MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.6.506.509

Morphological and Morphometric Variations of the Hyoid Bone in North Indian Population

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Key Words
Morphological, morphometric, forensic identification, anthropological

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Received: 20 March 2024
Accepted: 20 May 2024
Published: 25 May 2024

Citation: Bhavna, Shubhpreet Sodhi and Khayati Sant Ram, 2024. Morphological and Morphometric Variations of the Hyoid Bone in North Indian Population. Res. J. Med. Sci., 18: 506-509, doi: 10.36478/makrjms.2024.6.506.509

Abstract
The hyoid bone, a unique structure in the human body, plays a crucial role in various physiological functions, including swallowing, speech production and airway protection. While morphological and morphometric variations of the hyoid bone have been studied in different populations worldwide, data on these variations in the North Indian population remains sparse. Understanding these variations is essential for clinical practice, forensic identification anthropological research. A sample of 30 hyoid bones was collected from individuals. The study was conducted in the Department of Anatomy at the Government Medical College, Amritsar. Morphological parameters such as shape, size presence of bony prominences were assessed. Morphometric measurements, including length, width thickness, were recorded using standard techniques. Statistical analysis was performed to determine the mean values and variations in these parameters. The study revealed considerable morphological and morphometric variations in the hyoid bone among the North Indian population sample. The mean length of the hyoid bone was found to be 3.2 cm, with a width of 4.1 cm and a thickness of 0.6 cm. Various shapes, including U-shaped (40%), V-shaped (30%) irregular shapes (30%), were observed. Additionally, bony prominences such as the greater horns (mean length: 2.5 cm), lesser horns (mean length: 1.0 cm) the body of the hyoid bone (mean width: 1.2 cm) exhibited diverse configurations and dimensions. This study provides valuable insights into the morphological and morphometric variations of the hyoid bone in the North Indian population. The findings underscore the importance of population-specific studies in understanding anatomical variations, which have implications for clinical procedures, forensic investigations anthropological research. Further research in this area is warranted to elucidate the underlying factors contributing to these variations and their clinical significance.

INTRODUCTION

The hyoid bone, an isolated U-shaped bone located in the anterior neck, is unique in its anatomical position and function. It serves as an anchor point for the tongue and is involved in several critical physiological activities, including swallowing, speech production airway protection[1]. Due to its pivotal role in these functions, variations in the morphology and morphometry of the hyoid bone can have significant clinical implications, particularly in otolaryngology, forensic science anthropology.

Previous studies have highlighted the morphological and morphometric differences in the hyoid bone across various populations. For instance, Kim *et al*.[2] reported notable variations in the shape and size of the hyoid bone among Korean adults, while another study by Ratilal *et al*.[3] documented similar findings in a Portuguese population. These variations can influence the risk of fractures, susceptibility to certain diseases the outcomes of surgical interventions[4]. Despite these extensive studies, there remains a paucity of data regarding the morphological and morphometric characteristics of the hyoid bone in the North Indian population.

Understanding population-specific anatomical variations is crucial for several reasons. Clinically, such knowledge assists surgeons in planning and executing procedures involving the neck and throat, ensuring better outcomes and reduced complications[5]. Forensically, the hyoid bone is often examined in cases of strangulation and other neck traumas, where population-specific data can aid in more accurate identifications and interpretations[6]. Anthropologically, these variations provide insights into evolutionary and genetic differences among populations, contributing to the broader understanding of human diversity[7].

In light of the above, this study aims to investigate the morphological and morphometric variations of the hyoid bone in a North Indian population sample. By providing detailed measurements and descriptions, this research seeks to fill the existing gap in literature and enhance the understanding of the anatomical characteristics of the hyoid bone within this specific population. The findings of this study are anticipated to have significant implications for clinical practice, forensic investigations anthropological research.

MATERIALS AND METHODS

Study Design and Population: This cross-sectional study was conducted in the Department of Anatomy at the Government Medical College, Amritsar, India. The study period spanned from June 2011-May 2014. A total of 30 hyoid bones were collected from cadavers of individuals of North Indian descent. Ethical approval for the study was obtained from the Institutional Ethics Committee.

Sample Collection: The hyoid bones were extracted from cadavers during routine dissections in the anatomy department. The inclusion criteria were adults aged 18 years and above, with no history of neck trauma or congenital anomalies affecting the hyoid bone. Exclusion criteria included any visible deformities or pathological changes in the hyoid bone.

Morphological Assessment: The morphological characteristics of the hyoid bone were assessed by visual inspection. Parameters such as shape (U-shaped, V-shaped, or irregular), the presence of bony prominences the overall anatomical configuration of the greater and lesser horns were recorded.

Morphometric Measurements: Standard techniques were employed to measure the morphometric parameters of the hyoid bones. A digital caliper with an accuracy of 0.01 mm was used for all measurements. The following measurements were taken:

- **Length:** Measured as the maximum distance between the tips of the greater horns.
- **Width:** Measured as the maximum transverse distance of the hyoid body.
- **Thickness:** Measured as the anteroposterior diameter of the hyoid body at its thickest point.
- **Greater Horns:** The length of the greater horns was measured from the body to the tip.
- **Lesser Horns:** The length of the lesser horns was measured from the body to the tip.

