

Original research article**A Morphological Study of Adult Humerus**

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Abstract

Back ground: Humerus is the long bone located in the arm. The Nutrient foramen is an opening in the bone shaft. It allows the passage of nutrient artery which gives nourishment to the bone. The nutrient artery is the principal blood supply for long bones. Supratrochlear foramen is a small hole located at the distal epiphysis of the humerus. The supratrochlear foramen communicates the olecranon fossa with the coronoid fossa & is present over the trochlea of lower end of humerus. The main aim of the study is to determine the location, number and direction of nutrient foramen in relation to the growing end of adult humeri and also to observe the morphological features like incidence and shape of the supratrochlear foramen.

Material and Methods: A total number 100 adult humeri were used for this study. The bones were observed for direction, location and number of nutrient foramen and incidence and shape of the supra trochlear foramen. The collected data was analyzed by using the SPSS software and the results were tabulated.

Results: In the present study 95% of bones have single, 4% have double and 1% have triple nutrient foramina respectively. The location of nutrient foramina is found to be antero- medial surface in majority of the bones 94%, posterior surface in 4%, anterolateral surface in 1% and absent in 1% of bones. The direction of nutrient foramen is towards the elbow joint. In majority of the bones 91% nutrient foramina were located in the mid third of shaft of humerus, 8% in lower third and 1% in upper third. The supra trochlear foramen is seen in 18% of the bones. Among the 18 bones supra trochlear foramen is round in 10 humeri and oval in 8.

Conclusion: The chief blood supply to the shaft of humerus is by a nutrient artery passing through the nutrient foramen. The knowledge of the location and direction of nutrient foramen is useful in surgical procedures done over humerus such as open reduction of fracture humerus, in newer transplantation and bone grafting techniques being attempted by orthopedic surgeons. The incidence of supratrochlear foramen is varies from one population to other. Knowing the incidence in this population will be helpful to the orthopedic surgeons and radiologists for operative procedures and diagnosis.

Key words: Nutrient artery, Nutrient foramen, Supratrochlear foramen, Humerus.

Introduction

The vascular supply to all long bones is mainly through epiphyseal, periosteal & nutrient vessels. To the shaft of the long bone the chief vascular supply is by nutrient artery especially during its growing phase. The nutrient artery enters the bone through an orifice within the shaft called as nutrient foramen. The nutrient foramen leads to an oblique nutrient canal through which the nutrient vessels enters and reaches the medullary cavity. The direction of nutrient foramen is always directed against to the growing end ^[1] of the long bone.

Humerus being the largest and longest bone of the upper limb gets its blood supply from branches of axillary, brachial, ulnar and radial arteries. The humeral shaft has one or two main nutrient arteries entering the nutrient foramen located on its anteromedial surface in mid third of the shaft. It is obliquely placed, directed towards the elbow joint there by obeying the general rule that the nutrient artery is supposed to be directed away from its growing end i:e away from its upper end in case of humerus.

At the lower end of humerus a thin septum separates the olecranon and coronoid fossae. The thickness of the septum varies. A perforation in the septum causes the formation of supratrochlear foramen. The mechanical and genetic factors may be responsible for the formation ^[2]. The supratrochlear foramen of the humerus has been overlooked in standard literature. The anatomical knowledge of supratrochlear foramen will be useful for clinicians.

The present study is meant for learning more about the location, direction and number of nutrient foramina and also the incidence and shape of the supratrochlear foramen in adult humerus.

The knowledge of nutrient foramen and supratrochlear foramen is useful in clinical practice. The bone

growth and repair is mainly dependent on its blood supply. Any damage or trauma to the nutrient artery passing through it which might happen in surgeries done over humerus can cause devascularization and delay in the healing process. A sound knowledge about the incidence and shapes of the supratrochlear foramen will help radiologist and orthopedic surgeons to improve the diagnostic approach and management of pathological conditions of the distal humerus.

Material and Methods

After getting the permission from Institutional ethics and research committee we have conducted this study in the Department of Anatomy, Sri Venkateswara medical college, Tirupati. This study was conducted on 100 (50left &50 right side) adult dry humeri available in the department of Anatomy during the period of January 2022 to August 2022. Damaged bones were excluded from the study. The collected bones were observed for nutrient and supratrochlear foramina. The nutrient foramen was observed with the help of hand lens and circled for identification. The location, direction and number of nutrient foramina was observed. The supratrochlear foramina were observed for its shape and duly noted. The observations were tabulated and statistically analyzed.

Results

Among the 100 bones studied, 50 were right and 50 were left sided. The details regarding the number of nutrient foramina are presented in table 01 and figure.no.01

Table 1: Number of nutrient foramina

Number of nutrient foramina	Right		Left		Total Percentage %
	Number	Percentage %	Number	Percentage %	
Single	48	48	46	46	94
Double	01	1	3	3	04
Triple		-	1	1	01
ABSENT	01	1	--	--	01



Fig 1: The left humerus showing triple nutrient foramina.

In majority of bones the location of the nutrient foramina was on anteromedial surface followed by posterior and anterolateral surface respectively. The details of the location of nutrient foramina are presented in table 02 and figure: 02.

Table 2: Location of Nutrient Foramina

Location	Right		Left	
	Number	Percentage%	Number	Percentage %
Antero- medial surface	47	47	47	47
Posterior Surface	02	02	02	02
Anterolateral surface	0	0	01	01
Absent	01	1	0	0
Total	50	50	50	50



Fig 2: Humeri showing nutrient foramen on posterior surface

Most of the nutrient foramen were located in mid-third of the shaft of in 90% of humeri followed by the lower third in 8% (figure.03), a mere 1% upper third and absent in 1%. The direction of nutrient foramina were found to be directed obliquely downwards towards the elbow joint in all the humeri i:e away from its upper end which is the growing end of humerus.

