ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 2, April - 2022, Page No. : 515 - 521

Age estimation using pulp-tooth area ratio of mandibular teeth by an Orthopantomograph

[1]Dr. Krishan Kant Chaudhary, Associate Professor, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

[2]Dr. Nitin Agarwal, Prof & Head. Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

[3]Dr. Somi Fatima, Assistant Professor, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

[4]Dr. Pallavi, MDS, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

[5]Dr.Mohd Anas Hussain, MDS, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

[6]Dr. Rahilla Jan, PG student, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

Corresponding Author: Dr. Krishan Kant Chaudhary, Associate Professor, Dept of OMDR, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, U.P, India.

Citation of this Article: Dr. Krishan Kant Chaudhary, Dr. Nitin Agarwal, Dr. Somi Fatima, Dr. Pallavi, Dr. Mohd Anas Hussain, Dr. Rahilla Jan, "Age estimation using pulp-tooth area ratio of mandibular teeth by an Orthopantomograph", IJDSIR- April - 2022, Vol. – 5, Issue - 2, P. No. 515 – 521.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The purpose of study is to determine and compare the accuracy of pulp/tooth ratio method in three mandibular tooth (canine, 1st premolar and 2nd premolar) in age estimation.

Materials and Methods: A total 100 Orthopantomograph of (66 males and 34 females) were studied. Measurements of the pulp and tooth areas were done. Briefly, a minimum of 20 points from each tooth outline and 10 points from each pulp outline were identified and connected with the line tool in Auto CAD, followed by tooth pulp and tooth area measurement and pulp/ tooth area ratio (PTR) calculation. Data were subjected to statically analysis and compared by one way analysis of variance (ANOVA) followed by correlation and regression analysis.

Statistical analysis and Results: Our results showed canine, 1st and 2nd premolar can be used as a valuable tool for predicting age of different individuals. The study also revealed an inverse association between age and

pulp/tooth area ratio (canine, 1st and 2nd premolar). There was no statistically significant difference between chronological and calculated age.

Conclusion: The mandibular canine, first and second pre molar is a potential tool for age estimation in both anthropological as well as forensic dentistry. The pulp/tooth ratio of both the teeth is a useful method for age prediction with good accuracy.

Keywords: Age estimation; Orthopantomograph; Forensic odontology; canine, pre-molars; Pulp/tooth area.

Introduction

Estimation of age in an individual whether living or dead has received a considerable attention in forensic science because of it being difficulty to assess many times at also very important too. As it is an intimidating task in forensic investigations and is most difficult to achieve. [1]

The interest in the age determination of living young persons, for whom no birth certificates are available, is not a recent phenomenon but has a long history. For example, in ancient Rome adolescents were considered mature enough to be drafted into military service, as soon as their second molars had fully emerged. [2]

Age estimation of adults may be essential in post-mortem identification, verifying age in immigrants and refugees with disputed birth records, or in persons of criminal antecedents reluctant to reveal their age. [3]

It is relevant not only in routine case work but also in mass fatalities resulting from natural phenomena. [4]

Non-invasive radio graphic techniques using measurements of the reduction in the dental pulp cavity associated with advancing age due to secondary dentin formation has emerged a tool for age estimation. This reduction in pulp chamber was correlated with chronological age and regression equations were derived to estimate the age. [5]

Moreover, as stated by Babshet et al. radiographic evaluation of secondary dentine may be the only non-invasive approach to estimate age from fully developed teeth. Hence, there may be few alternatives to dental age estimation of living adults as well as in certain post-mortem circumstances wherein invasive methods are not feasible. [6]

Any tooth can be used to assess age, teeth which are often present in old age are Canines which are used for age estimation, they are less likely than other anterior teeth to suffer wear and attrition and are the single rooted with the largest pulp area and thus the easiest to analyses. [7] Premolars are also used as age indicator due to similar features as canine like they are also single-rooted teeth and lower premolars show good correlations between the decrease in dental pulp and increasing age. Moreover, they are less liable to be traumatized unlike other single-rooted teeth namely, upper and lower incisors. [8]

