

# Gender Determination by Radiographic Evaluation of Condylar Length, Coronoid Height and Gonial Angle

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## Abstract

**Introduction:** Forensic dentistry plays an important role in the identification of the gender of an individual in situations like natural disasters (eg. earthquakes, floods, etc.) or man-made disasters (such as accidents and bombings). Among all the bones in the human body, the pelvis and the skull show the maximum sexual dimorphism. But in cases where an intact skull is not found, the mandible becomes our first choice for gender determination, as it is covered with dense, compact bone, which makes it very durable and well-preserved. **Aims and Objectives:** To determine the effectiveness of condylar height, coronoid height and gonial angle of the mandible for sex determination using orthopantomography and to compare and determine the most reliable parameter for gender determination. **Materials and Method:** This study was conducted using digital panoramic images of 25 patients of each gender. The images captured were viewed on AutoCAD 2014 software and were subjected to measurements of the condylar, coronoid heights and gonial angles both on the left and right side using AutoCAD 2014 imaging software. The data was entered into a Microsoft Excel sheet and statistical analysis was done. **Results:** The Student t-test showed significant ( $P < 0.05$ ) differences and higher values for both condylar height and coronoid height on both the right and left sides of males as compared to females. However, the difference in the mean gonial angle on both the right and left sides did not differ ( $P > 0.05$ ) between the two genders. All three variables were higher in males as compared to females. **Conclusion:** The parameters such as condylar height, coronoid height and gonial angle using orthopantomographs are reliable in gender determination and the condylar height of the left side is the best parameter in gender determination.

**Keywords:** AutoCAD, Forensic, Orthopantomograph, Sexual Dimorphism

## Introduction

Human recognition and identification become challenging during a natural disaster like an earthquake, flood, etc. or a manmade disaster such as accident, bombing, etc.

In such situations, a scientific technique like forensic dentistry plays an important role in the identification of the gender of an individual<sup>1</sup>. Forensic dentistry deals with the processing, review, evaluation and presentation of

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dental evidence to contribute scientific and objective data in legal practices<sup>2</sup>.

Among all the bones in the human body, the pelvis and the skull show the maximum sexual dimorphism, so they can serve as the most reliable source of gender identification. But in cases where an intact skull is not found, the mandible becomes our first choice for gender determination as it is covered with dense, compact bone, which makes it very durable, so it is well preserved<sup>1</sup>. The shape and size of the mandible appear to differ between the sexes from the time of development of the deciduous tooth. Males' mandibles are larger and more robust with prominent muscular attachment sites than the female mandibles<sup>8</sup>. One of the prominent changes that have been suggested is the change of the gonial angle with age and gender.

Panoramic X-ray technology is commonly accessible and is used in daily clinical practice to assess mandibular vital structures bilaterally. It also allows the visualisation of the right and left sides of craniofacial structures in a single tomographic image<sup>10</sup>. Dentists must have knowledge encompassing all the disciplines since the records obtained can identify an individual or provide information to the authorities so that neglect, fraud and abuse can be exempted<sup>12</sup>. Based on the above advancement, the purpose of the study is to determine gender by evaluation of the condylar length, coronoid length and gonial angle from an orthopantomograph using AutoCAD 2014 software<sup>1</sup>.

## Aims and Objectives

A total of 50 patients were included in the study. Orthopantomographs were taken for these patients to determine the effectiveness of condylar height, coronoid height and gonial angle of the mandible and also to compare and determine the most reliable parameter for gender determination.

## Material and Methods

### Source of Data

The study sample comprised patients who reported to the outpatient department with routine dental problems. The study consisted of 50 patients of both sexes in the age group of 20 to 40 years, while patients with any form of developmental anomalies, fractures, post-surgical cases,

or any temporomandibular joint disorders were excluded from the study.

## Procedure

1. The subjects were seated comfortably in the dental chair and his/her oral cavity was thoroughly checked to ensure the conditions satisfied the exclusion and inclusion criteria.
2. Patients were positioned for OPGD, images were adjusted as previewed, saved in JPEG format in our operating system and saved in the folder. Then the saved image is analysed by AutoCAD 2014 software.

## Methods of Measuring the Parameters

### 1. Condylar Height

Condylar height will be measured from Point B (the most superior portion of the condylar process) to Point C (the most protruding portion of the inferior border of the mandible) (Figure 1).

