ORIGINAL RESEARCH

Morphometric Analysis of the Nutrient Foramen of the Human Humerus: An Osteological Study in a Sri Lankan Population

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Abstract

Objective: The nutrient artery is the principal source of endosteal blood supply to long bones and plays a crucial role in bone growth, remodeling, fracture healing, and vascularized bone grafting. Knowledge of the morphology and location of nutrient foramina is therefore important for orthopedic and reconstructive procedures. However, comprehensive data on humeral nutrient foramina in the Sri Lankan population remain limited.

Methods: A descriptive cross-sectional study was conducted on 91 adult human humeri obtained from the Departments of Anatomy, Faculty of Medicine, University of Peradeniya, Faculty of Medicine, Wayamba University of Sri Lanka, and the Faculty of Indigenous Medicine, Gampaha Wickramarachchi University of Indigenous Medicine. Nutrient foramina were identified using a magnifying lens, and measurements of humeral length, distance from the proximal end to the nutrient foramen, shaft circumference, and foramen index were recorded. The longitudinal position, surface distribution, and size of nutrient foramina were also assessed. Data were analyzed using SPSS version 23.0, and bilateral comparisons were performed using the independent samples t-test.

Results: Detailed analyses on 90 humeri (45 right and 45 left). The mean foramen index was 55.06 ± 6.66 for right humeri and 56.09 ± 6.72 for left humeri, with no significant bilateral difference ($p = 0.470$). Nutrient foramina were predominantly located in the middle one-third (95.6%) and on the anteromedial surface (77.8% of right and 86.7% of left humeri). The majority of nutrient foramina corresponded to the 26G needle (71.1%). Shaft circumference at the level of the nutrient foramen was significantly greater in right humeri than in left humeri ($p = 0.025$), while other morphometric parameters showed no significant side differences.

Conclusion: Nutrient foramina of the adult humerus exhibit a highly consistent anatomical pattern in the Sri Lankan population, being predominantly located on the anteromedial surface of the middle third of the shaft. These findings provide valuable anatomical reference data for orthopedic surgery, vascularized bone grafting, and forensic investigations.

Keywords: humerus; nutrient foramen; nutrient artery; morphometry; foramen index; Sri Lanka; osteology.

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Introduction

The vascular architecture of long bones is fundamental to their growth, remodeling, maintenance, and repair. Bone is a highly vascularized tissue that receives blood through an intricate network of nutrient, metaphyseal, epiphyseal, and periosteal arteries. Among these vascular components, the nutrient artery is considered the most important source of blood supply to the diaphysis and medullary cavity of long bones, contributing significantly to the nourishment of the inner two-thirds of the cortex and bone marrow (1). The nutrient artery enters the shaft of a long bone through a distinct opening known as the nutrient foramen and traverses the cortex via the nutrient canal before branching within the medullary cavity. Consequently, the nutrient foramen serves as a critical anatomical landmark reflecting the vascular pattern of the bone.

The nutrient artery develops early during embryogenesis and accompanies the process of endochondral ossification. During skeletal growth, it maintains a relatively constant anatomical relationship with the developing bone, resulting in characteristic locations and orientations of nutrient canals in different long bones (2). Hughes (1952) proposed that the direction of the nutrient canal is influenced by differential growth rates at the two ends of a long bone, giving rise to the classical anatomical principle that nutrient canals are directed away from the growing end. This developmental relationship contributes to the relatively constant topographical distribution of nutrient foramina observed within individual bones and among different populations (2).

The anatomical location and morphology of nutrient foramina are of great clinical importance in orthopedics, radiology, and forensic science. The nutrient artery is essential for bone viability and fracture healing, and its disruption can impair cortical blood supply, delay union, or lead to non-union. Therefore, preserving the nutrient artery is a key consideration during procedures such as fracture fixation, intramedullary nailing, osteotomy, and limb reconstruction (3, 4).

