Short Communication

Morphological Variations of Nutrient Foramina in upper limb long bones

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ABSTRACT

The nutrient artery is the principal source of blood supply to a long bone and is particularly important during its active growth period in the embryo and foetus as well as during the early phase of ossification. The aim of the present study was to study the topographic anatomy and morphology of the nutrient foramina in human adult upper limb long bones. The study was performed on 40 upper limb long bones which include 40 humerii, 40 radii, 40 ulnae. The bones were obtained from department of anatomy Punjab institute of medical sciences, Jalandhar. The variations were found in number and location of nutrient foramen in different upper limb bones. In humerus double and triple foramina were found. In radius and ulna double foramina were observed at the maximum. Absence of nutrient foramen was observed in radius. The knowledge about these foramina is useful in surgical procedures.

Key words: *Nutrient foramina, Humerus, Radius, Ulna*

Introduction

Nutrient foramina in the long bones of human limbs are described as being directed towards the elbow and away from the knee. This is due to, one end of limb bone growing faster than other. [1] These holes or nutrient foramina allow blood vessels to pass through the bone cortex. The nutrient artery is the principal source of blood supply to a long bone and is particularly important during its active growth period in the embryo and foetus as well as during the early phase of ossification. [2] The nutrient artery enters individual bones obliquely through a nutrient foramen [3] reported that the position of the nutrient foramina in mammalian bones are variable and may alter during the growth. The knowledge regarding nutrient foramina of bone is useful in surgical procedure such as microvascular bone transfer in order to preserve the circulation. [4] It is also useful in various clinical implications such as bone

grafting or radiologic evaluation for the fracture line.

The aim of the present study was to study the topographic anatomy and morphology of the nutrient foramina in human adult upper limb long bones.

Material and methods

The study included 40 upper limb cadaveric long bones which include 40 humerii(20 Right side and 20 left side), 40 raddii (20 right side and 20 left side), 40 ulnae (20 right side and 20 left side). The bones were obtained from osteology section of department of anatomy, Punjab institute of medical sciences, Jalandhar. All the bones were macroscopically observed for number, location and direction of nutrient foramina. A magnifying lens was used to observe the foramina.

Results

In the present study, 70% (28 out of 40) of the humeri had a single nutrient foramen. The double foramen was observed in 25% (10 out of 40) (Fig. 1) of the cases and triple foramen was found in 5 % cases. (2 out of 40) (Fig. 2)

Fig. 1 Double foramen on medial border of humerus

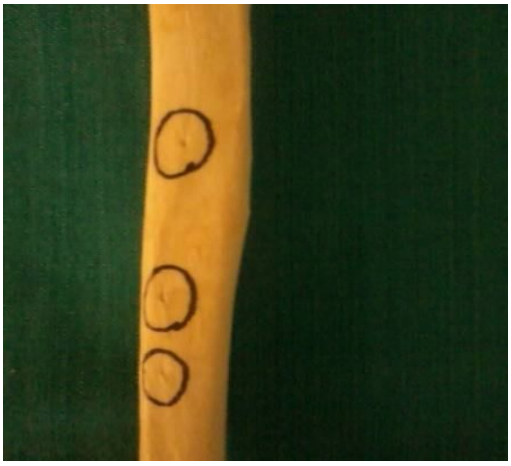

Fig. 2 Triple foramen on medial border of humerus

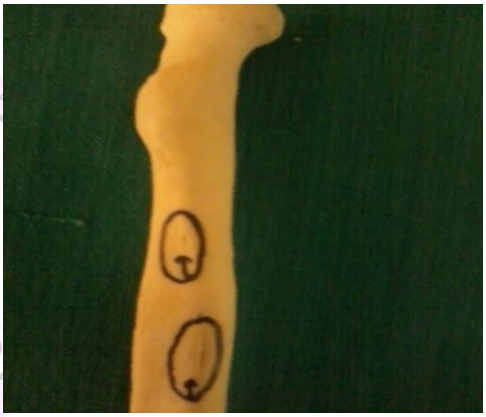

Fig. 3 Double foramen on anterior border of radius

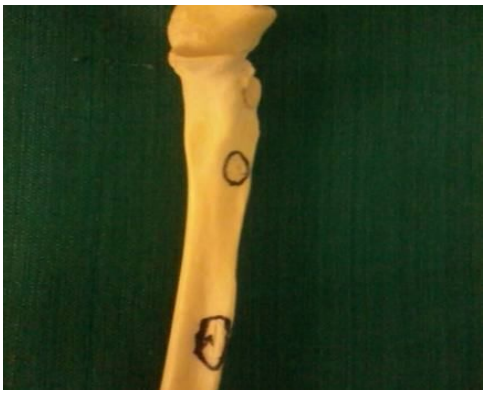

Fig. 4 Double nutrient foramen on anterior surface of ulna

The morphological and topographical distribution of the foramina of humerus is represented in table 1.

