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DENTAL AGE ESTIMATION USING AN INNOVATIVE EQUATION FOR EGYPTIAN ADULTS

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ABSTRACT

Background: Assessment of age through teeth is one of the most reliable and simple method than skeletal remains, to calculate age of an individual.

Purpose: The study was carried out with an aim to have a reliable equation for dental age assessment among Egyptian through coronal pulp length /crown length ratio

Materials and methods: A total of 100 digital panoramic radiographs, obtained from archives of orthodontic department for patients from different areas aged 20–60 years examined for their lower premolars by coronal pulp length /crown length ratio measurements

Result: high significant correlation were found between chronological age and Coronal Pulp length /crown length ratio CPL / CL, thus bring the following equation to calculate age in years:

Age in years = 60.677 ± CPL / CL (-62.351)

Conclusion: coronal pulp length /crown length ratio has the potential to estimate age of an individual on dental radiographs. It is simple, cost effective than histological methods and can be applied to both living and unknown dead.

KEYWORDS: Age estimation; panoramic radiograph, coronal pulp length /crown length ratio

INTRODUCTION

Forensic odontology is an emerging science of forensic medicine which deals with examination of dental evidences from which a proper evaluation and presentation of dental findings can be made. (1)

Dental identification of persons from dental records or x-rays has long been established and accepted as a mean to prove the identity of an individual from mass disasters where the bodies are not otherwise recognizable (2). However, in cases where the traditional fingerprint or dental identification cannot be done, genetic DNA identification of persons dominates the field of human identification (3)

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Nowadays, DNA evidence for identifications has become a widely used forensic technique and is considered by many investigators to be the gold standard. A swab from a close relative may provide adequate comparison material. However, for DNA analysis, the time required and the costs involved may be considered limitations for this type of identification method [(4)]

Age determination plays an important role in forensic medicine, not only in identification of bodies but also in connection with crimes [(5)]. The teeth are often the only means of identification when the subjects have undergone extensive changes that external characteristics yield no information In addition human teeth can be contained for a long time after death without gross changes to serve as an important tool in forensic science.[(6)]

Dental age assessment is the prediction of chronological age through information obtained from the teeth [(7).] Various methods are utilized for determination of age from dentition including clinical, radiographic, histological, physical and chemical analysis. Apart from above mentioned techniques, a radiographic method based on Regressive age-related changes and correlations between age and the height of teeth and the pulp cavity have been utilized for age estimation using direct digital radiography systems[(6,8)].

Adult age estimation by radiograph depends on the degree of secondary dentin deposition throughout life by odontoblastic cells lining the pulp chamber. This apposition leads to a gradual reduction in size of the pulp chamber and can affect the obliteration of the root canal. The continuous formation of secondary dentin is thought to be a biological response to masticatory stress and temperature fluctuation [(9)]. Several studies examined first and second premolar on intraoral periapical and panoramic radiograph to estimate dental age as these teeth have good delineation of pulp chamber [(8, 10, 11)]

MATERIALS AND METHODS

A total of 100 digital panoramic radiographs, obtained from archives of orthodontic department Faculty of Dentistry, Tanta University were selected for the study based on the inclusion and exclusion criteria. The digital panoramic radiographs of 100 subjects were selected from different areas and aged 20–59 years. Only their lower premolar were analyzed for the following criteria:

1. Good contrast without distortion.
2. Good image and morphology of selected tooth with complete root formation

Only single-rooted lower premolars were included in this work. Teeth were evenly distributed according to different age groups. Each group contained 25 premolar teeth. The ages of the patients ranged from 20 to 59 years old to assure that dental development and growth has been completed. The date of panoramic radiographs exposure and chronological age of subjects were recorded. (TableIV-1)

Exclusion criteria

1- Digital panoramic radiographs with distorted image

2- Carious, grossly decayed premolars or having periapical pathology, prosthesis, restored selected teeth, severely attrited or fractured selected teeth, rotated or malaligned selected teeth, and teeth with any developmental anomalies were excluded from the study

Radiographic measurements

All 100 panoramic radiographs were subjected to radiographic measurements. They were exported to JPEG image format by Digital Image and Communications (DICOM) software (Dentsply, Sirona). The measurements were performed on these JPEG images by using Adobe Photoshop 7.0 software (Adobe, California).

TABLE (1): Sample distribution according to age-groups

Age groups (years)	Total (teeth)
Group I (20<30ys)	25
Group II (30<40ys)	25
Group III (40<50ys)	25
Group IV (50-59ys)	25
Total	100

All the measurements were recorded in millimeters (mm). A straight cervical line was traced from the cement enamel junction, which is the division between anatomical crown and root. Coronal height (CH) was measured vertically straight from the cervical line to the tip of the highest cusp according to Moss et al. [12]

Coronal pulp cavity height (CPCH) was measured vertically from the cervical line to the tip of the highest pulp horn according to Ikeda et al. [13] [Figures 1-1]. Intra observer measurements of two variables (CH, CPCH) were also done.