With advances in reconstructive and microsurgical techniques, knowledge of nutrient foramina has become increasingly important. The success of vascularized bone grafts used for complex fractures, bone defects, tumor reconstruction, and avascular necrosis depends on maintaining an adequate blood supply through the nutrient artery. Accurate understanding of the location and distribution of nutrient foramina helps optimize surgical planning, minimize vascular injury, and improve graft survival (5).

Apart from their surgical importance, nutrient foramina have relevance in diagnostic imaging and pathology. Nutrient canals may occasionally appear as radiolucent lines on radiographs and computed tomography scans, potentially mimicking fractures or pathological lesions. Familiarity with their normal anatomical location and direction helps radiologists distinguish these structures from disease processes (6). In addition, nutrient arteries may serve as routes for the hematogenous spread of infection, particularly in osteomyelitis, and may influence the dissemination of metastatic lesions within the skeletal system (7). Nutrient foramina may also provide useful information in forensic anthropology for skeletal identification, estimation of bone vascularity, and population-based osteological investigations.

The humerus is the longest bone of the upper limb and serves as the principal skeletal component connecting the shoulder and elbow joints. It plays a vital role in upper limb mobility and functions as an attachment site for numerous muscles involved in movement

and manipulation. Fractures of the humeral shaft account for approximately 3–5% of all fractures and constitute a significant proportion of upper limb injuries encountered in orthopedic practice (8). Most humeral shaft fractures occur in the middle third of the bone, a region commonly associated with the entry of the nutrient artery (9). Consequently, injury to the nutrient artery may occur either as a result of trauma itself or during surgical fixation, potentially affecting fracture healing and long-term functional outcomes.

Several studies have investigated the morphology and morphometry of nutrient foramina in the humerus and other long bones. Carroll (1963) reported that humeral nutrient foramina are predominantly located on the anteromedial surface of the shaft (10), while Mysorekar (1967) highlighted the consistency of nutrient canal distribution among different populations (11). Longia *et al.,* (1980) further demonstrated that nutrient foramina exhibit characteristic topographical patterns within long bones (12). More recent investigations by Kizilkanat *et al.,* (2007), Pereira *et al.*, (2011), Ranaweera *et al.,* (2022), and Mazengenya *et al.,* (2025) have provided detailed morphometric analyses of nutrient foramina and emphasized their importance in fracture management and reconstructive surgery (9, 13, 14, 15). Despite these studies, variations have been reported with regard to the number, size, and precise location of nutrient foramina among different ethnic and geographical populations. Such variations may reflect genetic, developmental, environmental, nutritional, and biomechanical influences on skeletal morphology.

In Sri Lanka, studies focusing on nutrient foramina of Humerus remain relatively limited. Ranaweera *et al.,* (2022) examined the morphological and morphometric characteristics of nutrient foramina in Sri Lankan humeri and reported that 74% of humeri possessed a single nutrient foramen, while 22% and 2% exhibited two and three nutrient foramina, respectively (15). The authors further demonstrated that the nutrient foramen was most commonly located on the anteromedial surface and within the middle third of the shaft, while approximately 98% of nutrient canals were directed distally, supporting the classical developmental theory proposed by Hughes (1952) (2).

Despite these valuable contributions, the available Sri Lankan evidence is based on a limited number of osteological collections. Skeletal morphology may vary among populations due to genetic diversity, environmental influences, nutritional factors, occupational activities, and regional demographic characteristics. Therefore, studies involving osteological specimens obtained from different geographical regions of Sri Lanka are important for establishing more representative baseline anatomical data for the Sri Lankan population.

This study examined adult human humeri obtained from osteological collections maintained by the University of Peradeniya (Central Province), Wayamba University of Sri Lanka (North Western Province), and Gampaha Wickramarachchi University of Indigenous Medicine (Western Province). The inclusion of specimens from different geographical regions provides broader population-based data on humeral nutrient foramina in Sri Lanka. The study assessed the location, surface distribution, size, shaft circumference at the foraminal level, and foramen index of nutrient foramina, together with side-related variations. These findings contribute to the anatomical database of the Sri Lankan population and provide clinically relevant information for orthopedic, radiological, anatomical, and forensic applications.

