

Sex estimation from mandible using lateral cephalogram: A short study

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Abstract

The mandible is seen as an important tool for radiological identification because of several growth parameters that can be exploited using cephalometric analysis, ease of imaging, and no overlying bony structures. These parameters can be handy in sex estimation in extreme situations like mass disasters, remains of dead, exhumed and murderous mutilations, missing or severely burnt individuals, etc. The study was conducted on randomized 80 lateral cephalograms obtained from the Department of Oral Medicine and Radiology. The three linear measurements of mandibular growth were mandibular body length, mandibular length and mandibular height. Gonial angle was measured as the angle formed by the ramus line (RL) and mandibular line (ML). The values obtained were statistically analyzed by Student's *t*-test using SPSS version 24.0. After obtaining all the measurements, unpaired '*t*-test' was performed. The gonial angle, height of ramus, mandibular length showed statistically significant sex difference. Whereas mandibular body length were statistically non-significant in gender determination. The linear and angular parameters used in the study, when combined together, might prove to be of importance in studying the growth pattern of mandible in males and females for sex estimation.

Keywords

Mandible; Linear measurements; Sexual dimorphism; Lateral cephalogram.

Introduction

Recognition of gender is an important aspect of identification of an individual and is an important part of the medicolegal practice where forensic odontology has an important role.¹ Apart from the pelvis, mandible exhibits great amount of sexual dimorphism in the human body. The mandible is used as an important tool for radiological identification due to several growth parameters that can be recorded by using cephalometric analysis, ease of imaging, and no overlying bony structures. These parameters can be used in sex estimation in extreme conditions like mass disasters, remains of dead, exhumed and murderous mutilations, missing or severely burnt individuals, etc.² The equipment required for lateral cephalometry is readily available and the technique is cost effective, easy to perform offers quick results. So the lateral cephalogram is a reliable tool which can be routinely used for forensic and anthropological purposes.³ With this background the present study was focused towards the identification of sex by gonial angle and measuring three linear measurements of mandibular growth.

Materials and Methods

The aims and objectives were to assess the mandibular growth parameters such as total mandibular body length, mandibular

length, mandibular height and gonial angle using lateral cephalogram in the study population for determination of sex of an individual. Radiographs with Class I skeletal base are included and radiographs with skeletal class II or III skeletal base were excluded (because of exaggerated growth). Patients with missing teeth or with syndromes, cleft lip or palate, or other craniofacial pathology, were also excluded.

The study was conducted on randomized 80 lateral cephalograms obtained from the Department of Oral Medicine and Radiology data base. The study used the following cephalometric landmarks; condylon (Co), gonion (Go), and gnathion (Gn). Three linear measurements of mandibular growth were; mandibular body length (distance between Go and Gn Figure 1) mandibular length (distance between Co and Gn Figure 2) and mandibular height (distance between Co and Go Figure 3) as per the study conducted by Rai et al.⁴ These measurements were done using a mouse driven cursor. Gonial angle was measured as the angle formed by the ramus line (RL) and mandibular line (ML), where RL is a tangent to the posterior border of mandible and ML is the lower border of the mandible through the Gn as per the study conducted by Upadhyay et al.⁵ (Figure 4) All the measurements were done on a computer monitor using a mouse driven cursor and mathematical protractor. The values obtained were statistically analyzed by Student's *t*-test using IBM SPSS version 24.0.

Results

The study constituted of 80 participants out of which 40 were females and 40 were males. The age range was 10–35 years. Table 1 describes the distribution of samples and mean values of various linear measurements and gonial angle among males

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and females. In males, the mean values for mandibular body length, mandibular length, and the mandibular height, and the gonial angle were observed to be 76.01 mm, 108.7 mm, 51.35 mm, and 122°, respectively. In females, the mean values for mandibular body length, mandibular length, and the mandibular height, and the gonial angle were observed to be 73.76 mm, 105.22 mm, 48.49 mm, and 125.13° respectively.

Table 2 shows the sex differences in the different mandibular measurements studied. Statistically significant sex differences were observed for the mandibular length, the mandibular height, and the age of the study participants ($p < 0.05$).



