ANATOMICAL VARIATIONS IN DIAPHYSEAL NUTRIENT FORAMINA OF HUMERUS IN CADAVERS FROM KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

OBJECTIVE: This study was aimed at analyzing diaphyseal nutrient foramina with reference to the variation in number, location, position and direction of nutrient foramina of the dry humerus.

METHODOLOGY: This analytical study was conducted on 75 adult humerus bones of cadavers from Khyber Pukhtunkhwa, collected from anatomy museum of Khyber medical college Peshawar and Khyber medical university institute of medical sciences (KMU-IMS) Kohat. The damaged bones and bones having pathological anomalies were excluded from the study. In each bone, the diaphyseal nutrient foramen was identified for location, position, number and direction. Measurement was taken through the osteometeric board. The data was statistically analyzed by using SPSS version 17.

RESULTS: Out of 75 humerus bones, 68 (90.67%) were having single nutrient foramen and in 74 (98.67%) humerus bones, nutrient foramina were directed distally. Mean distance of the nutrient foramina from the medial epicondyle of the humerus was 9.92±1.93cm in all bones; 10.44±1.92cm on the left sided (n=41) bones and 9.36±1.95cm on the right sided (n=34) bones. Overall, 96% (n=72/75) of nutrient foramina were located on the middle 1/3rd of anteromedial surface, 2.67% (n=2/75) on the posterior surface and 1.33% (n=1/75) on the antero-lateral surface. While 97.5% (n=33/34) of nutrient foramina on right humeri and 95.13% (n=39/41) of nutrient foramina on left humeri were located on antero-medial side.

CONCLUSION: Majority of nutrient foramina of humerus in our set up are single, directed distally and located on the middle 1/3rd of antero-medial surface, reflecting no marked anatomical variation in number, direction and location.

KEY WORDS: Diaphyseal Nutrient Foramina, Humerus, Anatomical Variation.

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INTRODUCTION

Nutrient artery is the main source of blood to a long bone. Nutrient artery of the humerus arises from the brachial artery or profunda brachi. Inner half of the cortex and medulla are vascularized by nutrient artery and the outer half of the cortex is nourished by periosteal vessel and these vessels do not provide an effective collateral supply to the medulla.[1]

The nutrient foramina of human long bones are traditionally described as being directed towards the elbow and away from the knee. The possible explanation of this description is that one end of the long bone of the limb is growing faster than the other.[2] Nutrient arteries play an important role during active growth period as well as uniting callus formation in fractured bone. Nutrient artery after entering the shaft through the nutrient foramina obliquely, divides into ascending and descending branches in the medullary cavity. Each branch divides into a number of small parallel channels that are terminated in the adult metaphysis by anastomosing with the epiphyseal metaphyseal and periosteal arteries.[3]

The main nutrient foramina of hu-merus are found in the middle 1/3rd of the anteromedial surface, although various variations have been reported in the number and position of the fo-ra-mina.[4] Any manipulation in this area in the form of close or open reduction may cause damage to nutrient arteries, lea-ding to non-union or delayed union The knowledge regarding the nutrient foramina helps the surgeon to avoid these complications during manipulation in the fracture of shaft of humerus.[5,6]

There are very few local studies from India[7-9] and one study from Pakistan[10] on variation of nutrient foramina of the humeral diaphysis. This study was aimed at analyzing diaphyseal nutrient foramina with reference to the variation in number, location, position and direction of nutrient foramina of the dry humerus in our set up.

METHODOLOGY

Seventy five dry adult humerus bones (right and left side) irrespective of the sex were collected from the museum of the Anatomy, Department of Khyber Medical College, Peshawar and Khyber Medical University Institute of Medical Sciences (KMU-IMS) Kohat. Study was conducted from Feb 2013 to July 2013. Shaft of humerus was divided into following zones - upper 1/3rd, middle 1/3rd & lower 1/3rd. Each zone was observed for antero-medial surface, antero-lateral surface and posterior surface. The diaphyseal nutrient foramina in each bone were identified. The following parameters were noted mainly in the distance of the nutrient foramina from the medial epicondyle, location of the nutrient foramina & direction of the nutrient foramina with respect to the humerus. Measurement was taken on the osteometric board. The data was statistically analyzed by calculating the percentage, mean, range and SD. When more than one foramina were present, the distance of the dominant was taken.

RESULTS

Out of 75 bones were studied, 34 (45.33%) were right sided and 41 (54.67%) were left sided. Mean distance of the nutrient foramina from the medial epicondyle of the humerus was 9.92±1.93cm in all bones; 10.44±1.92cm on the left sided (n=41) bones and 9.36±1.95cm on the right sided (n=34) bones (Table I).

Table II is showing number, location, direction of nutrient foramina in right and left humerus bones. In majority of cases (90.67%), there was only one nutrient foramen and in 9.33% of cases there were >1 nutrient foramina of humerus bones. Right and left humerus bones had single nutrient foramen in 91.18% and 90.2% cases respectively.