Materials and Methods

A descriptive cross-sectional osteological study was conducted on a total of 91 adult human humeri obtained from the Department of Anatomy, Faculty of Medicine, University of Peradeniya (51 humeri), the Department of Anatomy, Faculty of Medicine, Wayamba University of Sri Lanka (20 humeri) and the Department of Basic Principles, Faculty of Indigenous Medicine, Gampaha Wickramarachchi University of Indigenous Medicine (20 humeri). The humeri were taken for the study from osteology collections which were prepared from the cadavers donated for medical education and research, with informed consent obtained from the donors prior to death. Only intact humeri with clearly identifiable anatomical landmarks were included in the study. Bones exhibiting fractures, pathological deformities, severe erosion, congenital anomalies, or any gross anatomical abnormalities that could affect measurements were excluded. The age and sex of the donors were not available in the osteological records and therefore could not be included in the analysis. However, the primary objectives of the study were to evaluate the location, distribution, size, and morphometric characteristics of nutrient foramina in adult humeri. The side of each humerus was identified and recorded as either right or left prior to data collection using standard anatomical features described by Standring & Tubbs (2025) (1).

Each humerus was carefully examined under adequate illumination using a magnifying lens to identify nutrient foramina. Nutrient foramina were distinguished from other vascular openings by the presence of a distinct nutrient canal and a characteristic oblique course through the cortex. The number of nutrient foramina present in each specimen was recorded. In bones with multiple nutrient foramina, the largest foramen with the most prominent canal was considered the principal nutrient foramen and was selected for detailed morphometric analysis.

Morphometric data were collected using an osteometric board and a flexible measuring tape. The total length of each humerus was measured as the maximum distance between the most superior point of the humeral head and the most distal point of the trochlea, following the standard osteometric methodology described by Bass (2005) (Figure 1) (16). The distance from the proximal end of the humerus to the nutrient foramen was measured from the most superior point of the humeral head to the center of the nutrient foramen following the methodology described by Hughes (1952) (2). The circumference of the shaft at the level of the nutrient foramen was measured using a flexible measuring tape. The direction of the nutrient canal was determined by gently introducing a fine probe into the nutrient foramen to assess its orientation along the shaft, in accordance with standard osteological methods (9).

The position of the nutrient foramen along the shaft was quantified using the Foramen Index (FI) described by Hughes (1952), calculated as the distance from the proximal end to the nutrient foramen divided by the total length of the humerus and multiplied by 100 (2). This index provides a standardized method for expressing the relative position of the nutrient foramen and allows comparison among specimens and populations. To assess longitudinal distribution, the shaft of each humerus was divided into upper, middle, and lower thirds based on the total bone length. The segment containing the nutrient foramen was recorded accordingly.

