



Original communication

Sex determination using mandibular anthropometric parameters in subadult Iranian samples



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ABSTRACT

Introduction: Sex determination is the first step in the identification of corpses and skeletal remains. The mandible is the largest and strongest bone of the face and has high durability. It is known that skeletal features vary by population, thus the need to establish population-specific standards. In this study, for the first time, we investigated mandibular anthropometric parameters for sex determination in subadult Iranian cadavers.

Methods: Eight mandibular anthropometric parameters were measured in 45 Iranian cadavers below the age of 20 (23 males and 22 females corpses), and the relationships of these variables with gender were determined. Collected data were analyzed using descriptive analysis, ROC curve, cross tabulation and discriminant analysis in SPSS 13.

Results: No significant statistical difference was seen in the mandibular anthropometric values between the two genders in samples below the age of 12. In the 12–19 age group, accuracy of symphyseal height and bigonial breadth in differentiation of gender was 69% and 86.2% respectively.

Conclusion: Although mandibular anthropometric parameters are not helpful in sex determination below the age of 12, if for some reasons such as explosions, air disasters and other accidents, only the mandible is available, symphyseal height and mandibular bigonial breadth could be used to determine the gender with high accuracy.

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1. Introduction

Skeletal remains from air disasters, natural disasters, explosions, mutilations, etc. are sent to forensic medicine departments.^{1,2} The known problem in forensic medicine is identification and sex determination which is in need of knowledge and expertise in anatomy, radiology, archeology, dentistry and other pertinent fields.³

Nearly all parts of the human skeleton are studied for sex determination and the accuracy of sex determination by different bones is investigated in some populations.⁴ Anthropometric parameters of some bones such as tibia, clavicle and radius in sex determination have been evaluated in previous studies in Iran.^{5–7}

Morphological, metric and molecular studies are also available.¹ Morphological criteria are observable and of course, need enough experience, but metric criteria are repeatable and are based on bone measurements which are applicable to bone fragments.⁸ Measurement techniques and data analysis can help us determine the identity with more accuracy.⁹ In addition, craniometrical measurements play a role in specific scenarios of sex determination.¹⁰

Mandibular growth begins in the fifth week of gestation from the ventral mesenchyme. At birth, mandible is in two halves which fuse anteriorly via a fibrous tissue that ossifies in the first year of life.¹¹

Mandible is the largest and strongest bone of the face, therefore, in comparison to other facial bones, remains for a longer time and has a slower degradation.¹¹ Several studies have examined mandibular anthropometric measurements in different races for gender identification and mandibular accuracy for sex determination is reported to be 80.2–92% in adults.^{2–4,8–13} Some researchers

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have used the mandible in age estimation,¹⁴ and others have studied its odontometrics in sex determination in subadults,¹⁵ but knowledge of mandibular parameters in gender determination in subadult population is scarce.¹⁶ To date, sex determination of subadult skeletal remains with satisfactory accuracy remains an important issue in archaeological research and forensic practice.¹⁶

As skeletal features vary by population, each population requires its own standards for assessment,^{12,13} given the fact that few studies investigated the mandible to determine the sex in subadult samples.^{17,18}

In this study, mandibular anthropometric measurements for gender determination were studied in Iranian cadavers younger than the age of 20.

2. Materials and methods

The study population of this cross-sectional investigation consisted of Iranian cadavers younger than the age of 20, which were brought to Tehran autopsy hall of Legal Medicine Organization from 2011 to 2012. The study was carried out on 45 cadavers. Nine male and 7 female cadavers were under the age of 12. Fourteen male and 15 female cadavers were in the 12–19 years old age group.

Exclusion criteria were unidentified cadavers, refusal to provide a written consent by the first-degree relatives, severely burned bodies, traumatic mandibular fractures and skeletal anomalies.

After obtaining written consent from the first-degree relatives of the deceased and according to the inclusion and exclusion criteria in cadavers which needed autopsy to determine the cause of death, neck dissection was performed with a Y incision expanded to the face. Without removal of the bone, mandibular anthropometric measurements including symphyseal height, mental foramen to basal border distance, mental foramen to alveolar border distance, mental angle, minimum ramus breadth, gonion (mandibular angle), mandibular body length and bigonial breadth were recorded (Fig. 1). All measurements were performed on the right side and the face was reconstructed after dissection.

Measurements were done using a caliper with an accuracy of 0.1 mm and angles were measured by a goniometer. In order to

determine the mandibular body length, distance between gonion and gnation was measured by placing a rod below the mandible between these two points.