There are limited studies performed to determine age by this method using canine, first premolar, and second premolar either on intraoral periapical or panoramic radiographs. But there is a need to validate the available data. [9] Hence this study was conducted to analyse the role of radiograph in age estimation using three mandibular teeth's. So, the main objective of the study was to assess the role of three mandibular teeth (canaine, 1st premolar and 2nd premolar) in age estimation of adults using panoramic radiographs. [10]

Aim and objective

To estimate the age of an adult individual based on the measurement of the pulp/tooth area ratio obtained from Orthopantomograph. To test the reliability and applicability of pulp/tooth area ratio (PTR) in three mandibular teeth as an indicator of age by Panoramic Radiographs. To examine the relationship between age

and age-related changes in the pulp/tooth area ratio in three mandibular teeth by Orthopantomograph.

Selection criteria

Inclusion Criteria

1) Age and Gender: Age group 18 to 45 years both genders included

2) The selected tooth on the panoramic radiograph, the (i.e.) mandibular canine and premolars is fully erupted into the oral cavity.

3) The root of the premolars is fully formed, firm mandibular left canine, 1st premolars and 2nd premolars

Exclusion criteria

1) Tooth with any pathology, such as caries or periodontitis or periapical lesions, which would alter the surface area of the tooth.

2) Patient undergoing/underwent fixed orthodontic treatment, endodontic treatment, oral surgical and prosthodontics treatment involving left mandibular canine first and second premolars.

3) Developmental anomalies related to left mandibular canine first and second premolars.

Material and Methods

In a cross-sectional study, done during October 2015 to September 2016. A total of 100 patients attending OPD Department of Oral Medicine and Radiology, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, Uttar Pradesh, India. Ethical clearance was obtained from the institutional ethical committee. The study group consisted of 100 subjects of both sex in the age range of 18 to 45 years. Only those patients were included in the study whose premolars are formed, firm mandibular left canine, 1st premolars and 2nd premolars. While patients with tooth pathology, such as caries or periodontitis or periapical lesions, undergoing /under went dental treatment involving left mandibular canine first and second premolars or with any developmental abnormalities were left as it may alter the surface area of the tooth. The clinical examination was carried out and relevant data including the date of birth and other details were collected. An informed consent was obtained from each patient enrolled in the study. Following the case enrolment orthopantomogram was done for all the patients.

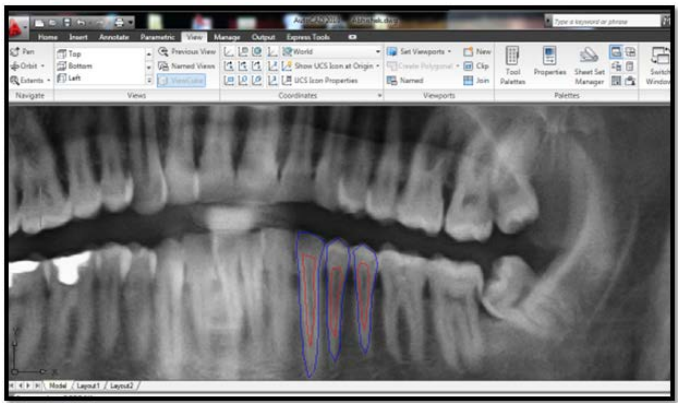

Fig 1: Analysis Done in An OPG Radiograph of Mandibular Left Canine, 1st Premolar And 2nd Premolar

All the radiographs were saved as high-resolution JPEG file and were imported to AutoCAD 2010 for further analysis. Measurements of the pulp and tooth areas were done. briefly, a minimum of 20 points from each tooth outline and 10 points from each pulp outline were identified and connected with the line tool in AutoCAD, followed by tooth pulp and tooth area measurement and pulp /tooth area ratio (PTR) calculation. Statistical analysis was done using SPSS version 17.0. Group were compared by one way analysis of variance (ANOVA) and the significance of mean difference between the groups was done by Tukey's post hoc test after ascertaining normality by Shapiro-Wilk's test and homogeneity of variance between groups by Levene's test. Pearson correlation analysis was done to assess association between the variables. Intra class correlation analysis was done to assess Inter-observer reliability. p value <0.05 was considered statistically significant.

