A Study of Direction and Obliquity of Diaphyseal Nutrient Foramina in Dried Adult Human Long Bones of Upper Limb in Pakistan

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ABSTRACT

Background: The circulation of blood in bones is necessary for the osteogenesis, maintenance of bone vitality, bone growth, repair of fractures and other injuries. The nutrient foramina are holes that allow blood vessels to pass through bone cortex.
Objective: The aim was to observe the diaphyseal nutrient foramina in the upper limb long bones besides other parameters for obliquity and direction.
Material and Methods: In the present study there were 90 long bones of upper limb (All the bones were well dried and cleaned). The bones were 30 humerii, 30 radii and 30 ulnae. For each of the above bones the direction and the obliquity of the nutrient foraminae were studied.
Results: As per results, the growing end theory (To the elbow I go, from the knee I flee) was observed in case of obliquity and direction of nutrient foraminae.
Conclusion: The results of the study confirmed the previous results regarding the direction and obliquity of the nutrient foraminae in cases of long bones of upper limb. It also provided the clinical information about the nutrient foraminae which can be useful in surgical procedures of orthopedics specially.
Keywords: *Diaphyseal Nutrient Foramina, Osteogenesis, Bone Vitality, Bone Cortex, Obliquity, Orthopedics.*

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INTRODUCTION

Skeleton of the human body consists of 213 bones, not including the sesamoid bones[1,9]. Axial skeleton consists of 74 bones, appendicular skeleton consists of 126 bones, ear bones are 6 in number.

During life each bone undergoes modeling in order to adapt to the changing biomechanical forces. It also helps to remove the old bone. The bone which is damaged is replaced by new bone. The strength of the bone is preserved by producing mechanically stronger bone[2,10]. There are many categories of bones, for examples, long bones, short bones, flat bones and irregular bones etc. the clavicle, humerous, radius and ulna are examples of the long bones of the upper limb. Similarly femur, tibia and fibula are long bones of lower limb.

Varieties of functions are performed by skeleton, for example, protection, support, acting as levers and mineral and acid base balance is maintained In the body. The bones also act as reservoirs for cytokines and the factors that help in growth. The circulation of the blood is necessary for the osteogenesis, maintenance of the bone vitality, bone growth and repair of fractures and other injuries[3,12]. The long bones are usually supplied by three sources, epiphyseal metaphyseal vessels at the ends of the bones, one or more arteries that enter the diaphysis (The nutrient arteries) and the periosteal vessels [4,13].

The six group arteries that supply the long bones are proximal epiphyseal, proximal metaphyseal, diaphyseal nutrient, distal metaphyseal, and distal epiphyseal and periosteal arteries. The blood vessels enter the epiphysis and metaphysic through small foraminae. These foraminae are called nutrient foraminae. These nutrient foraminae are oblique in direction and are directed away from the growing end. All the long bones possess small or large foraminae that are for the entrance of the blood vessels. It has been suggested that the direction of the nutrient foramina is determined by the growing end of the bone. Regarding direction variations have been observed.

MATERIAL AND METHODS

The present study included 90 dried cleaned long bones of upper limb. These included 30 humerii, 30 radii and 30 ulnae. These bones were obtained from the Department of Anatomy, Ayub & Khyber Medical Colleges respectively. The age and sex of

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the bones were not determined. All the bones which showed gross pathological deformities were not included in the study. All the bones were macroscopically observed for the direction and the obliquity of the foraminae. Those nutrient foramina were observed which were present on the diaphysis. The foraminae present at the ends of the bones were ignored. To confirm the direction and obliquity a stiff wire was used. Photographs were taken by (DSLR Canon 500D). Each photograph had a definition of 1.5 Mb (Resolution).

RESULTS

As per results, the growing end theory (To the elbow I go, from the knee I flee) was observed in case of obliquity and direction of nutrient foraminae.

In all the humerii, the nutrient foraminae were oblique and directed distally. In all the radii nutrient foraminae were directed proximally. They were all oblique. In cases of ulnae all nutrient foraminae were oblique with proximal direction.

Table: Direction and Obliquity of Nutrient Foramina in Long Bones of Upper Limb.

Bone	Direction	Obliquity
Humerii	Distally	Oblique
Radii	Proximally	Oblique
Ulnae	Proximally	Oblique

DISCUSSION

The nutrient canal or nutrient foraminae has a particular position for each bone. There is a jingle for the direction of nutrient foraminae: “It seeks the elbow and flees the knee”. In upper limb it means that it is directed towards the elbow and in the lower limbs it means that these are away from knee. In our present study the nutrient foraminae were directed away from the growing end of the bones, In humorous it was observed. A Study conducted by Boyle WJ, simonet WS and Laccy DL also showed the same results[5,14]. The direction of nutrient foraminae in radii was proximal. Study conducted by Bridgeman G, Brookes M also showed the same results[6,15]. The ulnae which we examined, nutrient foraminae were directed proximally. Our study is in accordance with the study of (Longia, etal; 1980 and Dyankeva, 2004) who stated that nutrient foraminae on the shafts of the ulnae entered obliquely and was directed towards the elbow.[7,8,16]

All the long bones of the upper limb (Humerii, Radii and Ulnae) showed that all the nutrient foraminae were obliquely placed on the shafts. This result is in line with the results of (Kizil Knat, etal; 2007)[9,17]. The anatomical data is important to the clinicians as the microvascular bone graft becoming the need of the day. Knowledge of nutrient foramina is important to avoid damage that can occur during surgical procedures[6,12,16]



Stiff Steel Wire

CONCLUSION

The present study has provided additional information on the morphology and topography of the nutrient foraminae in the upper limb long bones. The anatomical data is important to the clinicians as the microvascular bone transfer is becoming popular. Exact position and distribution of the nutrient foramina in bone diaphysis is important to avoid the damage that can occur to the nutrient vessels during surgical procedures.

AUTHOR'S CONTRIBUTION

EA, AU: Statistical analysis and manuscript wrting. FS, NW: Data collection. ZI: Concept review. HSK: Critical analysis and proof reading.

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