Student's Journal of Health Research Africa
Vol. 4 No. 9 (2023): September 2023 Issue
https://doi.org/10.51168/sjhrafrica.v4i9.672
Original article

THE CLINICAL SIGNIFICANCE OF THE ULNAR NUTRIENT FORAMEN: A MORPHOLOGICAL ANALYSIS.

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Abstract.

Background:

The arteries that provide nutrients to the bone enter the bone of the ulna through the nutrient foramina. During bone grafting, it is necessary to understand the position and number of nutrient foramina to ensure that the bone grafts have a good supply of vessels and that the blood vessels are not damaged. In this research, the morphology of nutrient foramina on the Human ulna bone is studied.

Methods:

100 ulna bones were procured from the anatomy department of Shivpuri, Madhya Pradesh. The bones were taken for study irrespective of gender or age. The bones were examined to determine the side of the ulna. The bones were thoroughly observed for the position and number of nutrient foramina. The nutrient foramina was located and marked. The bone's length and distance of the foramina from the end of the bones were determined and put into Hughes's formula to calculate the foramina index. The data obtained was statistically analyzed.

Result:

The nutrient foramina was located towards the end of the bone. Out of all bones, only 6% had two nutrient foramina; the rest all had one nutrient foramina. The relation of bone length to the number of nutrient foramina was not significant. According to the foramina index calculated, most of the nutrient foramina were located on the anterior part of the third of the middle part of the bone; the mean foramina index was 36.48.

Conclusion:

From this study, the morphology of the nutrient foramina on the ulna bones can be understood. This helps the surgeons during bone grafting to protect the location of the foramina so that the ulna remains vascularized.

Recommendation:

We recommend a Computed Tomography (CT) scan of the fracture to assess fragment sizes, displacement, and suitability for primary fixation.

Keywords: Ulnae bone, foramina index, nutrient foramina, Submitted: 2023-09-15, Accepted: 2023-09-17

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Vol. 4 No. 9 (2023): September 2023 Issue
https://doi.org/10.51168/sjhrafrica.v4i9.672
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1. INTRODUCTION:

Repair and growth in any part of the body are dependent on the nutrients it provides. Likewise, bones also require nutrients for their survival and repair [1, 2]. The arteries that supply the long bones enter the bones through a passage in the bone. The nutrient foramina is a passage through which nutrient arteries enter the bone; it is usually in the opposite direction to the growing part of the bone [3, 4].

The nutrient arteries then divide and divide to form branches that end near the endosteal surface. The endosteal surface can be damaged during various surgical processes [5, 6], such as placing metal implants and fixing fractures, if the proper technique of the procedure is not employed [7]. The nutrient supply is necessary for growing bones; if an injury to the nutrient foramina occurs during childhood, it can lead to stunted growth [8]. During tumors, trauma, and arthritis the supply of nutrients is essential to the osteocyte's survival [9, 10].

If the morphology of the nutrient foramina on the ulna is understood by orthopedic surgeons, they can be cautious during surgical procedures. This can prevent damage to the nutrient foram- ina and thus prevent further consequences. This study aims to locate the position and number of nutrient foramina on the ulna and determine their morphology.

2. METHOD:

This study was undertaken in the anatomy lab of Shivpuri, Madhya Pradesh. 100 human ulna bones that were not deformed or fragmented were procured from the osteology department, irrespective of the gender and age of the bones. Once the bones were obtained, the examination was performed to check whether it was a right-side or a left-side ulna. A thorough observation of the bones was done to look for nutrient foramina. The groove before the foramina that is raised from the surface is located, and then a needle is passed in it. Passing the needle confirms the presence of a passage through which arteries can pass. After observing the foramina its location is determined. If it is 1mm around the border of the bone it is considered to be present on the borders otherwise it is considered to be present on the surface. Using a Vernier caliper the length of the bone is measured from one end to the other. the location of the foramina was also determined from the prox- imal end.

Using the Hughes formula and the data obtained the foraminal index was calculated. Using a statistical package for social sciences the data was analyzed. Mean, range, and p-value to understand the relation between the length of the bone and the number of nutrient foramina.

