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ANALYTICAL AND MORPHOMETRIC STUDY OF NUTRIENT FORAMINA OF FEMUR IN TELENGANA REGION

Anatomy

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ABSTRACT

Introduction : The major blood supply to the long bones occurs through the nutrient arteries, which enter through the nutrient foramina. This blood supply is essential during the growing period of bones. Knowledge regarding the nutrient foramina of bones is useful in surgical procedures to preserve circulation particularly in orthopedic surgeries..

Material and Method: The study was conducted on 100 (50 right and 50 left) dry human femur bones collected from the Department of Anatomy, Osmania and Kakatiya Medical College, Telangana Region. These bones were separated in to right and left side bones. Number was given to all femur bones. The nutrient foramina location, distribution, direction and number/s were identified macroscopically by using hand lens and result were analysed.

Results : Single nutrient foramina on the diaphysis of femur was more frequent (70%), followed by double nutrient foramina (24%) and three nutrient foramina were found in bones (6%). Distribution of foramina is more on linea aspera (46%), 38% & 16% were found on medial and lateral surfaces respectively. Most of the nutrient foramina were present on the middle third of the intermediate area on linea aspera and second nutrient foramina were found on upper third and lower third as well as in between intermediate and medial lips. All nutrient foramina directed in upward direction only that is away from the knee joint.

Conclusion: This study provides data on the morphology of diaphyseal nutrient foramina in human femur which in turn will give information to preserve circulation during surgeries.

KEYWORDS:

Diaphysis, Femur, Linea Aspera, Nutrient Foramina.

INTRODUCTION:

Nutrient foramen is an opening into the bone shaft which gives passage of the blood vessels to the medullary cavity of a bone. Diaphyseal nutrient arteries enter the shaft obliquely through the nutrient foramina leading to nutrient canal.1 The nutrient canal which is initially horizontal gets slanted during the growth. The direction of slant is due to the difference in the growing rates of the both sides of epiphysis.2 The direction of slant from surface to marrow cavity points towards the end that had grown least rapidly.[1] The nutrient artery is the principal source of blood to a long bone particularly during its active growth period, supplies both osteal tissue as well as bone marrow.[1,2] The diaphysis of femur is irrigated by one or more nutrient arteries which divide in the medullary cavity into ascending and descending branches while accompanied by the terminal branches of numerous metaphyseal, epiphyseal arteries.[3] This foramen in the majority of cases is located away from the growing end.[4] Though the direction of the foramina are away from the actively growing end, their topography might vary at the non-growing end. So, the topographical anatomy of nutrient foramina may be of worth.[5] Very few studies has been done on the nutrient foramina morphology over linea aspera. So, the present study is aimed to analyze number, locations and direction of nutrient foramen in diaphysis and linea aspera of adult human femur.

Materials & Methods:

The present study was done on 100 (50right and 50 left) dry human adult human femurs, collected from Department Of Anatomy, Osmania and Kakatiya Medical College, Telangana Region. In all the bones, after determining the side and given number, were examined macroscopically by using hand lens. The location and the number of the diaphyseal nutrient foramina on diaphysis of the each of bone were identified by the presence of a well marked, often slightly raised edge at the commencement of the canal. The number and the topography of foramina in relation to specific borders, surfaces or linea aspera of the diaphysis were analyzed. The direction of the foramina was noted. The foramina within 1 mm from any border were taken to be lying on that border. For the bones which have double nutrient foramina, the larger foramen was taken into consideration as dominant or primary foramen. After noting all the details of foramen, results were tabulated and compared with previous workers.

RESULTS:

The direction of all the foramina was towards the upper end of femur. The majority (70%) of the femur had a single nutrient foramina followed by double nutrient foramina (24%) and three nutrient foramina were also observed in 6% femur. In the femurs having single nutrient foramina, 46% of the foramina were found on intermediate area of linea aspera, 38%, 16% were medial and lateral side of lips of linea aspera respectively(Table-3, Fig-1&2). When the shaft of femur was divided into three equal parts, the foramina were found the highest in middle one third (56%), followed by, upper third (42%) and lower third (2%)(Table-2).

The distribution of double nutrient foramina on diaphysis of femur were found the highest on middle third, followed by lower third. The double nutrient foramina on linea aspera were mostly found on medial lips (60%), followed by intermediate area (20%) and lateral lips (20%) of line aspera(Table-3).

