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Identification of hyoid bone morphometry in terms of gender in the Turkish population

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Abstract

Objectives: This study aimed to investigate differences in the morphology of the hyoid bone between genders.

Methods: This retrospective cross-sectional study analyzed patient records from the Akdeniz University Faculty of Medicine, Department of Radiology. The study included 51 male and female patients, aged 19 to 29, who underwent neck CT scans between January 1, 2015, and January 1, 2016. Measurements taken included the length (BL) and width (BH) of the hyoid bone corpus, length of the greater horns (CL), lower end width of the greater horns (CWI), upper end width of the greater horns (CWS), lower end length of the greater horns (CHI), upper end length of the greater horns (CHS), and the distance between the right and left upper edges of the greater horns (WCS).

Results: The values for CL, CWI, CHI, BL, BH, and WCS were significantly higher in males compared to females ($p<0.05$). However, no statistically significant difference was found between genders for CWS and CHS ($p>0.05$).

Conclusion: This study provides valuable insights that could contribute to the fields of anatomy, forensic medicine, and anthropology.

Keywords: forensic medicine; hyoid bone; morphometry; sex determination

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Introduction

The hyoid bone is connected to the pharynx, mandible, and cranium through various muscles and ligaments, playing a crucial role in swallowing and respiratory functions through its associated structures.[1] The oropharyngeal complex which is involved in swallowing, chewing, speech, and breathing, is significantly influenced by the development of the hyoid bone, as its growth affects the functionality of this region.[2–4] Understanding the morphometric characteristics of the hyoid bone can be important in the surgical treatment of cancers, as well as respiratory and swallowing disorders in this area. Additionally, abnormalities in the hyoid bone have been linked to conditions like sleep apnea.[5]

Beyond its clinical importance, the hyoid bone also serves as a useful tool in anatomy, anthropology and forensic medicine for determining gender. Previous studies have demonstrated that the fused hyoid bone exhibits sexual dimorphism, making it valuable for gender identification.[6,7] While some researchers suggest that the hyoid bone may be more useful than other bones for determining gender,[8] the accuracy of gender determination depends on the number of bones examined.[9]

Though the literature predominantly highlights the skull and pelvic skeleton as the most reliable bones for sex determination,[10] studies investigating sexual dimorphism through hyoid bone measurements are relatively scarce.

Therefore, the aim of this study is to explore potential anatomical differences between male and female hyoid bones using CT scan images and to establish new guidelines for anatomical classification based on anthropometric parameters.

This study was a poster presentation at the 17th National Anatomy Congress, 5–9 September 2016, Eskişehir, Türkiye.

Materials and Methods

This retrospective cross-sectional study was conducted using patient records from the Akdeniz University Faculty of Medicine, Department of Radiology. A total of 51 patients (29 males and 22 females), aged between 19 and 29, who underwent neck CT scans between January 1, 2015, and January 1, 2016, were included to analyze the anatomy of the hyoid bone. Measurements included the length (BL) and width (BH) of the hyoid bone corpus, length of the greater horns (CL), lower end width of the greater horns (CWI), upper end width of the greater horns (CWS), lower end length of the greater horns (CHI), upper end length of the greater horns (CHS), and the distance between the right and left upper edges of the greater horns (WCS).

Patients with neck trauma or motion artifacts were excluded from the study. The images were obtained using a Siemens Somatom Dual Source CT scanner (Siemens Healthcare AG, Erlangen, Germany) and derived from axial, sagittal, and coronal reformatted images (512×512 matrix, 1 mm section thickness, 100 kV voltage, 55 mAs current) transferred to a workstation. Additional processing was performed to isolate the hyoid bone by removing surrounding muscles, bones, and soft tissues, resulting in 3-dimensional volume-rendered images of the os hyoideum. Statistical analyses were conducted using the SPSS for Windows, version 23.0 (IBM, Armonk, NY, USA). Comparisons between male and female data were performed using Student's t-test and a p-value of <0.05 was considered statistically significant.

Results

The measurements taken from the hyoid bone are illustrated in **Figure 1**. The average values of the data and corresponding p-values are presented in **Table 1**. Significant differences were found in several measurements between males and females, with CL, CWI, CHI, BL, BH, and WCS values being significantly higher in males ($p<0.05$) (**Table 1**).

