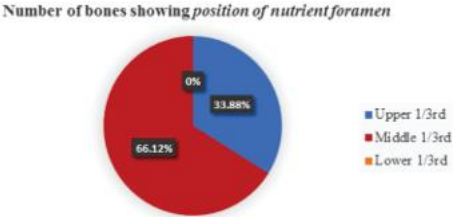
3. Position of Nutrient Foramen

Position of nutrient foramen was observed & to confirm the position, foraminal index was calculated & total length of radius was divided into 3 zones, as discussed earlier. This gives the comparable position of nutrient foramen in radii of different lengths. Position & the zones are depicted in graph no. 2 and table no. 2

Table 2: Number of Bones Showing Position of Nutrient for a Men

Position	Upper 1/3 (Zone I)	Middle 1/3rd (Zone II)	Lower 1/3rd (Zone III)
Foraminal index	25.41–32.92	33.33–48.81	Not observed
No. of Radii (total 62)	21 (33.88%)	41 (66.12%)	0 (0%)

In the present study, most nutrient foramina were located in the middle 1/3rd of shaft of radius (66.12%), while 33.88% were found in the upper 1/3rd. No nutrient foramina were observed in the lower 1/3rd. The foraminal index values ranged from 25.41-32.92 in Zone I and 33.33-48.81 in Zone II, confirming the predominance of nutrient foramina in the middle third of the shaft.



Graph 2: Number of Bones Showing Position of Nutrient Foramen

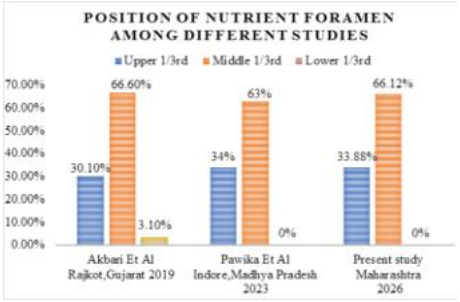
3. DISCUSSION

Table 3: Comparison of Number, Surface Distribution and Zonal Position of Nutrient Foramina in Radius Among Different Studies

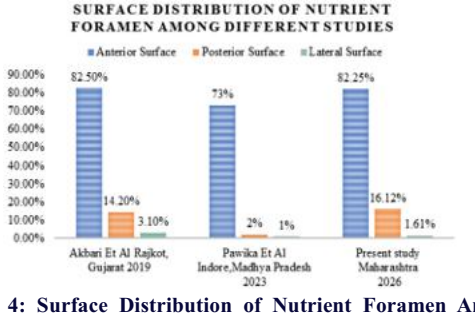
Sr. No	Study (Population)	Year	No. of Radii	No. of NF (%)			Position of NF (%)			Surface of NF (%)		
				0	1	2	Upper 1/3rd	Middle 1/3rd	Lower 1/3rd	Anterior Surface	Posterior Surface	Lateral Surface
1	Akbari Et Al Rajkot, Gujarat	2019	63	0% (0)	100% (63)	0% (0)	30.1% (19)	66.6% (42)	3.1% (2)	82.5% (52)	14.2% (9)	3.1% (2)
2	Pawika Et Al.Indore, Madhya Pradesh	2023	100	3% (3)	93% (93)	4% (4)	34% (34)	63% (63)	0% (0)	73% (73)	2% (2)	1% (1)
3	Present study. Chhatrapati Sambhajinagar, Maharashtra	2026	72	13.88% (10)	86.12% (62)	0% (0)	33.88% (21)	66.12% (41)	0% (0)	82.25% (51)	16.12% (10)	1.61% (1)

The radius is the most commonly fractured bone of the upper limb, particularly at its distal end. The knowledge of the morphology and distribution of nutrient foramina is therefore essential for orthopaedic procedures involving fracture management, bone grafting, microsurgeries, etc.

In the present study (2026), 86.12% of radii showed presence of a single nutrient foramen. 66.12% of radii showed that nutrient foramina were commonly located in the middle 1/3rd of the shaft. And 82.25% of radii showed that the nutrient foramen is present on the anterior surface. These findings are comparable with those reported by Akbari et al. (2019) and Singh Pawika et al. (2023). Table no. 3 summarises studies on nutrient foramina (NF) in the radius across different populations.



Graph 3: Position of Nutrient Foramen Among Different Studies



Graph 4: Surface Distribution of Nutrient Foramen Among Different Studies

CONCLUSION

From this study it can be concluded that presence of single nutrient foramen, on the middle 1/3rd of the anterior surface of shaft is the most common finding in radii of both sides.

Thus, this study contributes to valuable anatomical data of nutrient foramina of radius which can be used for major & minor surgeries involving radius.

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