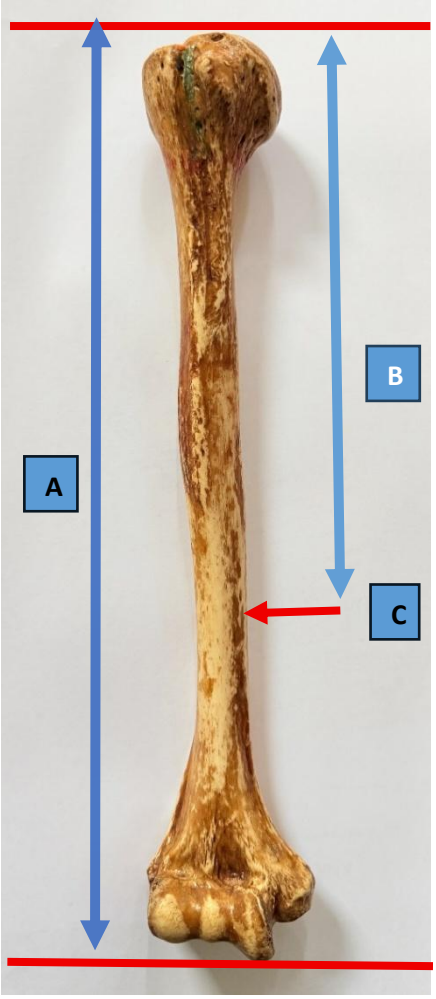


Figure 1: Measurements of the humerus for localization of the nutrient foramen. A- Total length of humerus (the maximum distance between the most superior point of the humeral head and the most distal point of the trochlea); B- The distance from the proximal end of the humerus to the nutrient foramen (the most superior point of the humeral head to the center of the nutrient foramen); C- The center of the nutrient foramen

The anatomical surface on which the nutrient foramen was located was identified and classified as the anteromedial, anterolateral, or the posterior surface of the humeral shaft (1). The frequency of occurrence on each surface was documented. The size of the nutrient foramen was estimated using hypodermic needles of different gauges. The largest needle that could be inserted into the nutrient foramen without applying force was used to classify the foramen size. Needles of 21G, 24G, and 26G were employed for this purpose, representing large, medium, and small foramina, respectively. To ensure consistency and minimize observer-related variability, all observations and measurements were performed by a single investigator. Each measurement was repeated three times, and the mean value was used for subsequent analysis. Measuring instruments were calibrated before data collection to maintain accuracy and reliability.

All data were entered into Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS) version 23.0. Descriptive statistical measures, including frequencies, percentages, means, standard deviations, minimum values, and maximum values, were calculated. Differences between right and left humeri were evaluated using the independent samples t-test for continuous variables. Where appropriate, associations between categorical variables were assessed using the chi-square test. Statistical significance was established at a p-value of less than 0.05.

The study was conducted in accordance with accepted ethical principles governing the use of human skeletal materials for research and education. The specimens were obtained from legally donated cadavers maintained by the respective anatomy departments. Institutional permission was obtained from the relevant authorities of the Faculty of Medicine, University of Peradeniya, the Faculty of Medicine, Wayamba University of Sri Lanka and the Faculty of Indigenous Medicine, Gampaha Wickramarachchi University of Indigenous Medicine Sri Lanka prior to the commencement of the study.

Results and Analysis

A total of 91 adult human humeri were examined in the present study. One right humerus was found to lack a nutrient foramen; therefore, detailed morphometric and topographical analyses were performed on the remaining 90 humeri, comprising 45 right and 45 left specimens. The morphometric characteristics, location, surface distribution, and size of the nutrient foramina are presented below.

The morphometric measurements of the humeri and the nutrient foramina are summarized in Table 1. The mean total length of the right humeri was 31.11 ± 1.55 cm, while that of the left humeri was 30.65 ± 1.71 cm. The mean distance from the proximal end of the humerus to the nutrient foramen was 17.15 ± 2.36 cm on the right side and 17.18 ± 2.18 cm on the left side. The mean shaft circumference at the level of the nutrient foramen measured 6.12 ± 0.44 cm in right humeri and 5.89 ± 0.50 cm in left humeri. The mean foramen index was 55.06 ± 6.66 for right humeri and 56.09 ± 6.72 for left humeri.

Comparison between the two sides demonstrated that only the shaft circumference at the level of the nutrient foramen differed significantly between right and left humeri ($p = 0.025$). No statistically significant side differences were observed for total humeral length ($p = 0.185$), distance from the proximal end to the nutrient foramen ($p = 0.952$), or foramen index ($p = 0.470$).

The distribution of nutrient foramina according to the longitudinal thirds of the humeral shaft is shown in Table 2. Nutrient foramina were predominantly located in the middle one-third of the shaft, accounting for 95.6% of both right and left humeri. Only 4.4% of nutrient foramina were observed in the lower one-third of the shaft on each side, while no nutrient foramina were identified in the upper one-third of any specimen.

