

Effectiveness of Age Estimation in Adults using Pulp: Tooth Area Ratio with Computer Aided Software

Neha Chauhan¹, Dr. Vela D. Desai²

Affiliation: Postgraduate Oral Medicine and Radiology, Jaipur Dental College

Email id: [chauhanneal23\[at\]gmail.com](mailto:chauhanneal23[at]gmail.com)

Guide

Abstract: ***Aim:** The purpose of the present study was to check for the effectiveness of assessing the chronological age based on the relationship between age and measure of the pulp/tooth area ratio on single-rooted teeth i.e., 3 mandibular teeth (canine, 1st premolar and 2nd premolar) using orthopantomographs and a computer-aided software program ImageJ. **Method:** It is a retrospective study where 250 OPGs were evaluated from the archives of dept of OMRof Jaipur dental college, Jaipur. Age was estimated using Cameriere et al. method after which regression equation derived by Mostafa M Afify was applied and result was calculated using SPSS software. **Results:** Linear regression analysis was used to derive multiple regression formulae for individual teeth. R² (coefficient of determination) for mandibular premolar teeth was highest (0.868) with a standard error of 0.007460 years and thus was a better predictor of age in the population of Jaipur, Rajasthan. Karl Pearson's correlation coefficient also showed correlation between age and the mean of ratios of single tooth. **Conclusion:** ImageJ is a promising tool for predicting age of an individual. 2nd premolar predicted the age accurately followed by canine and later 1st premolar for estimating the age in accordance to Morsi et al.*

Keywords: Age estimation, ImageJ, Forensic Odontology, OPG

1. Introduction

Age is one of the essential factors in the identity of a person. Estimation of the human age is a procedure adopted by forensic scientists, archeologists, etc. Radiological images in age estimation, is one of the essential tools in forensic science. In this digitalized era, digitalization of panoramic radiographs and their storage has become easy and can be saved for long durations. Radiographic methods of age estimation are non-invasive, uncomplicated, simple techniques. Noninvasive radiographic techniques depend on determining the amount of secondary dentin deposition. This is done by measuring the reduction of pulp chamber size, which is then correlated with chronological age. Further, Age-predicting regression equations using pulp/tooth area ratio in mandibular teeth was formulated by Mostafa M Afify on Egyptian samples, with high levels of accuracy. Thus, taking this fact into consideration, the present study was conducted to evaluate the effectiveness of pulp/tooth area ratio in three mandibular teeth (canine, first premolar, and second premolar), as an indicator of age using digital panoramic radiograph.

2. Materials and Methods

A total of 250 digital Orthopantomographs (OPGs) and clinical data of 250 patients of Jaipur who visited the Department of Oral Medicine and Radiology in Jaipur Dental College were retrieved from the archives as part of the retrospective study. Individuals ranging between ≥ 15 to ≤ 65 years of age were selected for the study. Since the study aimed at assessing the age in adults by pulp/tooth area ratio using computer aided software and to estimate the age of adults from pulp tooth area ratio in 3 mandibular teeth using panoramic radiographs. These teeth were selected as it is

easier and more feasible since they are single-rooted with large pulpal area and have simpler morphology with less diversity. High-quality panoramic radiographs with fully erupted permanent mandibular canine and premolars with complete root formation were included in the study. Teeth with pathologies such as caries, periodontitis, attrition, abrasion, erosion, fracture or impaction, restorations, endodontic fillings, malaligned or rotated, dilacerated mandibular canine and premolars were excluded. Mandibular canine, premolars with any prosthetic appliances. Patients undergoing fixed orthodontic treatment or endodontic treatment involving mandibular canine and premolars were also excluded. Panoramic radiographs have been shot on Kodak 8000C digital panoramic and cephalometric system Carestream at 73kV, 12 mA for 13.9 sec. and were stored as high-resolution JPEG files on the desktop computer from where they were extracted in a compact disk and were downloaded in a system installed with windows and Image J software.