3. RESULTS:

It was found that 56 bones were left side ulnae and 44 bones were right side ulnae. There were only six bones that had two foramina, and the remaining ulnae had only one foramen. The overall mean of the ulna length was 26.3 cm, whereas for the right-side ulnae, the mean was 26.7 and for the left-side ulna, it was 26.4 [Table no.1]. When the correlation was determined between the length of bone and the number of foramina, it was not found to be statistically significant.

The average distance of the foramina from the proximal end of the bone was 9.12 cm, so it can be understood that the foramina is located near the proximal end of the ulna. The average foram- inal index of the right-side ulna was 35.6, and the range for it was 20.84–49.61. The average foram- inal index of the left side ulnae was 37.6, and the range for it was 22.27–58.10 [Table no.1].

The ulnae were categorized based on the foraminal index. Ulnae belonging to category one were those that had a foraminal index of less than 30%. Category two ulnae were those that had foraminal indices between 30% and 60%, and category three ulnae were those that had foraminal indices greater than 60%. Most of the ulnae belonged to category 2, which indicates that the foramina are located in the middle third part of the ulna [Table no.2]

When the location of the foramina was studied [Table no. 3] it was found that foramina were mostly located on the anterior surface or anterior

Table 1: **Average length and the foraminal indices of the ulnae.**

Side	Average length	Average foraminal index
Left	26.4	37.6
Right	26.7	35.6
Overall	26.3	36.8

Table 2: **Category of ulnae.**

Category no.	Frequency of ulnae
1 (foraminal index lesser than 30%)	40
2 (foraminal index between 30% to 60%)	60
3 (foraminal index greater than 60%)	0

borders. This location of the foramina was not dependent on the side of the ulna.

4. DISCUSSION:

This study found that all the ulnae had foramina towards the proximal end towards the elbow and so the opposite end of it, is the growing end. Most of the foramina are positioned at the anterior part of the ulna and seldom foramina could be found at the posterior surface [11-14]. It can be inferred from the data obtained that majorly all the ulnae had only one foramen which is the only passage for nutrient arteries [15, 16]. If any damage occurs in the area of the foramina it can lead to ischemia of the ulna and death of osteocytes.

Although some bones have two foramina, the primary foramen is the one through which the majority of the nutrient arteries enter, and the other foramen is only for accessory arteries for additional supply [17, 18]. The average forami- nal index of the ulna was 36.71, which is consis- tent with a study that stated that foramina are present at the third middle part of the ulna [19- 21]. Hence, based on the data, the foramen of the ulna is present on the anterior surface, and the arteries enter the ulna from the anterior sur- face, passing through the middle third, or proxi- mal part, of the ulna. Thus, surgeons have to be particularly cautious while operating on or treat- ing the defects at the stated site [22, 23].

5. CONCLUSION:

The findings of this study are consistent with various studies that reported the presence of foramina at the anterior surface and in the mid- dle third part of the bone. However, a significant relationship between the length of the ulna and the number of foramina was not found. Knowing the exact direction, number, and position of the foramina can help surgeons perform orthopedic surgeries.

Also, any trauma that can cause damage to this site can lead to bone ischemia if it is not treated immediately. The study that is carried out here is from the ulnae of a specific population, and so the studies may vary on different populations. The inference of the study can be utilized by orthopedic surgeons while performing the procedure on this population.

6. LIMITATIONS:

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

7. RECOMMENDATION:

We recommend a Computer Tomography (CT) scan of the fracture to assess fragment sizes, displacement, and suitability for primary fixation.

Table 3: **Location of nutrient foramina on ulnae.**

Position of the nutrient foramina	Frequency of bones
Intraosseous border	10
Posterior surface	0
Anterior surface	79
Medial surface	1
Anterior border	16

8. ACKNOWLEDGEMENT.

We are thankful to the patients; without them, the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in the patient care of the study group.

9. LIST OF ABBREVIATIONS:

CT- Computed Tomography

10. SOURCE OF FUNDING:

The study was not funded.

11. CONFLICT OF INTEREST:

The authors report no conflicts of interest in this work.

12. Publisher details:

Publisher: Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256775434261
Location: Wisdom Centre, P.O.BOX. 148, Uganda, East Africa.

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