Original Article

Morphometrical Analysis of Diaphyseal Nutrient Foramina of Adult Human Dry Fibulae

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ABSTRACT

Objective: To investigate and analyze the morphometry of diaphyseal nutrient foramina in adult human dry fibulae.
Study Design: Cross-sectional study
Place and Duration of Study: This study was conducted at the Department of Anatomy, Nowshera Medical College, Nowshera, Pakistan from September, 2021.
Materials and Methods: The materials contained dry fibulae of a total of 20, out of which 12 were of the right side and 8 were left sided. The bone's length and the dimension of the nutrient foramina from the proximal end were determined. The Foramen Index (FI) was computed utilizing the formula such as the length/distance of nutrient foramen (DNF) from proximal end was divided by the total bone's length (TL), and then multiplied by a factor of 100. FI = (DNF/TL) x100.
Results: A single nutrient foramen was found in 13 bones (65%) in the left sided ones and 07 bones (35%) in the right sided fibulae. The left fibula had an average length of 34.6±2.3 cm while the right fibula had a length of 34.9±2.2 cm. On the left side, the FI was 47.5±7.6 while on the right side, it was 50.3±11.5. Type-I foramen was discovered in two (10%) bones, Type-II was found in 15 (75%) bones, and Type-III was found in three (15%) bones in the right fibulae. Whereas, in Left Fibulae, Type-I foramen was not discovered in any of the bone, Type-II was found in 18 (90%), and Type-III was found in two bones (10%).
Conclusion: These findings add to our knowledge of the morphometry of nutrient foramina of the adult human dry fibulae. Now a days, microvascular bone transfer becomes increasingly prevalent, such information about nutrient foramina will be useful to orthopedic and trauma surgeons.

Key Words: Anatomy, diaphyseal foramen, dry fibula, human, morphometry, nutrient foramen.

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INTRODUCTION

The fibula is a long bone on the lateral side of the leg. Aside from the muscles linked to it, it receives its neuro-vascular bundle. The nutrient artery that supplies the fibulae comes from the peroneal artery and spirals around the fibula's neck before descending along the fibula deep to the flexor hallucis longus. It emits a nutrient artery at the center of the fibula, which enters the nutrient foramen and ramifies within the fibula.[1] The increasing end of the bone, which is meant to expand at least twice as quickly as the non-growing end, determines the orientation of the nutrient foramina. As a consequence, the nutrient arteries shift away from the developing terminal of the bone.[2] Nutrient foramina information and details are important in clinical operations such as bone grafting and vascularized bone transplantation which is done microsurgically.[3] Fibula can be transplanted with little problems to repair gaps or faults in bones caused by a variety of reasons. Fibula can be uprooted with its nutrient arteries anastomosed with the vessels near the recipient's bone. Because the transplant is a live bone, it can fuse with the recipient's bone in the same way as regular fracture pieces do.[4] The compensations of the free vascularized fibular flap in removing mandible cancers comprise its capacity to be formed with comparative effortlessness and grafted at the same time tumors are excised, resulting in a decrease in surgery time.[5-7] To progress with the free implant of the vascularized bone, topographical information of the nutrition foramina of the fibula is required.[8] The spreading of nutrient foramina in long bones allows

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surgeons to pick bone section levels to insert the graft lacking injuring the nutrient arteries, thereby conserving diaphyseal vascularization and transplant association.[9] The distribution and exact position of the nutrient foramina in the bone shaft is critical to avoiding injury to the nutrient arteries throughout orthopedic operations such as crack mending, bone grafting, bone surgery, and in medico-legal matters. The current study was aimed to investigate the topographic and morphometric aspect of the diaphyseal nutrient foramina of adult human dry fibulae.