For males, the average BL (length of the hyoid bone corpus) was 23.04 mm, while for females, it was 18.93 mm. The average BH (width of the hyoid bone corpus) was 9.21 mm in males and 8.02 mm in females. The average CL (length of the greater horns) was 31.44 mm in males,

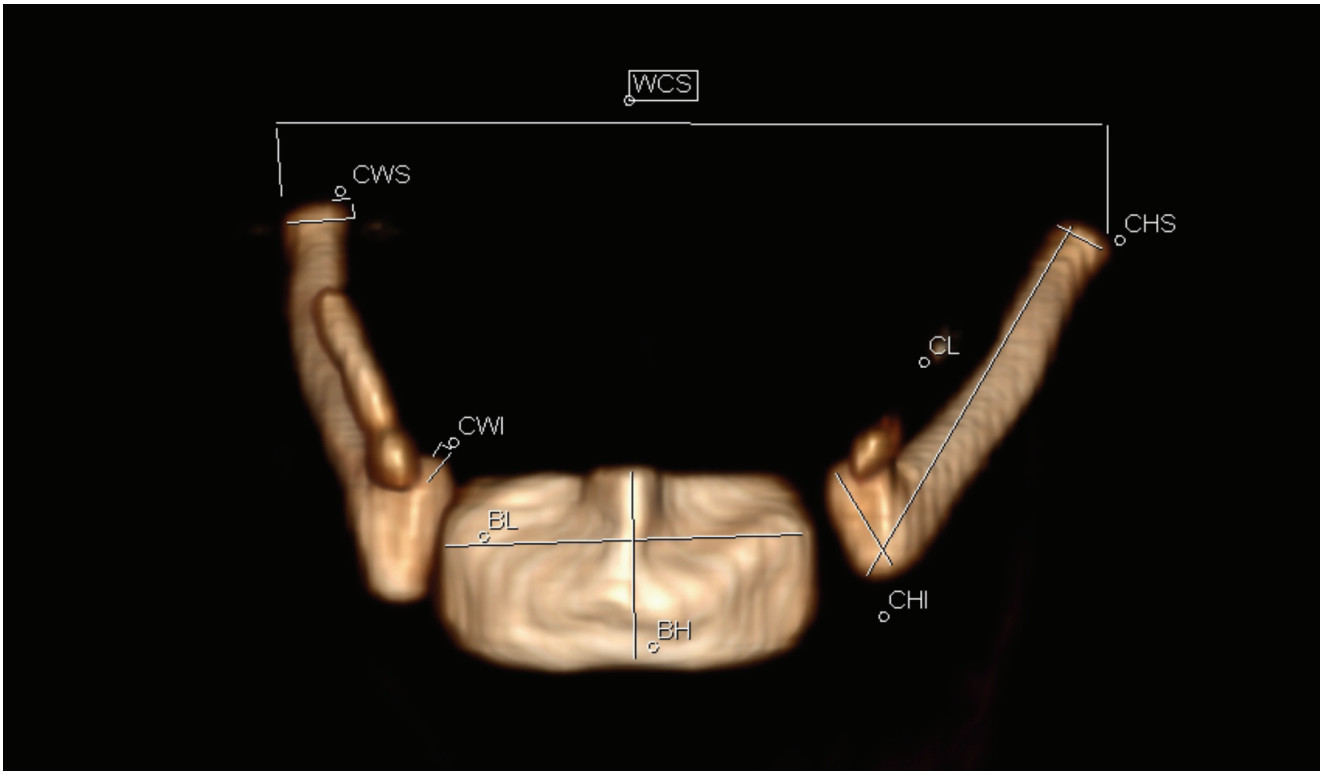

Figure 1. The measured sections on the hyoid bone. **BL:** the length of the corpus hyoid bone; **BH:** width of the corpus hyoid bone; **CL:** length of greater horns; **CWI:** the lower end width of the greater horns; **CWS:** the width of the greater horns at the upper end; **CHI:** the lower end length of the greater horns; **CHS:** the upper end length of the greater horns; **WCS:** the distances between the right and left upper edges of the greater horns.

compared to 26.55 mm in females. The average CWI (lower end width of the greater horns) was 4.93 mm in males and 3.53 mm in females. For CHI (lower end length of the greater horns), the average value in males was 7.51 mm, while in females it was 5.45 mm. The WCS (distance between the right and left upper edges of the greater horns) was 45.40 mm in males and 40.78 mm in females.