Figure 1: Mandibular body length

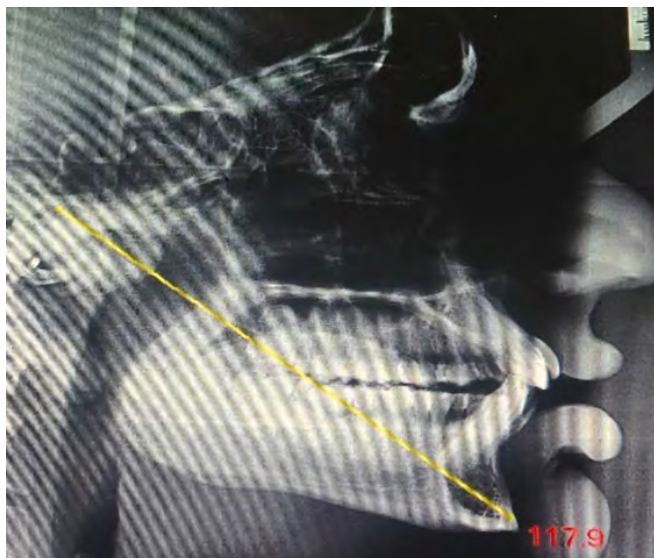


Figure 2: Mandibular length

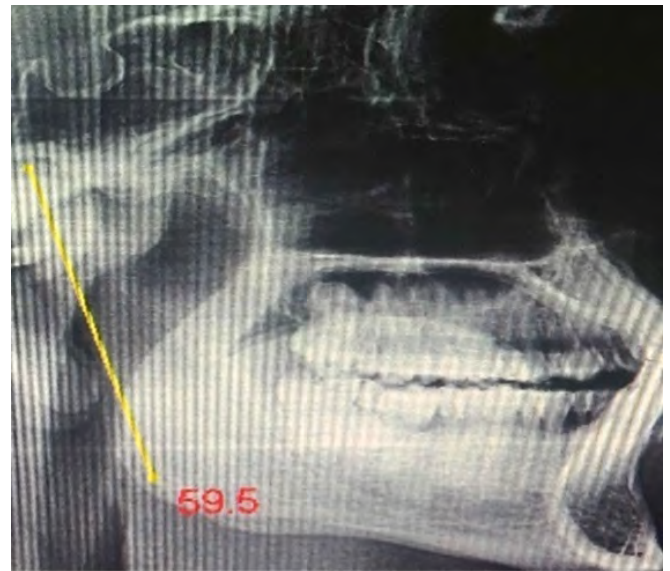


Figure 3: Mandibular height

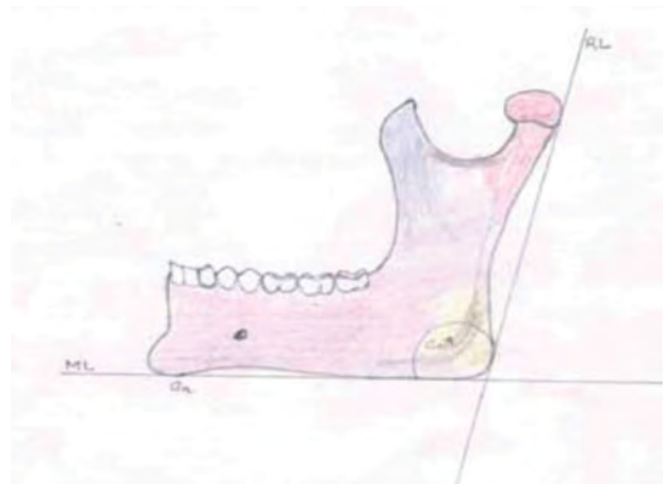


Figure 4: Measurement of gonial angle

Table 1: Group Statistics

| Parameter | Gender | N | Mean | SD | SEM |
|------------------------------|--------|----|----------|---------|---------|
| Mandibular Body Length (MBL) | Male | 40 | 76.0125 | 6.46181 | 1.02170 |
| | Female | 40 | 73.7625 | 5.09739 | .80597 |
| Mandibular Length (ML) | Male | 40 | 108.6975 | 7.55671 | 1.19482 |
| | Female | 40 | 105.2150 | 5.02504 | .79453 |
| Mandibular Height (MH) | Male | 40 | 51.3500 | 7.42784 | 1.17444 |
| | Female | 40 | 48.4925 | 3.97204 | .62804 |
| Gonial Angle (GA) | Male | 40 | 122.0000 | 7.07107 | 1.11803 |
| | Female | 40 | 125.1250 | 6.68403 | 1.05684 |

SD = Standard deviation; SEM = Standard error of the mean

Table 2: Sex differences in the different mandibular measurements investigated in the present study

| Measurement | t-score | p-value |
|-------------|---------|---------|
| Age | 1.009 | 0.033 |
| MBL | 1.729 | 0.115 |
| ML | 2.427 | 0.001 |
| MH | 2.146 | <0.001 |
| GA | 2.031 | 0.785 |

MBL = mandibular body length; ML = mandibular length; MH = mandibular height; GA = gonial angle

Discussion

In the present study, linear and angular parameters of mandibular growth were analyzed on cephalometric radiographs and were used to study the mandibular growth rate between male and female groups and the linear and angular measurements were compared between males and females. It has been observed that the mandible grows in a posterior superior direction resulting in an anterior-inferior displacement and that mandibular sagittal growth is due to anterior resorption in the ramus.