The distribution of nutrient foramina according to the anatomical surface of the humeral shaft is presented in Table 3. The anteromedial surface was the most common location for nutrient foramina on both sides, accounting for 77.8% of right humeri and 86.7% of left humeri. The posterior surface represented the second most frequent location, with 13.3% of right and 8.9% of left humeri exhibiting nutrient foramina on this surface. The anterolateral surface was the least common site, observed in 8.9% of right and 4.4% of left humeri.

The size distribution of nutrient foramina, estimated using hypodermic needles of different gauges, is presented in Table 4. The majority of nutrient foramina on both sides corresponded to the 26G needle, representing 71.1% of both right and left humeri. Medium-sized foramina (24G) accounted for 24.5% of right and 26.7% of left humeri, whereas large foramina (21G) were uncommon, occurring in only 4.4% of right and 2.2% of left humeri.

Discussion

The present study provides a comprehensive morphometric and topographical analysis of nutrient foramina in adult human humeri from Sri Lankans using osteological collections from three academic institutions in three geographical locations of Sri Lanka. Knowledge of nutrient foramen morphology is essential because the nutrient artery provides the principal endosteal blood supply to the medullary cavity and the inner two-thirds of the cortical bone, thereby playing a critical role in bone growth, remodeling, fracture healing, and the success of reconstructive procedures (1, 3).

Table 1: Morphometric characteristics of adult human humeri and nutrient foramina

Measurement	Right (Mean ± SD)	Min	Max	Left (Mean ± SD)	Min	Max	p-value
Total length (cm)	31.11 ± 1.55	27.50	34.00	30.65 ± 1.71	27.00	34.00	0.185
Distance from proximal end (cm)	17.15 ± 2.36	11.00	21.00	17.18 ± 2.18	12.00	21.00	0.952
Circumference at nutrient foramen (cm)	6.12 ± 0.44	5.40	7.20	5.89 ± 0.50	4.80	7.00	0.025*
Foramen Index	55.06 ± 6.66	37.67	65.02	56.09 ± 6.72	38.98	66.23	0.470

Statistically significant ($p < 0.05$)

Table 2: Longitudinal distribution of nutrient foramina in the humeral shaft

Position	Right n (%)	Left n (%)
Upper one-third	0 (0.0)	0 (0.0)
Middle one-third	43 (95.6)	43 (95.6)
Lower one-third	2 (4.4)	2 (4.4)

Table 3: Surface distribution of nutrient foramina in adult human humeri

Surface	Right n (%)	Left n (%)
Anterolateral	4 (8.9)	2 (4.4)
Anteromedial	35 (77.8)	39 (86.7)
Posterior	6 (13.3)	4 (8.9)

Table 4: Size distribution of nutrient foramina based on hypodermic needle gauge

Needle gauge	Right n (%)	Left n (%)
21G	2 (4.4)	1 (2.2)
24G	11 (24.5)	12 (26.7)
26G	32 (71.1)	32 (71.1)

The present findings reinforce the anatomical consistency of the nutrient foramen in the humerus while providing additional population-specific data that expand the existing Sri Lankan anatomical database.

Nutrient foramina were identified in 98.9% of the examined humeri, with only one right humerus lacking a detectable nutrient foramen. Similar incidences have been reported by Carroll (1963), Mysorekar (1967), Kizilkanat *et al.,* (2007), Pereira *et al.,* (2011), and Mazengenya *et al.,* (2025), where nutrient foramina were present in more than 95% of specimens (9, 10, 11, 13, 14). The occasional absence of a nutrient foramen is generally attributed to developmental variation or compensation by enlarged periosteal, metaphyseal, or epiphyseal vessels supplying the diaphysis. Although uncommon, such anatomical variations are clinically important because interruption of the remaining vascular supply during trauma or surgery may compromise cortical perfusion and negatively influence fracture healing.

