Age Estimation By Pulp Tooth Area Ratio Of Maxillary Central Incisors – A Retrospective Radiographic Study.

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Abstract

Aim and objectives: aim of the study is to estimate the dental age of the individual particularly from pulp tooth area ratios of maxillary central incisors using digital intra oral periapical radiograph and to compare it with the chronological age.

Materials and Methods: 56 intra oral periapical radiograph (iopa) of maxillary central incisor taken using digital radiography (rvg) was collected and pulp tooth area ratios was obtained.

Results: the mean chronological age of the sample population is 23.05 and the mean estimated dental age is 23.05.linear regression and paired t test had shown no significant difference between the chronological age and dental age.

Conclusion: The study showed no statistically significant difference between the estimated age and the chronological age which suggests that the present study is appropriate for the Mangalore population.

Keywords: Age Estimation , Rvg , Maxillary Central Incisors

Introduction

Age determination has become increasingly important in forensic science not only for the identification of corpses, but also for living individuals in a multicultural society, to clarify legal queries in delineating juvenile and young adults in spheres pertaining to employment, labour acts and criminal offences . It plays a crucial role in Forensic Medicine, especially in connection with crimes and accidents. Literature reports shows that different morphological and radiological techniques using tooth for age assessment is more effective.

Most commonly used morphological techniques using teeth are based on length of apical translucent zone, attrition, secondary dentin deposition, periodontal

attachment, cementum apposition and root resorption. But these methods require extraction of teeth which are time consuming and expensive .On the other hand, Radiographic methods need an attention in this scenario as they seem to offer a harmless approach towards age estimation among all the commonly used methods. Although most of the radiological methods are based on calcification stages of the developing teeth.

Dental pulp can also be used as an indicator of age as it undergoes reduction in size, with increase in age due to secondary dentin deposition, since this is a continuation process it can be used as a parameter for estimation of age even beyond 25 years of age.

Kvaal and Solheim[1] presented a method of age estimation which combined radiological and morphological measurements which could be used on adults, but extraction was still required As a continuation of this method Kvaal et al. reported a method of age estimation from radiographs using the radiographic parameters only .Also , single tooth radiographic method can be employed in patients who does not have complete set of dentition.

Therefore aim of the study is estimating the age of the individual particularly from pulp tooth measurements of maxillary central incisors using digital intra oral periapical radiograph.

Materials and Methods

A retrospective study was conducted in the Department of Oral Medicine & Radiology, Yenepoya Dental College & hospital, Yenepoya University, Mangalore. After obtaining Ethical clearance from institutions ethical committee, Intra oral periapical radiograph (IOPA) taken using digital radiography (RVG) was collected from the Department of Oral and Maxillofacial Radiology database (Archives) that have been taken for various purposes.

Inclusion criteria

1. Radiographic data of individual above the age of 15 years will be included
2. Radiograph of maxillary anterior tooth region with maxillary central incisors (left and right) will be included in the study
3. Radiograph taken using paralleling angle technique is only included in the study
4. Data with date of birth details of individuals will be only included in the study

Exclusion criteria

1. Faulty images such as cone cut, elongation and shortening of image , over exposed or under exposed radiographic images will be excluded from the study
2. Radiographic data of maxillary central incisors which missing/impacted/carious/filled/ prosthetically restored/ malposed /had periapical or pulpal pathologies, or morphological abnormalities including attrition/abrasion/ erosion were not taken into consideration.

The chronological age was obtained by subtracting the Date of Birth from the Date of Radiograph taken.