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Anatomy, Nowshera Medical College, Nowshera, Pakistan in September, 2021. A total of 20 fibulae of unidentified age and sex were inducted and studied, with 12 right sided and 08 were left sided. Using a magnifying lens, all of the bones were examined for the orientation, position, and number of the nutrient foramina. The existence of a well-marked groove directing to the nutrient foramina and a conspicuous somewhat elevated edge at the canal's beginning helped to identify them. Each bone was put on an osteometric board and its total length was recorded to calculate its length. The measurement was taken between the tip of the fibula's head and the point of the lateral malleolus. The fibula's nutrient foramen was discovered, and the bone was placed on an osteometric board to measure the length between the nutrient foramen and the bone's proximal end. FI was measured using the Hughes formula, which was determined such as the length of the foramen from the proximal end (D) was divided by the complete bone's length (L), and then multiplied by hundred.[10] FI = (DNF/TL) x 100 where DNF=the distance between the bone's proximal end and the nutrient foramen; and TL=total bone length. According to FI, the location of the foramina was classified into three categories;[11] Type-I had a foramen index lower than 33.3, and the foramen was located in the proximal portion of the bone. Type-II had a foramen index ranging from 33.3 to 66.6, with the foramen located in the central part of the bone. Type=III had a foramen index more than 66.6, and the foramen was located in the distal part of the bone. SPSS version 25.0 was employed to enter and analyze data. Descriptive statistics i.e., mean, standard deviation, frequencies and percentages were identified for bone length and length of the nutrient foramen from the proximal end. The foramen index (FI) was also calculated.

RESULTS

Twenty adult human dry fibulae of indefinite age and sex were studied for topographic and morphometric parameters, out of which 12 were right sided and 08 were left sided. Single nutrient foramen was found in 13 bones (65%) in the left sided ones and 07 bones (35%) in the right sided. The left fibula had an average length of 34.6±2.3 cm while the right fibula had a length of 34.9±2.2 cm. On the left side, the FI was 47.5±7.6 while on the right side, it was 50.3±11.5. Type-I foramen was discovered in two (10%) bones, Type-II was found in 15 (75%) bones, and Type-III was found in three (15%) bones in the right fibulae. Whereas, in left fibulae, Type-I foramen was not discovered in any of the bone, Type-II was found in 18 (90%), and Type-III was found in 02 bones (10%).

DISCUSSION

The majority of the life blood to the long bones is carried by the nutrient vessels, which go in through the nutrient foramina. Knowledge of these foramina is critical during surgical operations to protect circulation, particularly for the plastic surgeon doing microvascular bone transfer techniques.[12] The nutritive blood supply must be sustained in free vascular bone grafting to enhance fracture healing. It is required for osteoblast and osteocyte existence, as well as graft curing in the recipient.[13] Several studies have been conducted in different populations to establish the direction, location, and number of the nutrient foramen and foramen index of fibulae, but no such study on topography and morphometry of adult human dry fibulae has ever been conducted in our population. Prashanth et al.[14] discovered that 90.2 percent of fibulae had a single foramen and 9.8 percent did not. For fibulae, the mean foraminal index was 49.2. Sixty percent of the fibulae exhibited nutritional foramen at the third and fifth portions. Pereira et al. researched South Brazilian adults.[15] The fibula's typical foraminal index was 46.1 percent. This study assembled statistics on the people of Southern Brazil, providing cultural data for comparison and maybe assisting in operating practices and radiological image explanation. In Indian population research, the lack of nutrition foramen was identified in 12 (6%) of the fibulae, whereas 86.5 percent (173) of the fibulae held single nutrient foramen, 6.5 percent (13) owned double nutrient foramina, and 1 percent (2) fibula possessed triple foramen.[16] Kumar et al.[17] discovered in research that 30 of the 177 bones had more than one foramen, with four foramina pointing towards the developing end of the bone. Mazengenya P et al.[18] discovered the nutritional foramen immediately proximal to the midpoint in research on Korean populations. Anetai H et al.[19] discovered that in 90% of the cases investigated, there was a single nutrient artery, 6.6 percent had a double nutrient artery, and 3.3 percent had no nutrient artery.

CONCLUSION

Thus, the current findings add to our knowledge of the topography and morphometry of nutrient foramina of the adult human dry fibulae. Now a days, microvascular

bone transfer becomes increasingly prevalent, such information about nutrient foramina will be useful to orthopedic and trauma surgeons.

Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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