Descriptive statistical analysis (frequency-descriptive), ROC curve analysis, cross tabulation and discriminant analysis were used to analyze the data in SPSS 13.

3. Results

In cadavers younger than 12 years old, the mean age was 5.82 ± 4.03 yrs and in the 12–19 years old age group, the mean age was 16.38 ± 2.24 yrs.

Mandibular anthropometric measurements were not significantly different between the two genders, in cadavers below the age of 12 ($p > 0.05$). In the 12–19 years age group, symphyseal height and bigonial breadth were significantly different between males and females. Sex differentiation accuracy of symphyseal height and bigonial breadth was 69.0% ($p = 0.034$) and 86.2% ($p = 0.001$) respectively. Table 1 presents mandibular anthropometric measurements of the studied samples.

ROC curve was used for calculation of sensitivity and specificity of symphyseal height and bigonial breadth for sex determination in 12–19 years age group. Based on symphyseal height measurements, with the 3.25 cm cut point, calculated sensitivity and specificity for gender determination was 80% and 57% respectively. For bigonial breadth with a 7.85 cm cut point, calculated sensitivity and specificity for gender determination was 74% and 100% respectively.

Using Fisher's linear discriminant function test, the following formula was obtained which could predict gender with 86.2% accuracy:

$$A = [(Bigonial\ breadth(cm) \times 22.163)] - 84.027$$

$$B = [(Bigonial\ breadth(cm) \times 52.009)] - 106.804$$

If $A > B$, mandible belongs to a female cadaver otherwise it is for a male.

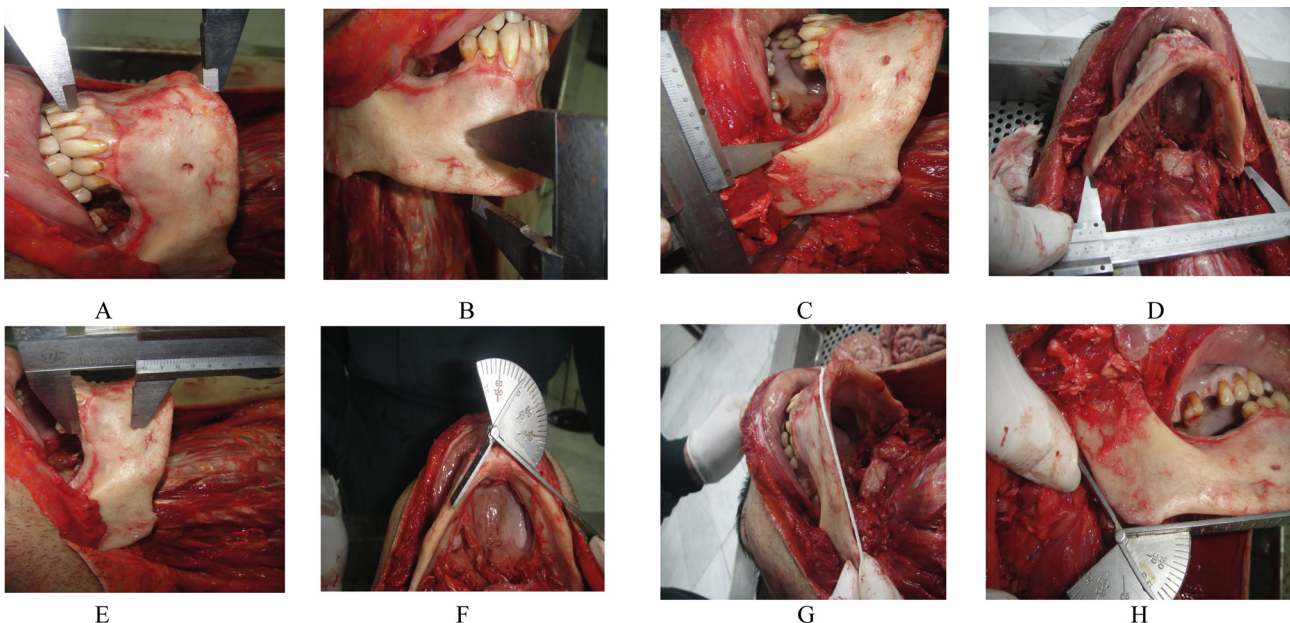


Fig. 1. Technique of measurement of Symphyseal height (A), Mental foramen to basal border distance (B), Minimum ramus breadth (C), Bigonial breadth (D), Mental foramen to alveolar border distance (E), Mental angle (F), Body length (G), and Mandibular angle (H).

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