Morphometric analysis demonstrated no statistically significant differences between right and left humeri with respect to total bone length, the distance from the proximal end to

the nutrient foramen, or the foramen index. These findings indicate a high degree of bilateral symmetry in the position of the nutrient foramen and are consistent with previous investigations conducted among Turkish, Brazilian, Indian, South African, and Sri Lankan populations (9, 13, 14, 15). The observed consistency supports Hughes' developmental theory, which proposes that the nutrient artery enters the cartilaginous model of the developing long bone early in embryogenesis and maintains a relatively constant position throughout skeletal growth (2). Consequently, the anatomical location of the nutrient foramen appears to be highly conserved despite population differences in stature, body size, and environmental influences.

The foramen index has been widely used as a standardized parameter to describe the relative position of the nutrient foramen independent of bone length (2). In the present study, the mean foramen index ranged from 55.06% to 56.09%, indicating that the nutrient foramen is typically situated slightly distal to the midpoint of the humeral shaft. These values closely resemble those reported by Pereira *et al.,* (2011), Ranaweera *et al.,* (2022), and Mazengenya *et al.,* (2025), suggesting that the location of the nutrient artery is remarkably stable across diverse populations (9, 14, 15). Such consistency provides surgeons with a predictable anatomical landmark during procedures involving the humeral shaft and may assist forensic anthropologists when reconstructing incomplete skeletal remains.

The overwhelming majority of nutrient foramina (95.6%) were located within the middle one-third of the humeral shaft, while only 4.4% occurred in the lower one-third and none were identified in the upper one-third. This distribution is highly consistent with the observations of Carroll (1963), Longia *et al.,* (1980), Mysorekar (1967), Kizilkanat *et al.,* (2007), Pereira *et al.,* (2011), Ranaweera *et al.,* (2022), and Mazengenya *et al.,* (2025), all of whom identified the middle third as the predominant site of nutrient artery entry (9-15). The findings also corroborate the only previous Sri Lankan study on humeral nutrient foramina conducted by Ranaweera *et al.,* (2022), which similarly demonstrated that almost all nutrient foramina were located in the middle third of the shaft (15). The agreement between the two studies suggests that this distribution is a characteristic feature of the Sri Lankan population and is likely determined by developmental rather than environmental factors.

The predominance of nutrient foramina within the middle third of the humerus has considerable clinical implications because this region corresponds to the most common site of humeral shaft fractures (8). Injury to the nutrient artery may occur either at the time of fracture or during operative interventions such as plating, intramedullary nailing, or external fixation. Experimental investigations have demonstrated that disruption of the nutrient artery reduces cortical blood flow, delays callus formation, and may contribute to delayed union or non-union, particularly when periosteal blood supply is simultaneously compromised (3). Therefore, detailed knowledge of nutrient foramen location may facilitate surgical planning and encourage biological fixation techniques that preserve both periosteal and endosteal vascularity (4).

The present study further demonstrated that the anteromedial surface was the predominant site of nutrient foramina, accounting for 77.8% of right and 86.7% of left humeri. Similar observations have consistently been reported by Carroll (1963), Mysorekar (1967), Pereira *et al.,* (2011), Ranaweera *et al.,* (2022), Elbeshbishy *et al.,* (2022), and Mazengenya *et al.,* (2025) (9, 10, 11, 14, 15, 17). The anteromedial location reflects the normal

anatomical course of the nutrient artery entering the humeral shaft near the insertion of the coracobrachialis muscle before passing obliquely towards the medullary cavity (1). This predictable relationship has practical surgical significance because anterior and anteromedial surgical approaches to the humerus may place the nutrient artery at risk if extensive periosteal stripping or cortical drilling is performed. Preservation of the nutrient artery has therefore become an important principle in modern fracture management and vascularized bone grafting.

