Morphometric and morphological study of nutrient foramina of dry human ulna bones in Telangana region

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Abstract

Background: Nutrient artery is the main source of blood supply of long bones along with the periosteal, epiphyseal and metaphyseal arteries. Nutrient artery enters the bone obliquely through nutrient canal and nutrient foramina. Materials and Methods: In the present study, 147 (69 right sided and 78 left sided) ulna bones of unknown age and sex were used from the bone bank of department of Anatomy, Mamata Medical College, Khammam, Telangana. The Foramen index (FI) was calculated using the formula: Foramen index = (DNF/TL) x 100 DNF = the distance from the proximal end of the bone to the nutrient foramen. TL = total bone length. Size of foramina was measured using syringe needles of various gauges. Results: Out of 69 right sided bones, four bones have two nutrient foramen and all the other bones showed single nutrient foramina. On the left side, out of 78 bones, nutrient foramina was absent in one bone and two bones showed two foramen and all the other bones showed single nutrient foramina. Mean foramen index was 36.78 ± 6.21 cm and the foramina are located on the upper and middle third and mostly (89.24%) on the anterior surface. Conclusion: The knowledge of morphometry and morphology is of much clinical significance in view of the available recent advancements in the surgical and orthopaedic procedures like joint replacements, graft techniques and micro vascular surgeries.

Key Words: Ulna, Nutrient foramina, Nutrient artery, Blood supply of bone.

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INTRODUCTION

Nutrient artery is the main source of blood supply of long bones along with the periosteal, epiphyseal and metaphyseal arteries. Nutrient artery enters the bone obliquely through nutrient foramina¹. Nutrient foramina is directed away from the growing end, due to differential growth of the ends of the long bone during development². The knowledge of the nutrient foramina in the long bones is required during surgical procedures, especially bone grafts, to ensure proper bone repair.

MATERIALS AND METHODS

In the present study, 147 (69 right sided and 78 left sided) ulna bones of unknown age and sex without any pathological changes were taken into consideration. Cleaned and dry ulna bones were obtained from the bone bank of department of Anatomy, Mamata Medical College, Khammam, Telangana. Osteometric board was used to calculate the total length of the bone and the distance of the nutrient foramina from the upper end. Total length was calculated as the distance between the proximal aspect of the ulnar olecranon process and the most distal aspect of the styloid process of the bone. The Foramen index (FI) was calculated using the formula: FI = (DNF/TL) x 100 (Hughes [5], Shulman [6]). DNF = the distance from the proximal end of the bone to the nutrient foramen. TL = total bone length. Hand lens was used to observe the nutrient foramina. Size of foramina was measured using syringe needles of various gauges.
measured using syringe needles of various gauzes. Foramina of size less than 24 gauze were not taken into account.

a. Size of the 18 gauze needle was considered to be between 1.27 mm or more (i.e. > 1.27 mm).

b. Size of the 20 gauze needle was considered to be between 0.90 mm and 1.27 mm (i.e. 0.90 mm to < 1.27 mm).

c. Size of the 22 gauze needle was considered to be between 0.71 mm and 0.90 mm (i.e. 0.71 mm to < 0.90 mm).

d. Size of the 24 gauze needle was considered to be between 0.55 mm and 0.71 mm (i.e. 0.55 mm to < 0.71 mm).

**RESULTS**

**Table 1: Showing the length of the bone, distance of the proximal nutrient foramina from the upper end and foramen index**

<table>
<thead>
<tr>
<th>Side</th>
<th>Total length of the bone</th>
<th>Distance from upper end to NF</th>
<th>Foramen Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median in cm</td>
<td>Mean ± SD in cm</td>
<td>Median in cm</td>
</tr>
<tr>
<td>Right (n = 69)</td>
<td>25.7</td>
<td>25.53 ± 1.87</td>
<td>9.2</td>
</tr>
<tr>
<td>Left (n = 78)</td>
<td>25.1</td>
<td>25.09 ± 1.87</td>
<td>9.1</td>
</tr>
</tbody>
</table>

n = total number of bones, SD = standard deviation, NF = Nutrient foramina

**Table 2: Showing the segmental position of nutrient foramen:**

<table>
<thead>
<tr>
<th>Location of foramina</th>
<th>Right radius (N = 91)</th>
<th>Percentage</th>
<th>Left radius (N = 88)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper 1/3rd</td>
<td>20</td>
<td>28.99%</td>
<td>Upper 1/3rd</td>
<td>23</td>
</tr>
<tr>
<td>Middle 1/3rd</td>
<td>46</td>
<td>66.67%</td>
<td>Middle 1/3rd</td>
<td>53</td>
</tr>
<tr>
<td>At the junction of upper and middle 1/3rd</td>
<td>3</td>
<td>4.34%</td>
<td>2</td>
<td>2.25%</td>
</tr>
</tbody>
</table>

N = total no. of foramina, NF = no. of foramina in each segment, No foramina were observed in the lower 1/3rd of the bone.