The processing of radiographic images was done by the following steps:

- The Image of panoramic radiograph was acquired from file option of Image J and later concerned teeth were zoomed with key (ctrl +) with prior placement of cursor at mandibular quadrant of interest so that canine, 1st premolar and 2nd premolar's pulp and tooth area could be visualized and calculated.
- Measurements of tooth and pulp area will be done according to Cameriere et al. A minimum of 20 points on each tooth outline and 10 points on each pulp outline. Selecting the polygon tool of Image J, a point is marked on pulp or tooth outline and then boundary is completed by running the cursor over the outline of pulp

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or tooth. Each point where cursor is given curve to accommodate the shape of concerned pulp or tooth is represented by a yellow dot along with outline marked. After completing the tooth or pulp boundary by uniting the starting point and ending point, the pulp and tooth area was calculated by selecting command (Ctrl M). The area of pulp and tooth of all three mandibular teeth i.e., canine, 1st premolar and 2nd premolar were calculated individually.

- After evaluating the pulp and tooth area of mandibular canine, 1st and 2nd premolar from a panoramic radiograph, the ratio of individual tooth was calculated by presetting the ratio formula (Pulp Area/ Tooth area) under a regression equation derived by Mostafa M Afify which are as follows:
 For mandibular canine = $69.6 + (-332 \times PTR C)$
 For 1st premolar = $67.8 + (-324 \times PTR PM1)$
 For 2nd premolar = $69.2 + (-336 \times PTR PM2)$
- Measurements of rest of the canine, 1st and 2nd premolars tooth area and their pulp area from the 250 radiographic images was done in similar manner as described above. Overall data was recorded, expressed in tables and then subjected to statistical analysis using SPSS (Statistical Package for Social Science) and following are the tests mentioned below where this SPSS is utilized – for calculating mean, standard deviation, coefficient of determination, Karl Pearson’s correlation coefficient.

3. Result

A correlation study was undertaken to evaluate the feasibility of pulp/tooth area ratio in three mandibular teeth canine, first premolar, and second premolar, as an indicator of age using 250 digital OPGs. The mean chronological age was 28 years. Linear regression analysis was used to derive multiple regression formulae for individual teeth. R² (coefficient of determination) was highest for 2nd premolar teeth (0.868) with a standard error of 0.0074 years and thus was a better predictor of age in the population of Jaipur, Rajasthan (Table I and II).

Table 1: Descriptive data of Pulp Tooth area ratio of Canine, 1st Premolar and 2nd Premolar

Data	Pulp Tooth area ratio of Canine	Pulp Tooth area ratio of Premolar	Pulp Tooth area ratio of 2 nd Premolar
N	250	250	250
Mean	0.120329	0.1170710	0.11865358
Std. Deviation	0.019741	0.0193123	0.0204994
Minimum	0.061069	0.0546273	0.06803669
Maximum	0.168800	0.1606948	0.16838828

Table 2: Coefficient of determination (R) and Standard Error of estimate S.E.E. for the Canine, 1st Premolar and 2nd Premolar

S. No.	Tooth	R ²	Adjusted R Square	S.E.E	P-Value
1.	Canine	0.703	0.702	0.010780	0.001
2.	1 st Premolar	0.546	0.544	0.013037	0.001
3.	2 nd Premolar	0.868	0.868	0.007460	0.001

Karl Pearson’s correlation coefficient showed correlation between age and the mean of ratios of single tooth (r = -0.932, -0.739, -0.838); p = 0.001 (Table III)

Table 3 (A): Karl’s Pearson correlation Coefficient of actual age with estimated age using Canine, 1st Premolar and 2nd Premolar

S. No.	Age estimated using Pulp tooth area ratio of	Karl’s Pearson correlation Coefficient (r)	P-Value
1.	Canine	-0.838	0.001
2.	1 st Premolar	-0.739	0.001
3.	2 nd Premolar	-0.932	0.001

4. Discussion

Forensic science encompasses the application of specialized scientific and /or technical knowledge to questions of civil and criminal law, especially in court proceedings. Many times, it is necessary to determine the age of living persons particularly in cases when the individual is either unwilling or is unaware about his age, which necessitates use of forensics especially forensic odontology which uses teeth and supporting structure for estimation of age.

