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# Exploring Corono-Condylar Distance as a Radiographic Marker for Chronological Age

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## ABSTRACT

Determining the age of an individual plays an important role in confirming identity. Facial bones serve as key markers of maturation and provide valuable insights into growth-related transformations. These bones undergo continuous changes from prenatal development through adulthood and into old age. In addition, they exhibit high resistance to fire and decomposition, making them valuable in forensic investigations even after prolonged burial. When a complete adult skeleton is available, age and gender can be determined with high accuracy. However, in cases involving mass disasters where only skeletal fragments are retrieved, the process of age estimation becomes significantly challenging. Extensive research has been conducted on dry adult skulls using various parameters for age and gender determination. However, limited studies have investigated the relationship between corono-condylar distance and age. Furthermore, the use of an orthopantomogram for this purpose has not yet been investigated. This study aimed to investigate the potential of the corono-condylar distance as a reliable parameter for age estimation using an orthopantomogram. The findings of this study showed that there is a positive correlation between the corono-condylar distance and increasing age. This suggests that the corono-condylar distance could serve as a new radiographic indicator for estimating chronological age.

**Keywords:** Age estimation, Chronological age, Corono-condylar distance, Digital radiograph, Forensic odontology

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## Introduction

Forensic odontology is a specialized branch of dentistry that bridges dental science and legal investigations. It is defined as "the field of forensic medicine that, in the interest of justice, focuses on the accurate handling, analysis, and interpretation of dental evidence" to aid in legal proceedings [1-3]. Within this discipline, dentists contribute significantly to crime scene investigations and the identification of victims in disasters or accidents. Additionally, forensic odontology plays a crucial role in detecting cases of abuse through bite mark analysis, determining an individual's age and sex, and serving as expert witnesses in court by presenting dental evidence [4, 5]. Human identification is often carried out using antemortem dental records. In situations where such records are unavailable, post-mortem profiling is conducted. The practice of dental identification dates back to 66 AD, with its first judicial acceptance occurring in the USA in 1849 [6-9].

Age determination is a critical aspect of forensic investigations. Facial bones act as maturational indicators, offering valuable insights into an

individual's developmental stages. These bones undergo progressive changes from the prenatal stage through adulthood and into old age [10, 11]. Their high resistance to fire and slow decomposition even after prolonged burial make them particularly useful in forensic examinations. When a complete adult skeleton is available, both age and gender can be defined with high precision. However, in mass disaster scenarios where only fragmented bones remain, the process of age estimation becomes significantly more complex [12-15].

Extensive research has been conducted on dry adult skulls using various parameters to determine age and sex. However, there is limited literature on age estimation based on corono-condylar distance, particularly using an orthopantomogram (OPG). Given this gap, the present study aims to evaluate the correlation between corono-condylar distance and chronological age through digital radiographic analysis, exploring its potential as a novel indicator for forensic age estimation.

## Materials and Methods

This study analyzed 100 orthopantomograms (OPGs) obtained from the Department of Oral and Maxillofacial Radiology. The radiographs were categorized into five groups, each consisting of 20 OPGs. The classification was based on age, with each group spanning a decade: group 1 (10–19 years), group 2 (20–29 years), group 3 (30–39 years), group 4 (40–49 years), and group 5 (50–59 years).

The corono-condylar distance was assessed bilaterally using Planmeca Romexis Viewer software (version 4.5.0.28). To determine this measurement, a tangent was drawn to the highest points of both the condyle and the coronoid process. The ruler tool within the software was then utilized to calculate the linear distance between these two reference points. All measurements were recorded in millimeters (mm).

**Figure 1** shows the corono-condylar distance measured using the software tool.


**Figure 1.** An OPG showing the corono-condylar distance measured using the software tool

The recorded data was systematically compiled and analyzed. Statistical evaluation involved computing the mean and standard deviation for each age group using IBM SPSS software version 20.

## Results and Discussion

On the left side, the mean corono-condylar distance measured 50.15 ± 4.14 mm in individuals aged 10–19 years and increased to 53.87 ± 2.43 mm in the 50–59 years group. For the right side, the measurements ranged from 51.83 ± 7.31 mm in the youngest age group to 54.55 ± 4.94 mm in the oldest group. A gradual increase in corono-condylar distance was observed over time, with an overall increase of 3.72 mm on the left and 2.72 mm on the right between the ages of 10 and 59 years **(Table 1)**.

**Table 1.** Mean corono-condylar distance on the right and left side

| Age (years) | CCD left (in mm) | CCD right (in mm) |
|---|---|---|
| 10-19 | 50.15 ± 4.14 | 51.83 ± 7.31 |
| 20-29 | 51.73 ± 4.49 | 52.93 ± 2.32 |
| 30-39 | 52.70 ± 3.56 | 53.88 ± 4.66 |
| 40-49 | 53.55 ± 6.77 | 53.98 ± 3.32 |
| 50-59 | 53.87 ± 2.43 | 54.55 ± 4.94 |

Note: CCD = Corono-condylar distance

This study found a progressive increase in the mean corono-condylar distance on both sides as age advanced, with a growth of 3.72 mm on the left and 2.72 mm on the right between the ages of 10 and 59 years. As individuals age, bone resorption surpasses bone formation, leading to a gradual reduction in bone mass [9]. According to researchers the number of osteons declines over time and is eventually replaced by marrow tissue [14, 15]. The mandibular growth pattern follows a posterior-superior trajectory, which results in an anterior-inferior displacement. Researchers [3] reported that this process contributes to an increase in the gonial angle, which could, in turn, be responsible for the expansion of the corono-condylar distance.

Additionally, this study noted that the increase in mean corono-condylar distance was slightly greater on the right side than on the left, with a difference of approximately 1 mm. This variation may be attributed to asymmetric growth patterns of the mandible. Another possible explanation is the difference in condylar path inclination, which was found to be steeper on the right (81.87%) compared to the left (78.85%).

## Conclusion

This study introduces a new approach for age estimation utilizing corono-condylar distance measured through OPG. To enhance the accuracy and reliability of this method, further research with a larger sample size is necessary. Future studies should focus on standardizing the findings and developing a precise equation for estimating age based on corono-condylar distance.

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