In the present study the mean value of the height of ramus of mandible was found to be 51.3 mm in males and 48.49 mm in females. The standard deviation for height of ramus in males was 7.42784 and in females was 3.97204. The values in the female mandibles was lesser compared to that obtained in males. Study conducted by Rai et al.⁶ showed mean mandibular ramus height was greater in males (53.9 cm) than in females (51.8 mm) and there was a statistically significant correlation in the height of ramus between the male and female mandibles. Study conducted by Al-Shamout et al.⁷ concluded that males have higher values of the height of ramus compared to female counterparts and statistically significant gender differences were recorded in the height of ramus. In accordance with studies done by Rai et al.⁶ and Al-Shamout et al.⁷ our study showed statistically significant differences between male and female mandible height with a p value of 0.036.

In the present study the mean value of gonial angle was found to be 122° in males and 125.2° in females. The standard deviation in males was 7° and females was 6°. The values of female mandibles were higher than that of males. Study conducted by Vinay et al.⁸ found that mandibular angle of male mandible varies from 111° – 136° with an average of 121° ± 6° and that of female mandible varies from 97° – 137° with an average of 122° ± 7°. The gender differences in mean values of mandibular angle of males and females is not statistically significant for mandible. Jayakaran et al.⁹ in their series of 207 mandible found that the mean of mandibular angle for male mandible was 121.43° and for female 124.19°. Standard deviation was 6.99 in males and 6.90 in females. Ranganath et

al.¹⁰ found that the mean for mandibular angle in males was 110.68° and for females mean was 114.53°. Standard deviation for males was 15.50 and for female 6.95. Ayoub et al.¹¹ observed no significant difference in mandibular angle in sex determination in the young Lebanese population (83 young individuals- 40 males and 43 females) aged between 17 and 26 years. In present study there was a statistically significant difference between male and female mandible with a p value of .046.

In the present study the mean value of the mandibular length was found to be 108.6 mm in males and 105.2 mm in females. Standard deviation for mandibular angle in males was 7.5 and in females was 5.02. Jayakaran et al.⁹ in their series of 207 mandible found that the mean of mandibular length for male mandible was 7.44 cm and for females was 7.06 cm. Standard deviation was 0.41 in males and 0.47 in females. Ranganath et al.¹⁰ in their study on 111 mandibles showed that the mean of mandibular angle in males was 6.78 cm and for females 6.63 cm. Standard deviation for male was 0.94 and for female was 0.76. Study by Ongkana et al.¹² on 102 mandibles showed that the mean value of mandibular length for male mandible was 8.94 cm and for females was 8.53 cm. Standard deviation for male was 0.60 and for females was 0.55. Vinay et al.⁸ in their study found the mean value of the mandibular length to be 7.54 cm in males and 7.25 cm in females. Standard deviation for mandibular angle in male was 0.43 and in female was 0.51. The demarking point of mandibular length for males was 8.81 and for females was 6.22. Limiting point for mandibular length was 7.36, by which 66.02% of male and 53.01% of female were correctly sexed. The t-value of mandibular length was 4.83. The sex differences in mean values of mandibular length of males and females was statistically significant (p<0.0001) for mandible bone. In accordance with studies done Vinay et al.⁸, Jayakaran F et al.⁹, Ranganath et al.¹⁰ and Ongkana et al.¹² our study showed statistical significant difference between male and female mandible length with a p value of 0.018.

In the present study the mean value of the mandibular body length was found to be 76.1 mm in males and 73.3mm in females. Standard deviation for mandibular body length in males 6.4 and in females was 5.0 which does not show statistically significant differences.

Conclusion

Human skeletal examination plays an important role in anthropology and medicolegal work to identify the individual. Sometimes if a part of bone is also available, sex and age can be determined based upon different morphological and metrical parameters. The present study utilizes the 4 different metrical parameters like gonial angle, height of mandible, mandibular length and mandibular body length. The application of these parameters along with morphological features could be a useful

tool for sex determination of mandibles. This is the first time where 4 different linear measurements have been used for sex estimation and out of those measurements all the other parameters showed significant sex differences except mandibular body length.

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Conflict of interest: None to declare

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