Cameriere et al in 2004 used right maxillary canine to check the variation of pulp tooth area ratio as an indicator of age, finally he concluded that pulp tooth area ratio is the best variable as compared to other variable like p = pulp/root length; r = pulp/tooth length; a = pulp/root width at enamel-cementum junction (ECJ) level; c=pulp/root width at midroot level; b = pulp/root width at midpoint level between ECJ level and mid-root level. The present study applied the technique of pulp tooth area ratio as suggested by Cameriere et al which was utilized in three mandibular teeth i.e., canine, 1st premolar and 2nd premolar to estimate the age. From the results of the study, it was established that Cameriere et al method can be used for estimation of age using pulp tooth area ratio.

Medha Babshet had conducted study on Indian population using three mandibular teeth ie., lateral incisor, canine and 1st premolar and Adobe Photoshop CS2 was used to calculate pulp tooth area of these three teeth. Their study showed that lateral incisor is best predictor of age followed by 1st premolar and canine with the poorest age correlation. But in this study mandibular 2nd premolar is the best predictor of age followed by canine and then 1st premolar.

Joesph and his associates measured mandibular premolars for pulp and tooth area on 120 RVG for estimating the age. They used Jenoptic ProgRes Version 2.7 software for measuring area. The r value of premolar pulp tooth area with chronological age was -0.763. And the study favored that mandibular premolar can be used to perform the forensic age prediction on Indian population with fairly accurate results. In accordance to their study similar procedure was performed by using Image J instead of Jenoptic ProgRes Version 2.7 software and panoramic radiographs instead of RVG and in addition canine were included along with premolars. The results of the study were similar as compared to theirs as far as the r values are concerned, in this study r = -0.932 (2nd premolar), which was closer to actual age.

El Morsi and associates in their study on mandibular 1st premolar, 2nd premolar and 1st molar utilizing Image J software, explained that 2nd premolar out of these three teeth gave the best predicted age which was similar with this study. They had analyzed indirect quantification of secondary dentin deposition, as pulp cavity decreases with increase in age suggestive of secondary dentin deposition which is similar to this study. From this it can be accepted that the image J software can be used to calculate the PTR of teeth and these measurements can be used to calculate the predicted age.

As we are aware Forensics medicine or odontology till date could not establish accurate age of an individual in many incidences rather only an estimated age could be predicted within a range. No formula or any teeth can give us the accurate age of an individual, but the estimated age is always given in a range from negative to positive values from the observations, hence closer the estimated age to actual age, better is the age predilection. With the advent of the modern softwares and future developments we can probably state that this limitation can be ruled out with the passage of time.

5. Conclusion

From the above retrospective study, it can be summarized that Image J is a promising tool for predicting age of an individual. It can be further stated that 2nd premolar predicted the age accurately followed by canine and later 1st premolar for estimating the age that utilized image J in accordance to Morsi et al who stated that 2nd premolar is the best predictor of age. Further research on well-distributed age-groups in larger samples is warranted with a greater number of teeth and additional parameters such as varying geographic regions and races to be carried out to throw further light for betterment of the future aspect of age estimation using this software.