After selecting IOPA image of a maxillary central incisor (either right or left) which is taken by GX S-700 Digital intra oral sensor machine the following measurements was taken using GIMP software:

- Maximum tooth length
- Maximum pulp length
- Maximum root length from cement enamel junction to root apex,
- The pulp and root width at level A (CEJ), at level C (mid root length) and at
- Level B (mid-point between CEJ (A) and mid root length (C)) are made.
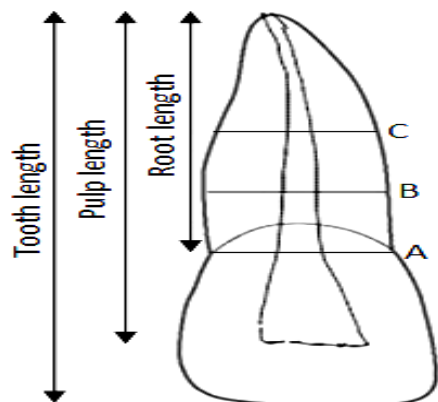
Ratios between the length and width measurements of the same tooth are calculated in order to avoid measurement errors due to differences in magnification of the image on the radiograph. The ratios calculated according to Kvaal's technique are:

- Pulp length /root length (P),
- pulp length /tooth length (R),
- pulp / root width at three different levels A, B and C

The dental age is calculated by specific regression formula by linear regression method was derived from the pulp tooth measurements taken from the selected tooth.

Regression Equation

Estimated   Age=28.132-3.943*P+0.492*R+5.077*WA-2.604*WB-6.863*WC

- P = Pulp length /root length
- R =pulp length /tooth length
- WA=pulp / root width at three different levels A
- WB= pulp / root width at three different levels B
- WC= pulp / root width at three different levels C

Statistics

Regression and co-relation analysis will be carried out. P value less than 0.05 was taken as significant.

Results

The mean chronological age of the sample population is 23.05 and the mean estimated dental age is 23.05.Linear regression and paired t test had shown no significant difference (p-value =0.998) between the chronological age and the age estimated.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.398[a]	.159	.075	1.64536

a. Predictors: (Constant), W-C, R, P, W-A, W-B

b. Dependent Variable: Chronological Age

| Model	Unstandardized Coefficients		Standardized Coefficients	T	p-value
	B	Std. Error	Beta		
1 (Constant)	28.132	3.921		7.174	.000
P	-3.943	2.648	-.197	-1.489	.143
R	.492	2.598	.025	.189	.851
W-A	5.077	2.807	.261	1.809	.077
W-B	-2.604	6.491	-.077	-.401	.690
W-C	-6.863	5.153	-.240	-1.332	.189

Paired t test showed no statistical difference between the estimated age and chronological age

ANOVA[b]

Model	Sum of Squares	Df	Mean Square	F	p-value
1 Regression	25.542	5	5.108	1.887	.113[a]
Residual	135.360	50	2.707		
	160.902	55			

a. Predictors: (Constant), W-C, R, P, W-A, W-B

b. Dependent Variable: Chronological Age
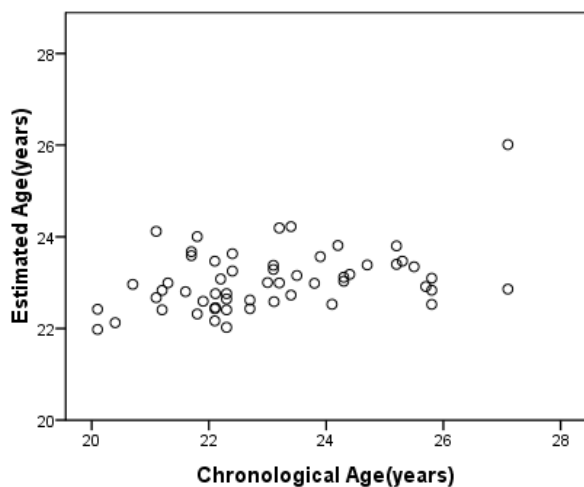
(Scatter plot for estimated age versus chronological age)

Comparison of chronological age and Estimated Age:

	Mean	Std. Deviation	T	Df	p-value
Chronological Age	23.0541	1.71041	.001	55	0.998
Estimated Age	23.0542	.68145			

No Significant difference was seen between the chronological age (M=23.05 , SD=1.71) and the age estimated (M=23.05, SD=.68)(p-value = 0.998)

Discussion

In recent years the determination of age has become important in living individuals for criminal investigations. Estimation of age of an unknown individual can be performed by correlating the physical, skeletal and dental maturity. Among the entire growth systems the dental maturity has the highest stability and hence it provides the most accurate way of assessing growth and development. Evidences say that dental development is less affected than skeletal development by malnutrition and hormonal disorders. Hence the age of an unknown young individual can be reliably determined from the dentition.