The distribution of third nutrient foramina on daiphysis of femur were found highest on the middle 1/3rd (100%). Location of these third nutrient foramina are mostly present near to medial lip (65%) than lateral lip (35%) of linea aspera.

DISCUSSION:

The observation of the present study shows that no femur with more than two nutrient foramina was found. The majority (70%) of the femur had a single nutrient foramina followed by double nutrient foramina (24%) these are correlating with Nirmalya saha et al[(14)] and three nutrient foramina were also observed in 6% femur (Table-1,4).in the study of Kizilkanat E et al.[6] where 75% of the femur had single and 25% had double nutrient foramina but no cases was observed with absent foramina and also was found by Collipal E et al.[7] and Mysorekar VR.[5] In present study Double and three nutrient foramina were found more on left side than right side. All the nutrient

foramina were directed towards the upper end of femur, also were found by Pereira GAM et al.[8] and Al-Motabagani MAH.[9] In present study double foramina present were not in equal size were also noticed by Al-Motabagani MAH.[8] Collipal E et al.[9] stated that, the nutrient foramina were restricted on linea aspera or adjacent area. Similar was stated by Kizilkanat E et al.[6] and Kumar S[10] that majority of the foramina were present on linea aspera with some foramina on the medial surface adjacent to linea aspera also was found in present study with some foramina on the lateral surface adjacent to linea aspera. Kumar S et al.[10] found single nutrient foramina on upper third and middle third of linea aspera were 48% & 32% respectively. In present study, the nutrient foramina on upper third (42%), middle third (56%) and lower third (2%)(Table-2).

CONCLUSION:

The observations of the present study on the nutrient foramina incidence and distribution on femur indicates that they were predominant on the middle one third of intermediate area on linea aspera and double and triple nutrient foramina were found on upper third and lower third as well as in between intermediate area and medial lip of linea aspera. Exact location and distribution of the nutrient foramina is important to avoid damage to the nutrient vessels and to preserve circulation during various surgical procedures.

Table 1 : Diaphyseal nutrient foramina distribution in femur, (% = percentage).

No of nutrient foramina	Right	Left	Total	Percentage
0	-	-	-	-
1	42	28	70	70%
2	8	16	24	24%
3	-	6	06	06%
Total bones	50	50	100	100%

Table 2 : Distribution of total foramina on shaft of femur, (% = percentage).

Position of foramina	Right (50)	Left (50)	Total	percentage
Upper 1/3rd	20	22	42	42%
Middle1/3rd	28	28	56	56%
Lower1/3rd	02	0	02	02%

Table 3 : Distribution of nutrient foramina on linea aspera, (% = percentage).

Location of foramina	Right (50)	Left (50)	Total (100)	Percentage
Medial to linea aspera	26	12	38	38%
Intermediate area of linea aspera	16	30	46	46%
Lateral to linea aspera	08	08	16	16%

Table 4 : Review of other workers with present study, (% = percentage).

Authors name	No of nutrient foramina			Position of nutrient foramina			Location of N.F in relation to linea aspera		
	one	Two	Three	Linea aspera	Lateral surface	Medial surface	Medial lip	Intermediate area	Lateral lip
Kumar s et al (%)	59.5	33.3	-	-	-	-	-	-	-
Pereira GAM et al (%)	63.8	34.9	-	93.4	-	-	-	-	-
ojaswini et al (%)	-	-	-	-	-	-	88.6	-	6.5
Bhatnagar S et al (%)	55	43.3	1.67	-	-	-	-	-	-
Kazilkanat E et al (%)	75	25	-	45	39.2	16	-	-	-
Al-motabagain MAH et al (%)	48.5	48.5	3	-	-	-	-	-	-
Kumar R et al (%)	-	-	-	57.33	53.33	53.33	18.36	27.33	11.33
Collipal E et al (%)	44	52	-	72.5	21.25	6.25	27.5	36.25	8.75
Prasanth KU et al (%)	47.7	46.2	4.4	76.7	18.6	1.2	56	36.4	7.6
Nirmalya saha et al (%)	71.8	24.7	3.5	93.3	5.9	3.8	36.6	59.1	4.3
Present study (%)	72	22	6	Upper1/3rd	Middle 1/3rd	Lower 1/3rd	38	46	16
				42	56	2			

Fig -1

fig - 2

Figure 1 & 2 showing femur bones with two and three nutrient foramina respectively.

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