The mean dental age was estimated by relation between coronal height and coronal pulp cavity height and the real age of the subjects.

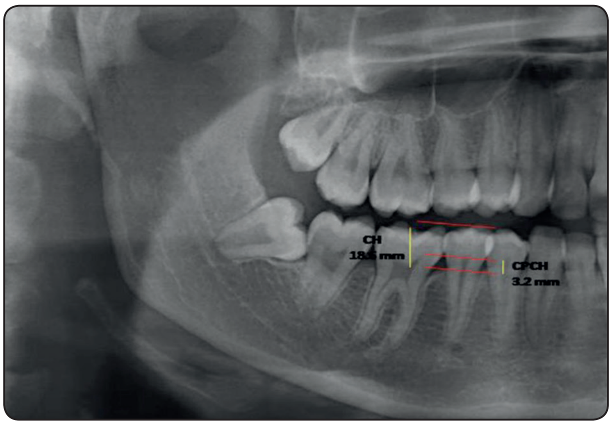

Fig. (1): Measuring coronal height and Coronal pulp cavity height.

Statistical Analysis

The collected data were organized, tabulated and statistically analyzed using SPSS version 19 (Statistical Package for Social Studies) created by IBM, Illinois, Chicago, USA. For studied variables, the range mean and standard deviations were calculated. The correlation between age in years and dental measurements was calculated using Pearson’s correlation coefficient. Linear regression was calculated to set an equation for calculation of age from dental measurements. The level of significant was adopted at $p<0.05$.

RESULTS

Table (2) demonstrate the mean and the standard deviation of age in years, crown length CL, coronal pulp length CPL and CPL / CL ratio in mm

Result displayed the mean and standard deviation of age and dental measurements. Concerning age of patients, it ranged between 20 to 63 years with a mean of 41.80+12.72. while Coronal pulp length and crown length ratio ranged between 0.11-0.50 with a mean value of 0.0+0.11.

TABLE (2): Mean and standard deviation of age, crown length CL, coronal pulp length CPL and CPL / CL ratio

Variable	Range	Mean ± SD
Age in years	20-59	41.80 ± 12.72
Crown length in mm	5-11	8.05 ± 14.43
Coronal Pulp length	1-4	2.49 ± 0.96
CPL / CL	0.11-0.50	0.30 ± 0.11

Table (2) displays the correlation between chronological age, crown length CL, coronal pulp length CPL and CPL / CL ratio. Results indicated that, high significant difference were found between chronological age and Coronal Pulp length and coronal pulp length /crown length ratio, ($p<0.05$). Nevertheless, there was no statistically significant difference between the crown length and the chronological age ($P>0.05$).

TABLE (3) Correlation between age, crown length CL, coronal pulp length CPL and CPL / CL ratio

Variables	Age in years	
	r	p
Crown length	-0.088	0.589
Coronal Pulp length	-0.477	0.002*
CPL / CL	-0.527	<0.001*

Significantat 0.05 level

Table (4) demonstrates correlation between coronal pulp length /crown length ratio and chronological age. Results showed significant good to strong correlation between coronal pulp length / crown length and chronological age that increases in strength with increased age

TABLE (4) Correlation between chronological age at different age groups and coronal pulp length/crown length CPL / CL ratio

Age groups in years	Coronal pulp length/crown length CPL / CL ratio	
	r	p
20 < 30	-0.544	0.006
30 < 40	-0.677	<0.001
40 < 50	-0.521	0.006
50 < 59	-0.756	<0.001
All ages	-0.527	<0.001

Table (5) displays the linear regression between age in years and CPL / CL, which was highly significant. This brings the following equation to calculate age in years based on CPL / CL ratio:

Age in years = 60.677 +_ CPL / CL (-62.351)