The supratrochlear foramina were observed in 18% of humeri. Among the 18 bones,12 were left sided and 06 where right sided. The shape of the supratrochlear foramina was observed as round, oval and triangle in outline. The details of the shape of the supratrochlear foramina are presented in table 03.

Table 3: Shape of the Supratrochlear foramina (figure 04&05)

Shape	Bone		Total %
	Right sided	Left sided	
Oval	01(5.5%)	07(38.8%)	44.5
Round	05(27.7%)	04(22.2)	49.9
Triangle	0	01(5.5%)	5.6
Total	06	12	100



Fig 3: Nutrient foramen at the lower third of the shaft of the humerus.



Fig 4: Right humeri showing the supratrochlear foramina



Fig 5: Left humeri showing the supratrochlear foramina

Discussion

The blood supply to any bone holds paramount importance in its growth or healing after a fracture. Humerus is a bone located in the arm spanning from the shoulder joint to the elbow joint. Being the largest bone of the region its shaft is also supplied by the biggest branch of the artery present around the bone i.e the Profunda Brachii of the Brachial artery. Profunda brachii gives a nutrient artery which enters the shaft through a single nutrient foramen located on the anteromedial surface in mid-third of the bone directed towards the elbow joint. Any surgeries done over this region such as open reduction of fracture humerus or bone grafting definitely hold a danger of damaging the nutrient artery which will hamper the healing process. Hence for surgeons operating upon the humerus, having a better idea of the nutrient artery and its course surely helps in preventing non-union or delayed healing^[3].

Table 4: Number of nutrient foramina found in this study Vs the previous studies done on the same

Name of the author	Number of nutrient foramina (%)				
	One	Two	Three	Four	Absent
Islam Mansur <i>et al.</i> ^[4]	60.87	28.85	6.32	1.98	1.98
Durga Sukumar <i>et al.</i> ^[5]	79.51	13.93	3.28	--	3.28
Poudel <i>et al.</i> ^[6]	88	16	---	---	4
Ankana Saha <i>et al.</i> ^[7]	60	30	5	--	5
Asharani <i>et al.</i> ^[8]	87	11	--	--	--
Rita kumara <i>et al.</i> ^[9]	90.62	7.8	--	--	1.56
Kalpana <i>et al.</i> ^[10]	81.19	18.35	0.45	--	3.67
Jagadeesh babu <i>et al.</i> ^[11]	89.01	10.98	--	--	--
Yaseen <i>et al.</i> ^[12]	79	19	02	--	--
Present study	94	04	01	--	01

According to review on the number of nutrient foramina, our study is correlating with the review studies. We observed the presence of single foramina is 94% followed by double foramina in 4% and three foramina in 1% and absent in 1%. In our study we did not observe any four nutrient foramina which was noticed by Islam Mansur *et al.*

Location of nutrient foramina.

The nutrient foramen is normally located at the middle of the shaft on the antero medial surface of humerus. In some humeri, its position may be variable. It might be located in either upper or lower third of the humerus. In our study we found 94% of nutrient foramina in middle third of the shaft followed by lower third 8% and upper third 1%. Our study findings are correlating with Shantha chandrasekhar *et al.*, Islam *et al.*, and Poudel *et al.*

In our review of studies done before, Shantha chandrasekhar *et al.*, Islam *et al.* and Poudel *et al.* reported the majority of the foramina in the anteromedial surface of the humerus. In our study we too observed the foramina majorly on anteromedial surface with less percentage on anterolateral and posterior surface.

The previous studies suggests that the supra trochlear foramen is more commonly seen Australians (46.5%)^[13] followed by Indians (34%)^[14, 15]. The incidence of supra trochlear foramen may varies from one population to other. The incidence of supratrochlear foramen is 18% in the present study. According to Shivaleela *et al.*^[15], Li *et al.*^[16], Nayak *et al.*^[14], and Paraskesav *et al.*^[17] the frequency of presence of supratrochlear foramen is more on the left side rather than right side which coincided with our study 12% on left side and 6% on right side.

The shape of the supratrochlear foramen is round in 49.9% followed by oval in 44.5% and triangle in 1%. Our findings are correlating with studies done by Shivaleela *et al.*^[15] who have done the study exclusively in the Indian population. The other authors opined that the shape of the foramen is oval in many cases followed by round^[14, 16, 18].

Conclusion

Our present study on nutrient artery of humerus reiterated all the findings of previous studies done on the same. A single nutrient foramen on the mid part of the shaft on its anteromedial surface directed towards the elbow joint is seen in most of the humeri studied.

Though humerus is not the most commonly fractured bone of the upper limb, in recent times where there is sharp incline in road traffic accidents the number of cases presenting with fracture shaft humerus has increased manifold. Mid shaft humerus is one of most common sites of fracture humerus. But in cases presenting with poly trauma or open fractures it becomes mandatory to do open reduction with placement of intramedullary nails or plates. The surface usually being preferred for plating is anteromedial surface because of its less muscular attachments which doesn't require unnecessary soft tissue dissection when compared to the anterolateral surface. Thus it becomes rather imperative to have a better knowledge of the nutrient foramina and the artery coursing through it in dealing such cases so as to prevent damaging it & have a better shot at healing.

The greater knowledge of supratrochlear foramen is very important for clinicians such as orthopedic

surgeons and radiologists during the diagnosis & operating upon cystic lesions and fractures at the lower end. In road traffic accidents mid shaft fractures are looked for damage of nutrient foramen and low energy fractures at supratrochlear foramen at the lower end of the humerus.

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