Results and Observation

Among 100 patients enrolled, 66 (66%) were males and the remaining 34 (34%) were females. The age group varied from 18 to 45 years (mean=32.21, SD±9.14 and median=36). The mean with ± SD pulp/tooth area ratio was 0.183± 0.068, 0.196± 0.073 & 0.187± 0.074 for canine, 1st and 2nd premolar respectively. The measurements of the pulp/tooth area ratio of the tested teeth did not reveal any significant differences between men and women, and consequently sex was not included in the statistical models

In this study, the entire sample was distributed into four different age groups -<20, 20-30, 30-40 and ≥40, years - to observe the effect of this method on different age groups. Comparing the mean of each pulp/tooth area ratio (canine, 1st and 2nd premolar) among different age groups, ANOVA showed significantly different pulp/ tooth area ratio among the groups is given in (Table 1).

Table 1: Comparison of pulp/tooth area ratio according to age of subjects

Pulp/tooth area ratio	Age (yrs)	N	Mean ± SD	p value
Canine	<20	11	0.216 ± 0.061	<0.001
	20-30	27	0.230 ± 0.049	
	30-40	36	0.157 ± 0.055	
	≥40	26	0.159 ± 0.076	
1st premolar	<20	11	0.246 ± 0.080	<0.001
	20-30	27	0.229 ± 0.067	
	30-40	36	0.171 ± 0.071	
	≥40	26	0.175 ± 0.056	
2nd premolar	<20	11	0.237 ± 0.085	<0.001
	20-30	27	0.238 ± 0.079	
	30-40	36	0.169 ± 0.051	
	≥40	26	0.138 ± 0.043	

One-way Anova analysis showed significant association between different age groups and pulp/tooth area ratio for all the three tooth, while Tukey test also showed significant relationship in all the groups except between age <20 vs 20-30 and 30-40 vs. ≥40 (Table 2).

Table 2: Comparison of mean difference in pulp/tooth area ratio between different age groups by Tukey test

Comparison-Age (yrs)	Pulp/Tooth area ratio		
	Canine	1st premolar	2nd premolar
<20 vs. 20-30	0.900	0.908	1.000
<20 vs. 30-40	0.029	0.010	0.011
<20 vs. ≥40	0.048	0.022	<0.001
20-30 vs. 30-40	<0.001	0.005	<0.001
20-30 vs. ≥40	<0.001	0.021	<0.001
30-40 vs. ≥40	0.999	0.996	0.219

Pearson correlation showed a significant and negative (inverse) correlation of age with pulp/tooth area ratio in all three tooths. Further, the significant correlation of pulp/tooth area ratio with age suggests that the age can be estimated from the pulp/tooth area ratio or can be used interchangeably (Table-3)

Table 3: Correlation between age and pulp/tooth area ratio of subjects (n=100)

Variables	Age	Pulp/Tooth area ratio-canine	Pulp/Tooth area ratio-1st premolar	Pulp/Tooth area ratio-2nd premolar
Age	1.00			
Pulp/Tooth area ratio-canine	-0.51***	1.00		
Pulp/Tooth area ratio- 1st premolar	-0.44***	0.47***	1.00	
Pulp/Tooth area ratio- 2nd premolar	-0.60***	0.50***	0.48***	1.00