### 2. Coronoid Height

Coronoid height will be measured from Point A (the most superior portion of the coronoid process) to Point C (the most protruding portion of the inferior border of the mandible) (Figure 1).

### 3. Gonial Angle

The mandibular line will be constructed as a tangent to the two lowest points on the anterior and posterior borders of the mandible. The Ramal line will be constructed through the two most distal points of the ramus. The intersection of these two lines will form the gonial angle.

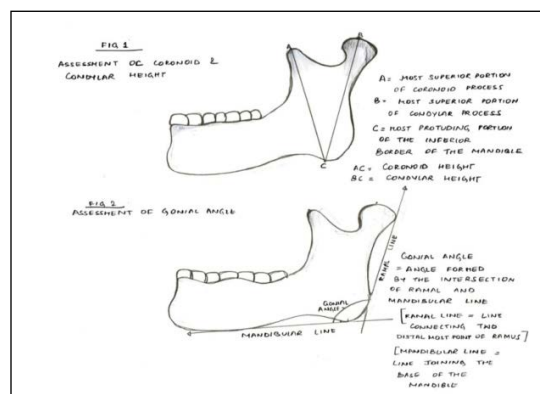


Figure 1 (a)



Figure 1 (b)



Figure 1 (c)

Figure 1. (a) Shows a diagrammatic illustration of the parameters, (b) shows the evaluation of condylar and coronoid height on AutoCAD Software and (c) shows the evaluation of gonial angle on AutoCAD software.

## Results

Differences in mean outcome measures (condylar height, coronoid height and gonial angle) between males and females were compared by an independent Student's t-test (Figure 2). A two-tailed ( $\alpha = 2$ )  $P < 0.05$  was considered statistically significant. Analyses were performed on SPSS software (Windows version 22.0).

Student's t-test showed significant ( $P < 0.05$ ) differences and higher condylar height and coronoid

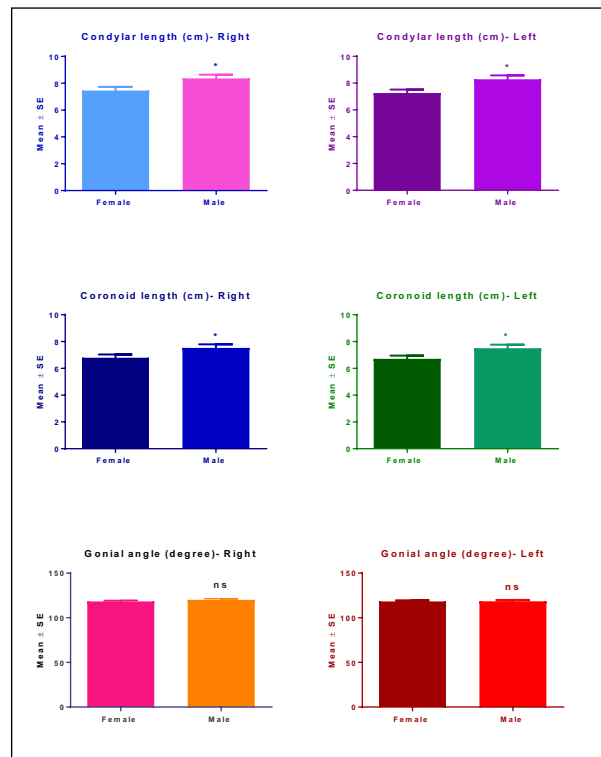


Figure 2. Comparisons of difference in mean condylar height, coronoid height and gonial angle between two genders.

Table 1. Summary and comparisons of condylar height, coronoid height and gonial angle between two genders

Outcome measure	Side	Females (n = 25)	Males (n = 25)	Mean diff	t value	P Value
Condylar height (cm)	Right	7.46 ± 0.27	8.36 ± 0.28	0.91	2.35	0.023
	Left	7.26 ± 0.26	8.29 ± 0.29	1.03	2.63	0.012
Coronoid height (cm)	Right	6.79 ± 0.25	7.53 ± 0.26	0.74	2.03	0.048
	Left	6.71 ± 0.25	7.51 ± 0.27	0.80	2.19	0.033
Gonial angle (degree)	Right	118.32° ± 1.09	120.00° ± 1.32	1.68	0.98	0.330
	Left	118.36° ± 1.20	118.44° ± 1.46	0.08	0.04	0.966

height on both the right and left sides of males as compared to females. The difference in both mean condylar height and coronoid height on the right side of males was found to be 10.9 and 9.8% higher, respectively, as compared to females. Similarly, the difference in both mean condylar height and coronoid height on the left side of males was found 12.4 and 10.6% higher respectively as compared to females. Thus, as compared to females, the males showed a higher difference in both mean condylar height and coronoid height on the left side as compared to the right side (right side < left side). However, the difference in the mean gonial angle at both the right and left sides did not differ ( $P > 0.05$ ) between the two genders, though it was 1.4 and 0.1% higher respectively in males as compared to females (Table 1).