There was no statistically significant difference between the CWS (upper end width of the greater horns) and CHS (upper end length of the greater horns) values between the sexes (p>0.05) (**Table 1**). The average CWS value for both males and females was 2.78 mm. The average CHS value was 45.40 mm for males and 40.78 mm for females. The distribution of these findings by sex is shown in **Figure 2**.

Table 1
Osteometric measurements of the hyoid bone.

Dimensions	Female	Male
BL	18.93±2.76 mm	23.04±1.96 mm
BH	8.02 ±1.58 mm	9.21±1.70 mm
CL	26.55±3.75 mm	31.44±3.65 mm
CWI	3.53±0.57 mm	4.93±1.98 mm
CWS	2.78±0.35 mm	2.78±0.53 mm
CHI	5.45±1.04 mm	7.51±1.06 mm
CHS	2.94±0.49 mm	3.03±0.42 mm
WCS	40.78±4.65 mm	45.40±6.01 mm

BL: the length of the corpus hyoid bone; **BH:** width of the corpus hyoid bone; **CL:** length of greater horns; **CWI:** the lower end width of the greater horns; **CWS:** the width of the greater horns at the upper end; **CHI:** the lower end length of the greater horns; **CHS:** the upper end length of the greater horns; **WCS:** the distances between the right and left upper edges of the greater horns.