***- p<0.001

Discussion

The role of dental development as a method of age estimation is increasing both criminal and civil proceedings. The genetic alteration involved to dental development is limited hence more or less every individual have similar pattern of tooth maturation. However, there are many other parts of the body which are or which can be used for the estimation of age. [11] But in many cases, such as crashes and fires in the case of the recently dead, dampness and burial conditions in the case of elderly subjects, make many parts of the body unusable the poor condition of remains doesn't allow their use at times especially in dead remains. This makes teeth an important part of the body which is used for estimation of age in dead remains. [12] Several age estimation methods apply the various forms of tooth modification including wear, dentin transparency, tooth cementum annulation, racemization of aspartic acid and apposition of secondary dentin. Some of the methods are very complex, destructive and are therefore not normally used; wear and the apposition of the secondary dentin are the currently available nondestructive methods.

Tooth wear is influenced by various external factors (masticatory function, type of food, timing and sequence of tooth eruption), tooth form, position of teeth, thickness and hardness of enamel and predisposition to enamel hypoplasia. However, apposition of secondary dentin is a continuing, regular process which is only modified by caries or particular abrasion. Secondary dentin has been studied using several methods, both by section and radiographs, [13] the study of radiographs of teeth is nondestructive and simple and can be applied to living as well as deceased persons. Furthermore, OPG's also provide information of the individual's identity and other age-related features such as third molar development, number of teeth and periodontal recession. [11]

Age estimation by apposition of secondary dentine is a quantitative method; more controllable scientifically and is less dependent on technical ability. However, the accuracy of these dental methods should be verified in different populations. Therefore, in the present study, the mandibular canine and premolars were analyzed to establish the patterns of the relationship between age and the apposition of secondary dentine. Consequently, the reliability and applicability of pulp/tooth area ratio (PTR) as an age indicator of age was tested. [14] Our study, shows there is good correlation between estimated age and chronological age, which meant that there is no significant difference between estimated age and chronological age as earlier showed by Bosmans et al .and Cameriere et al.

The correlation coefficient "r" was found to be 1, confirming the age estimation using pulp/tooth area ratio is accurate. Kvaal et al also showed that with advancing age the size of the dental pulp cavity is reduced as a result of secondary dentin deposition, allowing the measurements of this reduction to be used as an indicator of age. [15] A study was conducted by Kvaal et al. to correlate age among different factors like pulp/root length, tooth/root length, and pulp/root width and found that the width of the pulp had a strong correlation with age. [16]

In the present study, we used panoramic radiographs and observed that the estimated age has linear correlation with chronological age as confirmed earlier by different authors. Bosmans et al. This study also confirms that the pulp/tooth ratio has a good correlation with age as showed in earlier studies. However, there was no correlation was observed between gender and tooth development similar to Cameriere et al. [17] Our results

indicate the appropriateness of using canine, 1st and 2nd premolar as morphological variables to predict age of different individuals, especially when comparing the obtained standard deviation with other skeletal age calculation. Future research should aim at acquiring even larger sample sizes in order to reduce standard errors of estimates, and at investigating the effect of race and culture in model parameters. Different studies are required to investigate about pulp/tooth ratio to determine the general applicability of the method

Conclusion

The purpose of this study was to estimate the age of an adult individual based on the relationship between age and the measurement of pulp/tooth area ratio obtained from three mandibular teeth by panoramic radiograph. Further, the significant correlation of pulp/tooth area ratio with age suggests that the age can be estimated from the pulp/tooth area ratio or can be used interchangeably. Also, our study showed a decrease in the pulp length and root canal width with increasing age which is attributed to secondary dentin formation.

References

1. Schmeling, A., Garamendi, P. M., Prieto, J. L., Landa, M. I. Forensic Age Estimation in Unaccompanied Minors and Young Living Adults. In: Vieira, D. N., editor. Forensic Medicine - From Old Problems to New Challenges [Internet]. London: Intech Open; 2011 [cited 2022 Apr 05].