## Discussion

Gender determination is one of the most important assay marks in forensic analysis and anthropology. There are various methods used for gender determination like morphological, metrical and biochemical methods, of which biochemical are complicated and expensive while the morphologic method may differ due to intra-examiner variability. The metrical method is comparably more advantageous to the rest of them as the values are reproducible and intra-examiner variability is less.

The objectives of the study were (i) to find out if there were any differences in outcome measures (right and left condylar height, coronoid height and gonial angle) between two genders/groups (males and females), and (ii) to find out whether these outcome measures may help to determine/discriminate the genders. Similarly, in a study done by R. Aditi, *et al.*, (2018), a total of 150 orthopantomographs of dentate subjects with an age range of 20-60 years were included for measuring the CG and CoG in a total of 300 rami. It was observed that the CG and CoG values were significantly greater in males than in females.

In our study, the maximum condylar length on the right side in females is 9.0 cm and the minimum condylar height is 2.1cm with a mean of 7.05cm. The maximum and minimum condylar heights in males are 10.8cm and 4.08 cm with a mean of 8.03 cm. The role of the condylar height of the right side is found to be highly significant in gender determination. The mean condylar length on the left side in females is 7.02cm, and the maximum and minimum condylar lengths are 8.08cm and 2.0cm respectively, whereas in males the mean condylar height

on the left side is 8.02 cm with the maximum and minimum condylar length being 11.03cm and 4.08cm respectively. In a study done by Jyothsna M., *et al.*, (2017) the maximum condylar height in females was  $6.13 \pm 0.35$  cm and in males, it was  $6.804 \pm 0.42$  cm is significantly greater in males than females, but the values are lower as compared to our study.

In this study, the maximum coronoid length on the right side in females is 8.02cm and the minimum coronoid height is 2.1cm with a mean of 6.78cm. The maximum and minimum coronoid height in males on the right side is 9.5cm and 4.0cm with a mean of 7.53cm. The mean coronoid length on the left side in females is 6.71cm, and the maximum and minimum coronoid length is 8.2cm and 1.8 cm respectively whereas in males the mean coronoid height on the left side is 7.30 cm with a maximum and minimum coronoid length of 10.03cm and 4.0 cm respectively. Similar results were obtained in a study done on orthopantomographs by Rinki, *et al.*, (2016) with a mean value of coronoid height in males and females is  $6.228 \pm 0.54$  cm and  $5.68 \pm 0.480$  cm which was found to be highly significant.

In our study, the maximum gonial angle on the right side in females is  $132^\circ$  and the minimum gonial angle is  $112^\circ$  with a mean of  $118^\circ$ . The maximum and minimum gonial angles in males are  $131^\circ$  and  $107^\circ$  with a mean of  $120^\circ$ . The mean gonial angle on the left side in females is  $118^\circ$ , and the maximum and minimum gonial angle lengths are  $133^\circ$  and  $112^\circ$  respectively whereas in males the mean gonial angle on the left side is  $118^\circ$  with the maximum and minimum gonial angle being  $131^\circ$  and  $102^\circ$  respectively. Contrary to this, in a study done by Nirmala Rao, *et al.*, (2012) there was no correlation between gonial angle and gender, while in a study done by Punnya Angadi, *et al.*, the average angle was  $122.7^\circ$  for females and  $121.1^\circ$  for males and females were more accurately identified (61.9%) than males (50.3%).

## Conclusion

This study concluded that parameters such as condylar height and coronoid height measured with orthopantomographs are reliable in gender determination and that the condylar height of the left side is the best parameter in gender determination. There seems to be a difference in gonial angle with different age groups, as well as sex, males comparatively have higher angles than females but not significant and definitively reliable. Thus, the gonial angle can serve as an adjuvant and additional



forensic parameter and scientific growth scale, which guides gender determination and age group assessment, subject to odontological status.

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