References

- [1] Demirjian A, Goldstain H, Tanner JM. A new system of dental age assessment. *Hum Biology*. 1973;45(1):221–27.
- [2] Rosing FW, Kvaal SI. Dental age in adults: a review of estimation methods. *Dental anthropology. Fundamentals, limits and prospects*. Vienna: Springer. 1998;2(1):443–68.
- [3] Cameriere R, Ferrante L, Cingolani M. Variations in pulp/tooth area ratio as an indicator of age: a preliminary study. *J. Forensic Sci*. 2004;49(1):317-19.
- [4] Jeevan MB, Kale AD, Angadi PV, Hallikerimath S. Age estimation by pulp/tooth area ratio in canines: Cameriere's method assessed in an Indian sample using radiovisiography. *Forensic Sci Int*. 2011;30(204):1-3.
- [5] Cameriere R, Ferrante L, Belcastro MG, Bonfiglioli B, Rastelli E, Cingolani M. Age estimation by pulp / tooth ratio in canines by periapical X-rays. *J Forensic Sci*. 2007;52(2):166-70.
- [6] Landa M. I. To evaluate the reproducibility of the original method of Kvaal et al. on digital panoramic radiographs as well as to analyse the application of age-estimation formulae reported in the literature. *International Journal of Legal Medicine* 123,2(1):123-28.
- [7] Singaraju S, Sharada P. Age estimation using pulp/tooth area ratio: a digital image analysis. *J Forensic Dent Sci*. 2009;1(1):37-41.
- [8] Cameriere R, Cunha E, Sassaroli E, Nuzzolese E, Ferrante L. Age estimation by pulp/tooth area ratio in canines: Study of a Portuguese sample to test Cameriere's method. *Forensic Science International*. 2009; 128(1):1–6.
- [9] Saxena S. Age estimation of Indian adults from orthopantomographs. *Forensic dentistry. Braz Oral Res*. 2011;25(3):225-29.
- [10] Babshet M, Acharya AB, Naikmasur VG. Age estimation from pulp/tooth area ratio (PTR) in an Indian sample: A preliminary comparison of three mandibular teeth used alone and in combination. *J Forensic Leg Med*. 2011;18(2):350-54.
- [11] Babshet M, Acharya AB, Naikmasur VG. Age estimation in Indians from pulp/tooth area ratio of mandibular canines. *Forensic Sci Int*. 2010;15(2):197-99.
- [12] Agarwal N, Ahuja P, Sinha A, Singh A. Age estimation using maxillary central incisors: A radiographic study. *Journal of Forensic Dental Sciences*. 2012;4(2):1-6.
- [13] Redha Habeeb A H, Fattah A.A. Digital panoramic estimation of chronological age among Iraqi adult population in relation to morphological variables of canine teeth. *J Bagh College Dentistry*. 2013; 25(4):1-4.
- [14] Afify M M, Zayet K M, Mahmoud F N and Ragab R A. Age Estimation from Pulp/Tooth Area Ratio in Three Mandibular Teeth by Panoramic Radiographs: Study of an Egyptian Sample. *J Forensic Res*. 2014,5(1):3.
- [15] Juneja M, Devi B K Y, Rakesh N, Juneja S. Age estimation using pulp/tooth area ratio, *Journal of Forensic Dental Science*. 2014;6(3):132-37.
- [16] Sakhdari S, Mehralizadeh S, Zolfaghari M, Madadi M. Age Estimation from Pulp/Tooth Area Ratio Using Digital Panoramic Radiography. *Journal of Islamic Dental Association of IRAN (JIDAI) Winter*. 2015;27(1):155-159.
- [17] Basoya S, VC Vinod, Nath P, Bhogte A. Estimation of Age by Pulp-Tooth Area Ratio Using Three Computer Aided Software's. *Quality in Primary Care*. 2016;24(4):161-66.
- [18] El Morsi DA, Rezk HM, Aziza A, Sherbiny M Tooth Coronal Pulp Index as a Tool for Age Estimation in Egyptian Population. *J Forensic Sci Criminol*. 2015;3(2):201-04.
- [19] Jayaraman J, Wong HM, Roberts GJ, King N M, Cardoso H, Velusamy P, Vergara R, Yanagita K and Jorns T. Dental age estimation in southern Chinese population using panoramic radiographs: validation of three population. *BMC Medical Imaging*. 2019;19(242):1-9.
- [20] Miranda JC, Azevedo ACS, Michel-Crosato E, Biazeic MGH. Age estimation in Brazilian adults by Kvaal's and Cameriere's methods. *Braz. Oral Res*. 2020;34(1):1-10.

- [21] Dehghani M, Shadkam E, Ahrari F. Age estimation by canines' pulp/tooth ratio in an Iranian population using digital panoramic radiography. *Forensic Sci Int.* 2018;285(1):44-49.
- [22] Ilayaraja V, Ganapathy N, Jisha G, Keerthipriyadharshini T, Maheswaran T and Yoithapprabhunath T. Digitized Morphometric Analysis using Maxillary Canine and Mandibular First Molar for Age Estimation in South Indian Population. *The Open Dentistry Journal.* 2018;12(1):762-69.
- [23] Joseph C, Reddy S, Cherian M, Kannan K, George G, Jose S. Intraoral Digital radiography for Adults Age Estimation: A Reliable Technique. *Journal of Indian Academy of Oral Medicine and Radiology.* 2013;25(4):287-90.
- [24] El Morsi DA, Rezk HM, Aziza A, Sherbiny M Tooth Coronal Pulp Index as a Tool for Age Estimation in Egyptian Population. *J Forensic Sci Criminol.* 2015;3(2):201-04.