2. Kumar V, Venkata Raghavan K, Krishnan R, Patil K, Munoli K, Karthik S. The relationship between dental age, bone age and chronological age in underweight children. Journal of pharmacy &bio allied sciences. 2013 Jun;5(Suppl 1): S73.

3. Keller EE, Sather AH, Hayle's AB. Dental and skeletal development in various endocrine and metabolic diseases. J Am Dent Assoc. 1970; 81: 415-9.

4. Morse DR, Esposito JV, Schoor RS, Williams FL, Furst ML. A review of aging of dental components and a retrospective radiographic study of aging of the dental pulp and dentin in normal teeth. Quintessence Int. 1991; 22: 711-20.

5. Koranne VV, Mhapuskar AA, Marathe SP, Joshi SA, Saddiwal RS, Nisa SU. Age estimation in Indian adults by the coronal pulp cavity index. Journal of forensic dental sciences. 2017 Sep;9(3):177.

6. Meinl A, Tangl S, Pernicka E, Fenes C, Watzek G. On the applicability of secondary dentin formation to radiological age estimation in young adults. Journal of forensic sciences. 2007 Mar;52(2):438-41.

7. Kolltveit KM, Solheim T, Kvaal IS. Methods of measuring morphological parameters in dental radiographs. Comparison between image analysis and manual measurements. Forensic Science International. 1998; 94: 87-95.

8. Age Estimation from Pulp/Tooth Area Ratio in Three Mandibular Teeth by Panoramic Radiographs: Study of an Egyptian Sample.

9. Panchbhai AS. Dental radiographic indicators, a key to age estimation. Dentomaxillofacial Radiology. 2011 May;40(4):199-212.

10. Rajpal PS, Krishnamurthy V, Pagare SS, Sachdev GD. Age estimation using intraoral periapical radiographs. Journal of forensic dental sciences. 2016 Jan;8(1):56.

11. Paewinksy E, Pfeiffer H, Brinkmann B. Quantification of secondary dentine formation from orthopantomograms – a contribution to forensic age estimation methods in adults. Int J Legal Med.2005; 119: 27-30.

12. Manjunath a BS, Soni NK. Estimation of age from development and eruption of teeth. Journal of forensic dental sciences. 2014 May;6(2):73.

13. Cameriere R, Brogi G, Ferrante L, Mirtella D, Vultaggio C, Cingolani M and Fornaciari G. Reliability in age determination by pulp/tooth ratio in upper canines in skeletal remains. J Forensic Sci 2006; 51(4): 861-864.

14. Cameriere R, Ferrante L, Belcastro MG, Bonfiglioli B, Rastelli E and Cingolani M. Age estimation by pulp/tooth ratio in canines by peri-Apical X-rays. J Forensic Sci 2007; 52(1): 166-170

15. Singh S, Sandhu N, Puri T, Gulati R, Kashyap R. A Study of Correlation of Various Growth Indicators with Chronological Age. Int J ClinPediatr Dent. 2015 Sep-Dec;8(3):190-5. doi: 10.5005/jp-journals-10005-1311. Epub 2015 Sep 11. PMID: 26628853; PMCID: PMC4647038. Singh S, Sandhu N, Puri T, Gulati R, Kashyap R. A Study of Correlation of Various Growth Indicators with Chronological Age. Int J ClinPediatr Dent. 2015 Sep-Dec;8(3):190-5. doi: 10.5005/jp-journals-10005-1311. Epub 2015 Sep 11. PMID: 26628853; PMCID: PMC4647038.

16. Mittal S, Nagendra Reddy SG, Sharma ML, Agnihotri P, Chaudhary S, Dhillon M. Age estimation based on Kvaal's technique using digital panoramic radiographs. Journal of forensic dental sciences. 2016 May;8(2):115.

17. Kazemipoor M, Motallaei MN, Dehghani M. Digital Panoramic Radiography in Dental Age Estimation.