In case of radius 80% (32 out of 40) had single foramen, 15% (6 out of 40) had double foramen (Fig. 3) and in 5% (2 out of 40) cases the foramen was absent. The morphological and topographical distribution of the foramina of radius is represented in table 2.

Table 1: Morphological and topographical distribution of the nutrient foramina in the humerus (n= 40)

No. Of foramina	*Right side*	*Left side*	*Total*	*%*	*MB*	*MS*	*LB*	*PS*
1	16	12	28	70	26			2
2	4	6	10	25	4	8	4	4
3	-	2	2	5	6			
Total	20	20	40	100	36	8	4	6

MB-medial border; MS-medial surface; LB-lateral border; PS-posterior surface

Table 2: Morphological and topographical distribution of the nutrient foramina in the radius (n= 40)

No.of foramina	*Right Side*	*Left Side*	*Total*	*%*	*AB*	*AS*	*IB*
1	18	14	32	80%	8	14	10
2	2	4	6	15%	7		5
Absent		2	2	5%			
Total	20	20	40	100%	15	14	15

AB-Anterior Border; AS-Anterior Surface; IB-interosseous border

Table 3: Morphological and topographical distribution of the nutrient foramina in the ulna (n=40)

No.of foramina	*Right side*	*Left side*	*Total*	*%*	*AB*	*AS*	*IB*
Single	20	18	38	95%	16	20	2
Double		2	2	5%	2	2	
Total	20	20	40	100%	18	22	2

AB-Anterior border; AS-Anterior surface ; IB-Interosseous border

In case of ulna 95% (38 out of 40) had single foramen, 5% (2 out of 40) had double foramen. (Fig. 4) The morphological and topographical distribution of the foramina of ulna is represented in table 3.

Discussion

The morphological knowledge of nutrient foramina is significantly important for orthopaedic surgeons undertaking an open reduction of a fracture to avoid injuring the nutrient artery and thus lessening the chances of delayed or non-union of the fracture. [5] It is well known fact that one of the causes of delayed union or non-union of fracture is lack of arterial supply.

In the present study, a single nutrient foramen of the humeri has a higher percentage 70% compared to that of double (25%) and triple foramina (5%) respectively. Many studies reported a percentage approximately similar to that of present result. [1,6,7,8] The other studies reported the higher percentage of a single nutrient foramen (80-88%). [9,10,11] The range of occurrence of double foramina varied from 13% [9] to 42%. [1] According to kizilkanat, [11] the percentage of occurrence of triple foramina in the humerii did not exceed 1-7%. The latter observations were in accordance to those reported in the present study. On the other hand kizilkanat [11] reported the presence of four nutrient foramina in 1% of the humerii studied. Such number was not observed in the present study. Moreover, the absence of nutrient foramina in some humerii was also reported by other authors, [6,12,9,11] they stated that in such cases, the periosteal vessels were entirely responsible for the blood supply of the bone. In 95% (38 out of 40 cases) the nutrient foramina were located along the whole middle third of the humerus. In accordance with the present results, previous studies reported the position of the nutrient foramina within the middle third of the bone. [1,7-11]

In the present study, 80% (32 out of 40) radii had single foramen. In most of the previous studies 100% radii have single foramen. [9,11] Mysorekar,[1] Longia et al,[9] Kizilkanat et al [11] Shulman, [13] reported the single foramen in more than 90% cases. In the present study 15% (6 out of 40) had double foramen. Mysorekar, [1] Longia et al, [10] Shulman, [13] also reported the same findings. Forriol campos et al [8] and kizilkanat et al [11] has reported the double foramen in 0.63% cases. In the present study in 5% (2 out of 40) cases the foramen was absent.

In the present study 95% ulnae (38 out of 40) had single foramen. Double nutrient foramen were observed in rest of the ulnae examined. With the exception of Nagel (1993) who recorded a single nutrient foramen in all specimen examined, other authors reported a single nutrient foramen in more than 91% of ulnae. [1,8,9,11,13] Furthermore, Longia et al [9] observed three nutrient foramina in 1% of ulnae examined while Shulman [13] and Mysorekar [1] reported the absence of nutrient foramina in 0.6% and 1.1% of ulnae respectively. Such findings were not found in present study.

The result on the nutrient foramina incidence and distribution in upper limb long bones are consistent with most studies. The knowledge about these foramina is useful in the surgical procedure to preserve the circulation. The findings are important for the clinicians who are involved in bone graft surgical procedures and are enlightening to the clinical anatomists and morphologists.

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