Efficacy of Pulp/Tooth Area Ratio in Age Estimation by Using Radiographs of Permanent Canine - A Preliminary Study

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Abstract

Objective: To examine the possible application of pulp/tooth area ratio of canine in Intra Oral Periapical X-ray using RVG for estimation of age of an individual.

Material and Method: 25 Individuals aged between 18 to 27years, with apparently normal canine were included in the present study. Radiovisuographic images of canine of upper and lower jaws were obtained. These images will be then transformed to CAD2007 software from which area of pulp/tooth ratio will be calculated with the help of 10 points from each tooth outline and 5 points for each pulp outline. By using regressive formula the age was calculated.

Results: The estimated age using maxillary canine (x1) showed no statistically significant difference between the estimated age and the real age (p=0.1) which means that there is little difference between real age and estimated age. So, it is feasible to estimate age using Pulp to tooth area ratio of maxillary canine.

Key words: Age Estimation, Radiographs, Canine

Introduction

The new millennium has entered with renewed hopes of finding solutions to the existing problems and also with new challenges resurfacing in our day-to-day lives. Although last century has witnessed major breakthroughs in the field of science and technology, crime still persists in all aspects of our lives.

Forensic sciences comprise a vast area of expertise right form conventional forensic medicine to the modern "white collared" cyber forensics, but as progress is being made at the advancing front of this science, its backdrop still suffers from lack of specificity and sensitivity of certain procedures such as "Age Determination."

Age estimation of living or dead individuals is an important aspect of forensic sciences and amongst the various methods involved in the determination of age, those involving teeth have given consistent results. Most of the dental age estimation methods reported are based on the age related changes in the teeth like Root dentine translucency (1-3), tooth cemental annulations(4,5) and apposition of secondary dentine(6,7). But the quantification of these morphological changes nearly always requires extraction and sectioning of teeth which is impossible and unethical in living individuals8. Hence, the techniques which are being developed for age estimation in living individuals mostly on radiological imaging of teeth.

Apposition of secondary dentine is a continuing regular process resulting in the reduction in the pulp area with the advancement of age. This reduction in pulp area can be measured radiographically and has been the basis of many radiological age estimation methods9.

Roberto Cameriere et. al (2007) have developed one such age estimation method, which uses Pulp/Tooth area (P/T) ratio as an indicator of age. Canines were preferred for present study. The present study was carried out to examine the possible application of P/T area ratio by periapical radiographs for age estimation of an individual using Autocad 2007 software10.

Material and Methods

Source of Data: The present study was carried out in the Department of Oral Pathology and Microbiology, KLES's Institute of Dental Sciences, Belgaum. Students aged between 18 – 25 years with apparently normal canine were included in the

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present study. Of the 25 individuals 13 were males and 12 were females.

Exclusion Criteria

Canines with caries, periapical pathology, abrasion, erosion and any other developmental anomalies.

Method of Collection of Data

All the students aged between 18 to 25 years were given numbers and 25 students among them were selected randomly by using table of random numbers. After obtaining an informed consent, a brief case history was recorded. The real age of the individual was calculated based on the subject's date of birth. Each of the selected individuals was assigned an identification number from 1-25.

IOPA radiographs of both maxillary and mandibular canines were obtained from each individual by a radiologist using Radiovisuography (Kodak 5000 Radiovisuography system). The obtained RVG images were labeled according to their corresponding identification number and were analyzed for estimation of age.

Estimation of Age

The obtained RVG images of canine were processed using a Autocad 2007 software. Pulp and tooth area were obtained by identifying 25 points on the tooth outline and 15 points for pulp outline. From the obtained pulp and tooth areas P/T area ratio was calculated. P/T areas of maxillary canines were designated ($X2$) and that of mandibular

AGE USING X2 & X1: 114:624 - 431:183x1 - 456:692x2 +1798:377x1x2 ………………(1)

AGE USING X1: 89:456 - 461:873x1……………………………………………………… (2)

AGE USING X2: 99:937 - 532:775x2………………………………………………………... (3)

canine ($X1$). Using $X1$ and $X2$ parameters, age of the individual was calculated using the following regression formulae's.

Results

The real and estimated age of the study groups and their means are shown in Table No 1. The mean difference between the real age and the estimated ages ($X2$, $X1$, and $X2$ $X1$,) were calculated. In the present study, the estimated age using maxillary canine showed no statistically significant difference between the estimated age and the real age ($p=0.1$) which means that there is little difference between real age and estimated age (Table no 2). The Karl Pearson's correlation coefficients between Real age and the estimated age using the means are displayed in Table No 3.

Table No. 1: Comparison of real age and estimated age.