Data Analysis: The collected data were analyzed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including mean, standard deviation (SD) range, were calculated for all morphometric parameters. The morphological variations were presented as frequencies and percentages. Statistical significance was determined using appropriate tests a $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSIONS

The study examined 30 hyoid bones from individuals of North Indian descent, revealing significant morphological and morphometric variations.
Morphological Variations

The morphological assessment of the hyoid bones showed a variety of shapes and configurations. The distribution of hyoid bone shapes is summarized in

Various bony prominences, such as the greater horns and lesser horns, were observed. The greater

Table 1. Distribution of Hyoid Bone Shapes

Shape	Frequency (%)
U-shaped	12 (40%)
V-shaped	9 (30%)
Irregular	9 (30%)

Table 2: Morphometric Measurements of the Hyoid Bone

Parameter	Mean±SD	Range
Length (cm)	4.1±0.3	3.5-4.7
Width (cm)	3.2±0.4	2.6-3.8
Thickness (cm)	0.6±0.1	0.4-0.8
Length of Greater Horns (cm)	2.5±0.2	2.1-2.9
Length of Lesser Horns (cm)	1.0±0.1	0.8-1.2

horns varied in length and prominence, while the lesser horns were present in all samples but showed diversity in size and shape.

Morphometric Measurements: The morphometric parameters of the hyoid bones are presented in (Table 2). The mean values, along with standard deviations and ranges, are provided for each parameter.

Detailed Observations:

- **Length:** The mean length of the hyoid bones was 4.1 cm, with a standard deviation of 0.3 cm ranged from 3.5 cm-4.7 cm.
- **Width:** The mean width was 3.2 cm, with a standard deviation of 0.4 cm ranged from 2.6 cm to 3.8 cm.
- **Thickness:** The thickness of the hyoid bones had a mean value of 0.6 cm, with a standard deviation of 0.1 cm ranged from 0.4 cm-0.8 cm.
- **Greater Horns:** The mean length of the greater horns was 2.5 cm, with a standard deviation of 0.2 cm ranged from 2.1 cm-2.9 cm.
- **Lesser Horns:** The mean length of the lesser horns was 1.0 cm, with a standard deviation of 0.1 cm ranged from 0.8 cm-1.2 cm.

The results of this study highlight the considerable morphological and morphometric diversity of the hyoid bone within the North Indian population. The variation in shapes, including U-shaped, V-shaped irregular forms, along with differences in the size and prominence of bony structures such as the greater and lesser horns, underscores the importance of considering population-specific anatomical data.

These findings have significant implications for clinical practices, such as surgical procedures involving the neck, forensic identification anthropological studies. Further research with larger sample sizes is warranted to validate these results and explore the underlying factors contributing to the observed variations.

The findings of this study provide significant insights into the morphological and morphometric variations of the hyoid bone in the North Indian population. The observed diversity in shape and size underscores the necessity of considering population-specific anatomical data in clinical practice, forensic investigations anthropological research.

The mean length, width thickness of the hyoid bones in our sample were comparable to those reported in other populations. For instance, a study on Korean adults reported a mean hyoid bone length of 4.2 cm, which is similar to our finding of 4.1 cm[1]. However, the mean width in our study (3.2 cm) was slightly smaller than that observed in a Portuguese population, which had a mean width of 3.4 cm[2-5]. These differences highlight the potential for anatomical variation across different ethnic groups, which can influence clinical and forensic practices.

Understanding the morphological and morphometric characteristics of the hyoid bone is crucial for various medical procedures. For example, the hyoid bone's position and structure are important considerations in surgical interventions involving the neck, such as hyoid suspension surgeries for obstructive sleep apnea[3]. Accurate knowledge of hyoid bone dimensions can enhance the precision of such procedures, potentially improving patient outcomes and reducing complications.

The hyoid bone is often examined in forensic investigations, particularly in cases of strangulation. Population-specific data on the hyoid bone can aid forensic experts in distinguishing between traumatic fractures and anatomical variations[4-8]. Our findings contribute to a growing body of literature that can improve the accuracy of forensic analyses, ultimately aiding in the administration of justice.

From an anthropological perspective, the variations in hyoid bone morphology and morphometry can provide insights into evolutionary and genetic differences among populations. Studies like ours can help anthropologists trace migration patterns and understand the evolutionary adaptations of different human groups[5-10].

Limitations and Future Directions: This study had a relatively small sample size, which may limit the generalizability of the findings. Future research with larger sample sizes and more diverse populations is needed to validate our results and further explore the factors contributing to hyoid bone variations. Additionally, advanced imaging techniques could provide more detailed analyses of the hyoid bone's structural characteristics.

CONCLUSION

In conclusion, this study reveals significant morphological and morphometric variations in the

hyoid bone within the North Indian population. These findings have important implications for clinical practice, forensic science anthropological research. Population-specific anatomical data are essential for enhancing the accuracy and efficacy of medical procedures, forensic investigations anthropological studies. Further research is warranted to expand our understanding of hyoid bone variations and their clinical significance.

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