In 72 out of 75 (96%) humerus bones, nutrient foramina were located on antero-medial surface of the humerus bones. Location of nutrient foramina was anteromedial in 97.06% and 95.12% of right and left humerus bones respectively.

In majority (98.67%) of the cases, nutrient foramina were directed distally. Distal direction of foramina were seen in 97.06% & 100% of right and left humerus bones respectively.

TABLE I: STATISTICAL PARAMETERS OF ANATOMICAL LOCATION OF NUTRIENT FORAMINA

Statistical parameters	Distance of the nutrient foramina from medial epicondyle		
	Right Humerus	Left Humerus	Total
Number	34	41	75
Mean	9.36	10.44	9.92
Standard deviation	1.95	1.92	1.93
Minimum	7.8	8.1	7.8
Maximum	16.7	16.9	16.9

DISCUSSION

In this study of 75 humerus bones, majority (90.67%) was having single nutrient foramina and in 98.67% cases, nutrient foramina were directed distally. In 96% of nutrient foramina were located

TABLE II: NUMBER, LOCATION, DIRECTION OF NUTRIENT FORAMINA IN 75 HUMERUS BONES

Description of Nutrient Foramina		Right Humerus		Left Humerus		Total	
		Frequency (n=34)	%age	Frequency (n=41)	%age	Frequency (n=75)	%age
Number of nutrient foramina	One nutrient foramen	31	91.18	37	90.2	68	90.67
	More than one nutrient foramina	3	8.82	4	9.7	7	9.33
Location of nutrients	Antero medial surface	33	97.06	39	95.12	72	96
	Antero lateral surface	0	0	1	2.44	1	1.33
	Posterior surface	1	2.94	1	2.44	2	2.67
Direction of nutrient foramina	Distal	33	97.06	41	100	74	98.67
	Proximal	1	2.94	0	0	1	1.33

on the middle 1/3rd of anteromedial surface, very few on the posterior surface or antero-lateral surface.

The knowledge of the blood supply to the shaft of humerus is important in knowing the healing of fracture, delayed union and non-union of the bone.[5,6,11] Non-union of the humeral shaft is a difficult clinical problem. Surgeon can minimize this complication by avoiding damage to a limited area of the cortex of humerus containing nutrient foramina, particularly in open reduction. Variations in position and direction of nutrient foramina have been documented in human long bone.[12] Mysoreker VR[2] & Caroll SE,[5] in their studies stated that surgery or fracture in distal and middle 1/3 of the shaft of the humerus leads to the poor healing compared to fracture of proximal half of the bone which is unlikely to compromise the blood supply.

In the present study, mean distance of the nutrient foramina from the medial epicondyle of the humerus on the left side was 10.44±.8.1cm and on the right side was 9.36±1.95cm. These figures correlate with a study of Omer N, et al[10] where the mean distance between these point was 11.99 cm. Average distance from the proximal end of the humerus to the nutrient foramen was showed as 16.96 cm by Anusha P, et al[9] and 18.97±1.85 cm by Ukoha UU, et al.[13]

In our study, majority of bones had single nutrient foramen. More than one nutrient foramen were observed in 51% cases by Nagel A[6], 37% by Joshi H, et al[7], 34% by Ukoha UU, et al[13], 30% by Sharma M, et al,[5] and 19.23% by Gopalakrishna K.[14] These figures are much higher than our figures of 9.33%. However, our results are in agreement with 5.49% by another Pakistani study.[10]

In present study out of total 75 hu-merus, 96% nutrient foramina were located on the anteromedial surface, 2.66% on the posterior surface and 1.33% on the anterolateral surface. These findings are supporting other studies showing 90.8%[13], 84%,[15] 77%[7] and 70.97%[14] of nutrient foramina of humerus on anteromedial surface of the shaft. Anusha P, et al had 67.2% of nutrient foramina on anteromedial surface and 19% on the posterior surface.[9]

It has been documented that the main blood supply to the shaft of the humerus is through a restricted area and one must be careful to guard against injuring this vessel in operation on the shaft of the humerus.[16] A posterolateral approach is therefore recommended to minimize damage to the blood supply of the humerus and limiting the chances of delayed or non-union in fracture shaft of the humerus. The number of nutrient foramina did not show any relation to the length of humerus in our study. Chhatrapti DN, et al studied the position of the nutrient foramina of the long bones and concluded that a single bone may have more than one nutrient foramen irrespective to the length of long bone.[17]

CONCLUSION

Majority of nutrient foramina of hu-merus in our set up are single, directed distally and located on the middle 1/3rd of anteromedial surface, reflecting no marked anatomical variation in number, direction and location. As nutrient artery is the major source of blood supply to the medullary wall of bone, therefore, this region should always be avoided during surgical procedure and posterolateral approach should be adopted.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

ASK: Conception and design, acquisition of data, drafting the manuscript, final approval of the version to be published

ZS: acquisition and analysis of data, drafting the manuscript, final approval of the version to be published

QI: critical revision, final approval of the version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Author declares no conflict of interest

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