The present study was conducted using regression formula derived from the pulp tooth measurements of maxillary central incisors which helps in determining the dental age of an individual from radiographs .

Statistically there is no significant difference (p value= 0.998) was seen when the chronological age was compared with the age estimated using regression equation. Hence, present study is significant for forensic age estimation.

This study was in accordance with the studies conducted by BR Sathvikalakshmi et al, Ridhima Sharma and Shruthi K.Patil et al.

A study was conducted in 2017 by BR Sathvikalakshmi et al, for estimating the age of a person from his teeth particularly using the pulp to tooth area ratio. This ratio will be measured from the digital intraoral radiographic images taken for different patients with a sole purpose of estimation the age of the. Each patient's maxillary central incisors will be evaluated and their pulp to tooth area ratio is taken. The study comprises of 60 patients divided into two subsets of 10 test subjects and 50 study subjects. The RVG images of maxillary central incisors were collected and the pulp to tooth area ratio was measured and intra observer variation was evaluated with paired t-test. Considering the possible errors ±10 years were added to this method of age estimation provides a fairly accurate and reliable method.

A study was conducted in 2010 by ridhima Sharma[6] to evaluate the in the estimation of age of adults, using Kvaal's method in the set sample.The material consisted of the digital long-cone intraoral periapical radiographs from 50 subjects of either sex in the age group of 15–60 years, who were selected after evaluation for the set inclusion and exclusion criteria. The pulp width and length from radiographs of 6 selected teeth, namely, maxillary central incisor, lateral incisor, and second premolar and mandibular lateral incisor, canine, and first premolar of either right or left side were measured using the RVG trophy software In order to compensate for the differences in magnification and angulation, various ratios were calculated and the mean of all ratios (M) was taken as the first predictor, while the difference between the mean of 2 width ratios and the mean of 2 length ratios (W – L) was taken as the second predictor. Different regression formulae for all 6 teeth, 3 maxillary teeth, 3 mandibular teeth, and each of the individual teeth were derived and the age was assessed. The assessed age was then co-related with the actual age of the patient using the Student's t test. The results showed that the coefficient of determination (R) was the strongest (0.198) for the mandibular first premolar indicating that age can be estimated better with this particular tooth. No significant difference was observed between the estimated age and the actual age for all (P>0.05) except in mandibular lateral incisor and maxillary lateral incisor, where a significant difference was observed.

Age estimation using radiographs by Kvaal and coauthors has shown to be reliable method, possible variation in ethnicity restricts its use in sample Indian population.

A study was conducted by Shruthi K. Patil[7] et al in 2014 which comprised of 2 aims. In the first part, they evaluated the accuracy of Kvaal's formula in sample Indian population while comparing the results with those obtained by them in the Norwegian population. In the second part of the study, they developed a new formula (modified Kvaal's formula) for a sample Indian population by using the ratios from first part of the study and tested it again on another group of subjects and compared the results obtained by using Kvaal's formula and modified Kvaal's formula to establish the need for local Indian-based formulae.The subjects (1-100) between the age group 20 and 50 years digitized intraoral periapical (IOPA) radiograph of maxillary central incisors was taken and length and width of the teeth were measured and their ratios were calculated and applied to Kvaal and coauthors formula. The estimated age and chronological age were compared, less accurate results were found in sample Indian population. Modified Kvaal's formula was then developed by using regression analysis of the ratios and to evaluate the accuracy of this formula, the study was repeated using same criteria and methodology on another subjects (101-200).Using Kvaal's formula standard error of estimated age was more in sample Indian population when compared with Norwegian population. Then modified Kvaal's formula was developed and applied to sample Indian population, which showed accurate results.

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