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# Study on Nutrient Foramen of Humerus and Its Clinical Implication.

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***Abstract: Introduction****: Knowledge of the location and relevant anatomy of nutrient foramina is important in orthopedic technique to maintain vascularity. Non-union of fracture of shaft of humerus is most common complication. Nutrient artery along with other factor plays an important role in healing of fracture. Therefore the precise location of the nutrient foramen of the humerus should be known.* ***Material &Methods****: The study was conducted on 64 dried adult humerii in the Department of Anatomy, Rajendra Institute of Medical Sciences, Ranchi. The number, location, and direction of nutrient foramen were observed.* ***Observation****: The nutrient was single in 90.62%, double in 7.8% and absent in 1.56 % of bones. The maximum number of foramen present on anteromedial surface in 65.62% humerii followed by medial border in 21.87%humerii. Majority of foramen (81.25%) was present on middle third of the diaphysis of humerus. Direction of nutrient foramen in all humerii was distal.* ***Conclusion****: Knowledge of number, location and direction of nutrient foramina is important for an orthopedic procedure such as bone grafting.*
***Keyword****: Humerus, Nutrient artery, Nutrient foramina.*

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## I. Introduction

Humerus is largest and longest bone of upper limb. It is supplied by a nutrient artery which is a branch of brachial artery. The nutrient foramen is an opening in the shaft of bone which allows passage of blood vessels to the medullary cavity of a bone for its nourishment and growth. The nutrient artery enters the bone through nutrient foramen located on Anteromedial surface a little below its midpoint which is directed downward, opens close to the medial border. Their sites of entry and direction are almost constant and characteristically directed away from the dominant growing ends. Nutrient artery plays an important role during active growth period as well as formation of callus in fractured bone.[1]

In long bones, the nutrient foramen is found in the shaft, and in irregular bones, it is found in other locations. Long bones are supplied by four sets arterial system – Nutrient artery, epiphyseal, metaphyseal and periosteal arteries. Nutrient vessels enter the bone through these foramina and divide into ascending and descending branches in the medullary cavity and supply bone marrow and inner two-thirds of the compact bone[2.]

Healing of fracture or hematogenic osteomyelitis is closely related to the vascular system of bone[3]. Study of nutrient foramina in the upper limb is very important for morphological, clinical and pathological point of view. Knowledge of detailed anatomy of blood supply to the long bone has crucial role in orthopedic technique[4]. The present study was carried out to determine number, direction and location of nutrient foramen of humerus.

## II. Materials and Methods

The study was conducted on 64 dried adult humerii in the Department of Anatomy, Rajendra Institute of Medical Sciences, Ranchi. Exclusion criteria: Damage and deformed bone. Bones were divided into three zones; Zone I – upper 1/3rd, Zone II – middle 1/3rd and zone III –lower 1/3rd. All bones were observed for the number, direction, and location of nutrient foramen with respect to the surface and border. All the observation were noted and tabulated.

## III . Observation

In the present study out 64 humerii 32 were the right side and 32 were of left side.

**Table 1:** Number of nutrient foramen on humerus

| Number of Nutrient foramen | Right | | Left | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| 1 | 29 | 45.31 | 29 | 45.31 | 58 | 90.62 |
| 2 | 2 | 3.12 | 3 | 4.68 | 5 | 7.8 |
| Absent | 1 | 1.56 | 0 | ---- | ---- | 1.56 |

Single nutrient foramen was observed in 90.62% of bones; double nutrient foramina were observed in 7.8% of the bones and absent nutrient foramina were observed in 1.56% of the bones. All the nutrient foramina observed in humerus were directed distally.

**Table 2:** Location of nutrient foramen on humerus

| Location of Nutrient foramen | Right | | Left | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Anteromedial surface | 18 | 28.12 | 24 | 37.5 | 42 | 65.62 |
| Medial border | 10 | 15.62 | 4 | 6.25 | 14 | 21.87 |
| Lateral border | ---- | ---- | ---- | ---- | ---- | ---- |
| Anterior border | 3 | 4.68 | 4 | 6.25 | 7 | 10.93 |
| Posterior surface | 1 | 1.56 | ---- | ---- | 1 | 1.56 |

Nutrient foramina were most commonly observed on anteromedial surface (65.62%) of bones, followed by medial border in 21.87% bones, anterior border 10.93% and posterior surface in 1.56%.