**Table 3: Showing the location of nutrient foramen on the bone:**

<table>
<thead>
<tr>
<th>Location of foramina</th>
<th>Right (N = 69)</th>
<th>Percentage</th>
<th>Left (N = 78)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior surface</td>
<td>63</td>
<td>91.3%</td>
<td>68</td>
<td>87.18%</td>
</tr>
<tr>
<td>Interosseous border</td>
<td>4</td>
<td>5.79%</td>
<td>5</td>
<td>6.41%</td>
</tr>
<tr>
<td>Anterior border</td>
<td>2</td>
<td>2.89%</td>
<td>5</td>
<td>6.41%</td>
</tr>
</tbody>
</table>

N = total no. of foramen

**Table 4: Showing the size of the nutrient foramen**

<table>
<thead>
<tr>
<th>Size of the foramen</th>
<th>Right (N=69)</th>
<th>Percentage</th>
<th>Left (N=78)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1.27 mm</td>
<td>4</td>
<td>5.79%</td>
<td>8</td>
<td>10.25%</td>
</tr>
<tr>
<td>≥ 0.90mm to &lt; 1.27mm</td>
<td>6</td>
<td>8.69%</td>
<td>6</td>
<td>7.69%</td>
</tr>
<tr>
<td>≥ 0.71mm to &lt; 0.90mm</td>
<td>28</td>
<td>40.57%</td>
<td>27</td>
<td>34.61%</td>
</tr>
<tr>
<td>≥ 0.55mm to &lt; 0.71mm</td>
<td>31</td>
<td>44.93%</td>
<td>37</td>
<td>47.43%</td>
</tr>
</tbody>
</table>

N = total no. of foramen

![Figure 1: Showing two nutrient foramina on the exterior surface](image-url)
Direction of the nutrient foramina: In all the bones of both right and left side, the nutrient foramen were directed upwards (i.e. towards the elbow joint). Incidence of nutrient foramen: Out of 69 right sided bones, four bones have two nutrient foramen and all the other bones showed single nutrient foramina. On the left side, out of 78 bones, in one bone nutrient foramina (of size above 24 gauze) was not at all found in the shaft, two bones showed two foramen and all the other bones showed single nutrient foramina. Total length of the bone, distance from the upper end to proximal nutrient foramina and formen index are shown in the Table 1. Segmental position and location of nutrient foramen on the bone and the size of foramina are shown in the Table 2, 3 and 4.

**DISCUSSION**

During development, nutrient artery enters the bone obliquely by excavating the bone which is being newly formed and contributes to 70 to 80 percent of the growth and development.\(^8,9\) Mysorekar \(et\ al^{10}\) opined that the direction of nutrient foramina is away from the growing end due to differential growth of the ends of the long bone, but Henderson \(et\ al^{11}\) observed in his studies that the above mentioned fact is not always true in case of mammals. In the present study it was observed that the all the nutrient foramina are directed towards the elbow joint, away from the growing end as quoted by Mysorekar. According to the observation by Longia \(et\ al^{12}\), the nutrient foramina is usually observed on the flexor surfaces of the bones. The same is observed in almost all the other studies of ulna bone by Murali Manju \(et\ al^{13}\), Durgesh \(et\ al^{14}\), Satish M Patel \(et\ al^{15}\), Sharma \(et\ al^{16}\) and including the present study [Fig no 1 and Fig No. 2]. On the contrary KS Solanke\(^{17}\), Ojaswini Malukar \(et\ al^{18}\) found that 1.29%, 1.06% of bones, respectively, have nutrient foramina on the location other than flexor surface. The location of the nutrient foramina in relation to the segmental position was observed was in correlation with all the other authors excepting KRS Prasad \(et\ al^{19}\), which reported 18.4% of bones have nutrient foramina in the lower 1/3rd of the ulna bone. The mean foramen Index observed in the present study is 36.78 ± 6.21 cm.

Mysorekar\(^1\) and Shulman\(^2\) reported the absence of nutrient foramina in ulna bone in 0.6% and 1.1% respectively, which closely corresponds with the present study of 0.68%. Whereas Solanke KS \(et\ al^{18}\) observed the absence of nutrient foramina in 3.75% bones. According Patake SM \(et\ al^{2}\), In case of absence of nutrient foramina, the periosteal arteries take the role of nutrient artery in nourishing the bone.

**CONCLUSION**

The knowledge of morphometry and morphology is of much clinical significance in view of the available recent advancements in the surgical and orthopaedic procedures like joint replacements, graft techniques and micro vascular surgeries. The results of this study are in consistent with almost all the other studies. This added information may adjoin the present statistical data available, especially in the Telangana region.

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**REFERENCES**


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