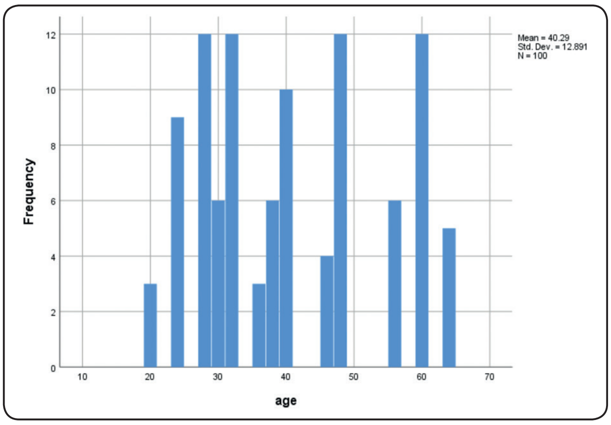

Fig. (2): The chronological age of all study participant

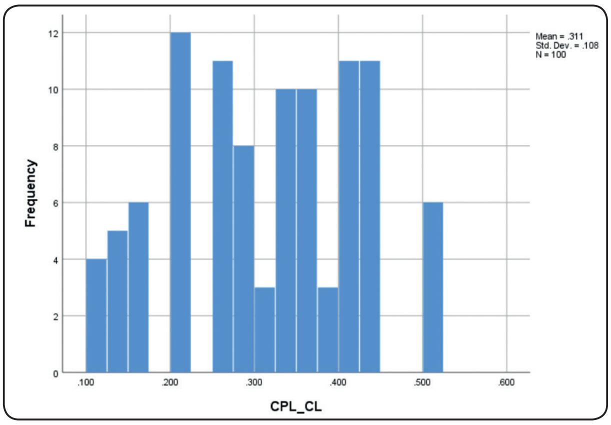

Fig. (3): Coronal pulp length/crown length CPL / CL ratio among study participants

TABLE (5) linear regression for coronal pulp length CPL and crown length CL ratio as predictors for age in years

Variables	B	t	p
CPL / CL	-62.351	3.818	<0.001
Constant	60.677		

Significantat 0.05 level

DISCUSSION

Identification of living and dead persons is importance in routine forensic odontology. Age estimation principally aids in identification of missing persons and gives a hand to solve judicial or civil problems concerned with children abuse[14]. For anthropologist, archaeologists, and forensic experts dental age evaluation represents the most accurate method of chronological age assessment among human beings above 20 years[15]

In the field of dentistry, dental age estimation is essential for orthodontists in planning and timing of the orthodontic treatment relative to maxillofacial growth. Moreover dental age assessment is important for pediatric dentists to verify the stage of dental development, possible timing of eruption, determining maturity of a child and to calculate the exact medication doses [16].

In the current study, the examined teeth from patients ranging in age from 20 to 59 years to assure that dental development and growth has been completed. The teeth were evenly distributed according to different age groups to observe aging effect on accuracy of change in pulp chamber size of teeth with age [17]

Also, single rooted premolars were better used in age estimation with panoramic radiographs to overcome the difficulties of pulp size determination among multirooted morphologically complicated molars [18]

Age estimation through panoramic radiograph considered conservative techniques for age assessment has been used. Various studies have reported that, dental pulp size decreases with increasing age due to apposition of secondary dentin, can be used as an age estimator with a high degree of accuracy among diverse populations beyond 20 years. [10, 19]

Gustafson 1950, was the first to introduce secondary dentin measurement method for age estimation (20). Furthermore, ***Kvaal SI, et al 1995***, pointed that high correlation between change in pulp chamber size of teeth using periapical and panoramic radiographs with age [21]. Also ***Paewinsky et al., 2005 and Talabani et al., 2015*** declared that ,change in pulp chamber size of teeth on digital panoramic radiographs of individuals aged 14–81 years give accurate correlation with age [22,23]

The results of the present study revealed that high correlation between chronological age and coronal pulp length /crown length ratio. This result come in a line with **Igbibi PS, et al ., 2005 and Veera SD, et al., 2014** who reported high negative correlation between real age and coronal pulp length /crown length ratio for both mandibular premolars and molars , thus emphasizing that the height of pulpal cavity decreases with advancing age[24,10]

Moreover, ***Ravleen N et al., 2018*** found highly negative correlation between real age and coronal pulp length /crown length ratio for mandibular second Premolar than first molar indicating second premolar as a more reliable indicator of dental age [25]. Conversely, ***Talabani et al., 2015*** found strong negative correlation between age and coronal pulp length /crown length ratio for mandibular first molar [23]

One of the most important limitations of the current work is the dependence on coronal pulp and crown length than their volume emphasizing the need for three dimensional radiograph as cone beam computed tomography which might influence the accuracy of measurements Additionally, Future studies needed on different population, in different geographical locations, and on other teeth taking into account various environmental, racial, dietary, genetic, and cultural factors.

CONCLUSION

Estimation of age using coronal pulp length / crown length ratio by radiographs is one of the most Simple, reliable, and cost effective methods. From the results of the study, it could be concluded that dental age showed strong negative correlation with coronal pulp length /crown length ratio, thus emphasizing the decrease of size of pulp cavity with advancing age exploring an innovative equation of age estimation for Egyptian adults, but in future studies on different population, in different geographical locations, and on other teeth should be encouraged.

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