**Table 3:** Location of Nutrient foramen with respect to zone of humerus

| Location | Right | | Left | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Middle 1/3rd | 24 | 37.5 | 28 | 43.75 | 52 | 81.25 |
| Junction of middle & lower 1/3rd | 7 | 10.93 | 4 | 6.25 | 11 | 17.18 |
| Lower 1/3rd | 1 | 1.56 | ---- | ---- | 1 | 1.56 |

In present study 81.25% have nutrient foramen located in middle 1/3rd, 17.18 % at the junction between middle 1/3rd and lower 1/3rd and 1.56% in lower 1/3rd.


**Fig 1:** Shows location of nutrient foramen (NF = Nutrient foramen)

## IV. Discussion

Blood supply of bone is a very important factor in healing of fracture[5]. Among all the bones of upper limb humerus have highest vascularity. It is mainly supplied by branch of brachial artery and also by branch of axillary, radial and unlar arteries[6] . In spite of proper treatment some of fractures fail to heal or some heal slowly. This indolent fracture healing may be related to the severity of the injury, poor blood supply, age, nutritional status of patient etc[7].

**Table 4:** Number of nutrient foramen observed by different authors

| Sl .no | Authors | 1 | 2 | 3 | Absent |
|---|---|---|---|---|---|
| 1. | Present study | 90.62% | 7.8% | ---- | 1.56% |
| 2. | Pankaj AKet al (2017)[10] | 80.86% | 13.42% | 0.29% | 5.43% |
| 3. | Khan AS et al (2014)[8] | 90% | 10% | ---- | 0% |
| 4. | Yaseen S et al (2014)[6] | 79% | 19% | 2% | ---- |
| 5. | Ukoha UU et al(2013)[9] | 66% | 18% | ---- | 26% |

In our study single nutrient foramina was present in 90.62% humerus, double in 7.8% and absent foramina in 1.56% of humerus. These findings well correlated with the finding of Khan AS et al [8].Yaseen S et al [6]in their study noted 3 nutrient foramen in 2% of humerus, but in the present study none of humerus show 3 nutrient foramen.

**Table 5:** Location of Nutrient foramen on humerus by different authors

| Sl .no | Authors | Anteromedial surface | Medial border | Lateral border | Anterior border | Anterolateral surface | Posterior surface |
|---|---|---|---|---|---|---|---|
| 1. | Present study | 65.62% | 21.87% | | 10.93% | ---- | 1.56% |
| 2. | Pankaj AK et al(2017)[10] | 84.23% | ---- | ---- | ---- | 3.16% | 12.11% |
| 3. | Roul B et al (2015)[11] | 89.92% | ---- | ---- | ---- | 1.55% | 8.53% |
| 4. | Khan AS et al (2014)[8] | 96% | ---- | ---- | ---- | 1.33 | 2.67% |
| 5. | Yaseen S et al(2014)[6] | 88.5% | ---- | ---- | ---- | 3.5% | 11% |

**Location of nutrient foramen with respect to zone of humerus**

Roul B et al [11] and Pankaj AK et al[10] in their study observed that nutrient foramen was found in middle 1/3rd in most of the cases and in lower 1/3rd by in few cases. This finding was also supported by a study done by Chandrasekaran S et al[7]. The result of the present study also correlates with this.

Carroll SE[5] ,observed that nutrient artery enters through the restricted Anteromedial surface in middle 1/3rd of humerus and that the surgeries which are done on the middle 1/3rd of the shaft of the humerus handled well without causing damage to nutrient foramen in order to prevent delayed unions or non-unions of the fracture.

The anatomical knowledge of nutrient foramen is important for orthopedic surgeons during operation on the humerus like microsurgical bone transplantation and bone grafting[12]. The precise location of nutrient artery before elective surgery also plays an important role in arterial anastomosis for vascularized grafts[13].

## V. Conclusion

Knowledge of number, location, and direction of nutrient foramina of humerus are very important for orthopedic surgeons who are involved in various surgical procedures like treatment of fracture and bone grafting.

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