Sl. No	Real age (Years)	Estimated age using x2 (Years)	Estimated age using x1 (Years)	Estimated age using x1x2 (Years)
1	18	21	25.5	24.31
2	23	25.1	22.4	24.5
3	25	26.1	32	29.04
4	19	15	23	21.3
5	20	22.8	27	25.6
6	21	26.1	31.2	26.1
7	20	23.5	18.7	22.5
8	21	23.4	22.5	26.28
9	22	19.6	24.1	23.13
10	22	26.85	31.89	28.25
11	20	18.2	23.57	22.312
12	20	22.2	30.8	26.16
13	18	16.7	16.9	19.07
14	20	28.1	30.3	28.5
15	18	15.5	26.2	22.1
16	26	18.2	20.2	21.8
17	19	16.8	10.8	17.7
18	19	21.16	16.4	20.9
19	20	20.1	20.3	22
20	18	24.2	26	25.2
21	21	23.2	25.4	25
22	21	29	29	29
23	24	24.9	26	26
24	27	23.1	33.9	28.1
25	22	25.5	23.3	25
Mean ± SD (age in years)	21.0±2.5	22.3 ± 3.9	24.7 ± 5.6	24.4 ± 3.1

Table No. 2: Paired t-tests between real age and estimated age

Variables	Mean difference	t-value	p-value	significance
Real age and X2	1.3 ± 3.9	1.68	0.1	NS
Real age and X1	3.74±5.18	3.60	<0.01	S
Real age and X2X1	3.4 ± 2.9	5.84	<0.01	S

Table No. 3: Karl Pearson's coefficient between real age and estimated age

Variables	r-value	p-value	Standard error	R2
Real age and X2	+0.34	0.09(NS)	2.4	12%
Real age and X1	+0.38	0.06 (NS)	2.3	14%
Real age and X2X1	+0.45	0.02 (S)	2.2	21%

Discussion

The present study utilizes P/T area ratio as a parameter for age estimation. Previous studies have produced reliable results with reduced inter and intra-observer variability. Canines are usually preferred for the following reasons.

*Usually present in old age.

*Undergo less wear when compared to the posterior teeth.

*Are less likely to suffer wear when compared to other anterior teeth.

*Are the single-root teeth with the largest pulp area and thus the easiest to analyze.

In the present study the estimated age using maxillary canine showed no statistically significant difference between the estimated age and the real age (p=0.1) which means that there is little difference between real age and estimated age. This is in accordance with the studies done by Roberto et.al.

Estimated age using mandibular canines alone and combined maxillary and mandibular canines showed statistically significant difference between real age and estimated age with a p value of <0.01, which means that there is more difference between real age and estimated age. These results are in contrast with studies done by Robert et al. In the mandibular canines, the difference between real age and estimated age was more which may be because of difficulty to adopt RVG sensor to the mandible arch due to lack of space to accommodate it.

Nevertheless, the present age estimation method has the following distinctive advantages.

*This method does not require sectioning of tooth.

*Method is tested in subjects aged between 18-79 years.

*Possible to use in both living subjects and skeletal remains.

*This method can be used even though the skeletal remains are in poor conditions.

*Is a fast and chip method (needs approximately just 30 min for age estimation).

Future scope of this study lies in analyzing larger sample sizes in order to reduce the standard errors of the estimates and investigating the effect of race and culture.

Conclusion

Based on the results of the present study, we can conclude that P/T area ratio of the maxillary canine can be used as a reliable method to predict the age of the individual.

References

1. Bang G, Ramm E. "Determination of age in humans from root dentine transparency". Acta Odonto Scand 1970; 28:3–35.

2. Drusini AG. "Age-related changes in root transparency of teeth in males and females". Am J Hum Biol, 1991; 3:629–37.

3. Lamendin H, Baccino E, Humbert JF, Tavernier JC, Nossintchouk RM. "A simple technique for age estimation in adult corpus: the two criteria dental method". J Forensic Sci 1992; 37:1373–9.

4. Wittwer-Backofen U, Gampe J, Vaupel JW. "Tooth

cementum annulations for age estimation: results from a large known-age validation study". Am J Phys Anthropol 2004; 123:119–29.

5. Jankauskas R, Barakauskas S, Bojarun R. "Incremental lines of dental cementum in biological age estimation. Homo 2001; 52:59–71."

6. Lopez-Nicolas M, Canteras M, Luna A. "Age estimation by IBAS image analysis of teeth". Forensic Sci Int 1990; 45:143–50.

7. Drusini A, Toso O, Ranzato C. "The coronal pulp cavity index: a biomarker for age determination in human adults". Am J Phys Anthropol 1997; 103:353–63.

8. Bosmans N, Ann P, Aly M, Willems G. "The application of Kvaal's dental age calculation technique on panoramic dental radiographs". Forensic Sci Int, 2005; 153:208–12.

9. Roberto Cameriere, Luigi Ferrante, Maria Giovanna Belcastro, Benedetta Bonfiglioli, Elisa Rastelli, Mariano Cingolani. "Age Estimation by pulp/tooth ratio in canines by periapical x-rays". Journal of Forensic science, 2007; 52:1.

10. Roberto Cameriere, Luige Ferrante, Math. D, Mariano Cingolani. "Variation in pulp/tooth area ratio as a indicator of age, a preliminary study". Journal of Forensic science, 2004; 49: 2.