Assessment of nutrient foramen size revealed that most foramina corresponded to a 26G (0.57mm to 0.72mm) hypodermic needle (71.1% for right and left), indicating relatively small nutrient foramina in the majority of specimens. Ranaweera *et al.,* (2022) studied size of the nutrient foremen of Sri Lankan with different needle gauges and they reported the smallest size of nutrient foremen represented by 27G needle (26%) among Sri Lankans (15). Although foramen diameter may indirectly reflect nutrient artery calibre, the functional importance of the vessel should not be underestimated. Even relatively small nutrient arteries contribute substantially to endosteal blood supply, and their preservation remains essential for maintaining cortical viability following trauma or surgery.

Among the morphometric parameters evaluated, shaft circumference at the level of the nutrient foramen was the only variable demonstrating a statistically significant bilateral difference, with right humeri exhibiting slightly greater circumferences than left humeri. Although the biological significance of this finding remains uncertain, it may reflect adaptive remodeling associated with limb dominance and habitual mechanical loading, consistent with the principles of Wolff's law (17). Nevertheless, because information regarding age, sex, handedness, occupation, and physical activity of the donors were unavailable, this interpretation should be considered speculative. Future investigations using documented skeletal collections would help clarify the influence of functional loading on nutrient foramen morphology.

Compared with previous Sri Lankan investigations, the present study offers several important strengths. Whereas Ranaweera *et al.,* (2022) (15) examined humeri from a single institutional collection, the present investigation incorporated specimens from three universities representing the Central, North Western, and Western Provinces of Sri Lanka. Consequently, the findings are likely to provide a more representative assessment of nutrient foramen morphology within the Sri Lankans. Furthermore, in addition to evaluating the location and surface distribution of nutrient foramina, the present study assessed foramen index, shaft circumference, and nutrient foramen size for right and left side humeri thereby providing a more comprehensive morphometric characterization than previous studies.

Despite these strengths, certain limitations should be acknowledged. The study was conducted using dry osteological specimens of unknown age and sex, precluding the assessment of demographic influences on nutrient foramen morphology. Consequently, age- and sex-related variations could not be evaluated. Although most previous studies have focused on the location and morphometry of nutrient foramina irrespective of sex, recent evidence suggests that certain parameters, such as the foramen index, may exhibit sex-related variation in some populations. Additionally, the absence of information regarding limb dominance prevented assessment of possible functional asymmetry. As measurements were obtained from dry bones, foraminal diameter may have been influenced to a minor extent by

postmortem changes, specimen preparation, or long-term preservation, although the location and distribution of nutrient foramina are unlikely to be affected. Furthermore, because only gross anatomical examination was performed, the internal architecture of the nutrient canals and their associated vascular network could not be evaluated. Future studies incorporating specimens of known age, sex, and limb dominance, together with advanced imaging techniques, would provide a more comprehensive understanding of the morphometric characteristics of humeral nutrient foramina in the Sri Lankan population.

Future studies incorporating computed tomography angiography, micro-computed tomography, or three-dimensional reconstruction techniques would improve understanding of intraosseous vascular anatomy. Additionally, investigations involving documented skeletal collections and comparisons among different ethnic groups within Sri Lanka would further clarify population-specific anatomical variations.

Conclusion

In conclusion, the present study confirms that nutrient foramina of the adult humerus exhibit a highly conserved anatomical pattern within the Sri Lankan population. The majority are located on the anteromedial surface of the middle one-third of the shaft, with a mean foramen index of approximately 55–56%, indicating a consistent position relative to total bone length. These findings closely correspond with previous international studies and validate the observations of Ranaweera *et al.,* (2022) (15) in Sri Lankan humeri. By incorporating specimens from three geographically distinct osteological collections, the present study expands the anatomical evidence available for Sri Lanka and provides clinically relevant information for orthopedic surgeons, anatomists, radiologists, and forensic anthropologists. The findings may contribute to safer surgical approaches, improved fracture management, optimization of vascularized bone graft harvesting, and a better understanding of humeral vascular anatomy in both clinical and research settings.

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