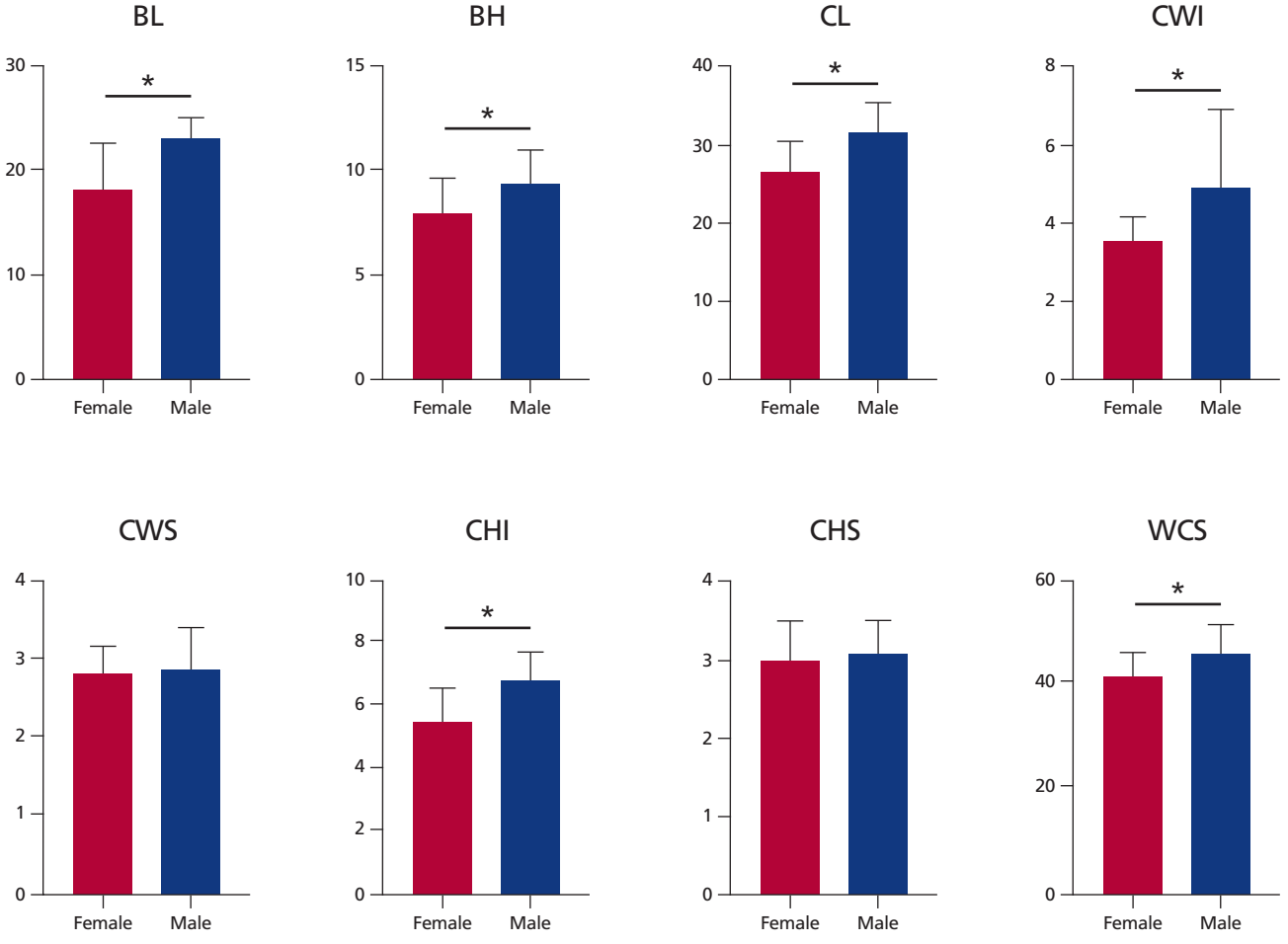

Figure 2. Distribution of measurements between male and female groups (*p<0.005). **BL:** the length of the corpus hyoid bone; **BH:** width of the corpus hyoid bone; **CL:** length of greater horns; **CWI:** the lower end width of the greater horns; **CWS:** the width of the greater horns at the upper end; **CHI:** the lower end length of the greater horns; **CHS:** the upper end length of the greater horns; **WCS:** the distances between the right and left upper edges of the greater horns.

Discussion

The morphometric values and variations of the hyoid bone are critical for both clinical and anthropological evaluations. Given its close relationship with muscles, ligaments, fascia, the sternum, and clavicle, any dysfunction of the hyoid bone can lead to both local and systemic issues.[11] Therefore, understanding the anatomical dimensions, angles, and morphology of the os hyoideum is essential in the surgical treatment of cancers, as well as respiratory and swallowing disorders in this region.[12]

In our study, we examined the morphological characteristics of the hyoid bone, specifically the body, and the height and width parameters of the greater horns (cornu majus). Although our results were similar to those of Kinschuh et al.,[8] the values for females in our study were slightly lower. When compared to the study by Dursun et al.[13] the CL, BL, BH, and WCS values were consistent. However, our CWI value was found to be approximately half of the value reported in that study

In the study by Kim et al.[14] most of the hyoid bone measurements were similar between males and females, with the exception of WCS. In our study, the WCS value for females was 40 mm, while Kim et al.[14] reported it as 35 mm. However, our WCS value for males was very similar. These small differences could be attributed to variations in the demographic characteristics of the study populations, differences in measurement techniques, or inherent differences in hyoid bone sizes.

All of our measurements showed that the hyoid bone dimensions were larger in males compared to females. Werner et al.[15] also observed that the width of the hyoid bone was greater in males, although they found the length to be longer in females. The CL, BL, and BH values of our study were consistent with those reported by Chatzioglou et al.[16] on adult hyoid bones, regardless of gender. In their study, the average WCS length was 43.89 mm, while we found it to be 40 mm in females and 45 mm in males. Similarly, while they reported an average CL length of 30 mm, we found it to be 26 mm in females and 31 mm in males.

In the study by Shimizu et al.[17] it was noted that the body and greater horns of the hyoid bone were longer in males, and the width of the corpus was wider. Our study corroborated these findings, as we also observed that the length of the greater horns, the widths of both the lower and upper ends, as well as the length and width of the corpus, were larger in males compared to females.

Conclusion

Knowing the measurements of the hyoid bone is crucial for determining both age and gender. Some researchers suggest that assessing sex from the hyoid bone is simpler compared to other bones, and thus, recommend its use in cases where bone analysis is needed for gender determination. We believe that the comprehensive measurements obtained in our study will provide valuable insights and make a significant contribution to the fields of anatomy, forensic medicine, and anthropology.

Conflict of Interest

Authors declare that they have no conflict of interest.

Author Contributions

AK: project development, data collection, data analysis, manuscript writing; SOB: project development, data analysis, manuscript writing; GA: project development, manuscript writing; MS: project development, manuscript editing.

Ethics Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the suitably constituted Ethical Committee at the Researches Department of Akdeniz University, within which the work was undertaken, and the study conforms to the Declaration of Helsinki (Protocol code:2012-KAEK-20, date: 03.08.2016).

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