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Secondary Changes in Dentin as a Biomarker in Age Determination: Study Using Digital Orthopontomograms of Senegalese Subjects

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Abstract

Knowledge of age is essential for people living because of its social, legal and judicial involvement. The tooth represents an excellent medico-legal tool for age assessment through its growth, biological behaviour and aging. The aim of this study was to find a correlation between pulp volume dimension and chronological age using the Drusini et al method.

Materials and Methods: A total of 150 panoramic radiographs of Senegalese subjects aged 10-44 years were included in this study. Drusini's method was used to estimate age. The collected data were analyzed with R software version 3.6.1. The comparison of the means was made with the t-test of Student and a significance threshold p 0.01 was choosen.

Results: The average premolar CPCH value was 2.64 mm in men and 2.28 mm in women. The mean molar TCI-M1 value was 41.59-4.04 in women and 38.78-487 in men. The result of the Person's correlation test shows a negative correlation very equal to -0.899, significant between molar ICT and chronological age p <0.001. A strong correlation was also noted between chronological age and premolar ICT p <0.001.

Conclusion: In short, Drusini et al's method has proved its validity in determining the age of Senegalese subjects.

Keywords: Age Estimation; Coronal Pulp Index; Forensic Dentistry; Drusini Method

Introduction

In the face of an unknown body, a question about age often comes to the mind of a medical examiner or a criminal police investigator.

Research is then undertaken to determine the biological profile (ethnicity, sex and age) of the victim. In age as-sessment, bone and dental methods are the most widely used. The role of the dental organ in this estimation process is often decisive. An excellent time tracer, the tooth represents a medico-legal tool of extreme impor-tance in the assessment of age because of its biological behaviour and morphological features [1,2].

In 1993, Drusini applied the calculation of TCI on radiographs of living subjects [5]. According to Drusini, this affixing of secondary dentin remains a morphological indicator, a significant biomarker of dental age, as it is not an alteration caused by dental erosion [6].

The correlation between pulp reduction and dental age has been the subject of much investigation among Cau-casian populations [7], Indian [8], and Arab [9].

To date, no studies have tested its applicability in West African melanoderm subjects. The objective of this stu-dy was to test the validity of the coronal pulp index on a sample of Senegalese melanoderm subjects.

Materials and Methods

This descriptive study was carried out within the Department of Odontology of the Faculty of Medicine, Phar-macy and Odontology of Dakar (Senegal).

Inclusion criteria

The selection criteria concerned the subjects:

- Senegalese and Senegalese parents
- Aged 15-45 years
- Known date of birth
- Operable panoramic radiographs good legibility and sharpness.

Criteria not included

Excluded from this study were:

- Radiographs of patients with systemic disease that may affect tooth development.
- Radiographs or the first mandibular molars and premolars are not visible.
- Panoramic radiographs with image distortion
- Lack of clarity due to incorrect exposure technique
- Patient with a history of orthodontic treatment.

The sample size was determined from the results obtained by Ngom et al [10].

The statistical formula below was used to estimate the study population (95% confidence level and 0.06 degree of accuracy).

$$\mathbf{n} = \frac{\left(\frac{Z\alpha}{2}\right)^2 P(1-P)}{d^2} \mathbf{n\ n} = \frac{(1.96)^2 * 0.72(1-0.72)}{(0.06)^2} = \mathbf{150}$$

Drusini Methods [5]

The method is based on the calculation of the ratio between the height of the pulp chamber and the coronary height.
The parameters CH, CPCH and TCI were studied (Figure 1).

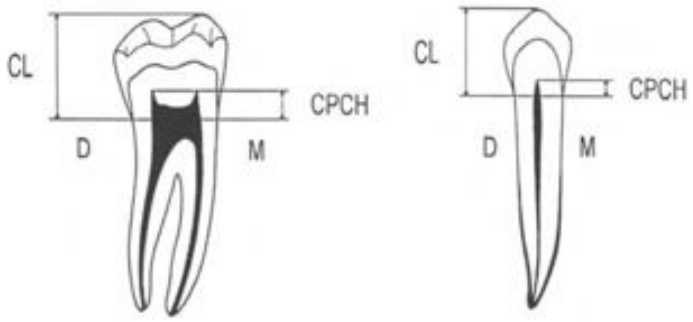

Figure 1: CH (coronal height); CPCH (coronal pulp cavity height)

- CH: corresponds to the measurement obtained between the right passing through the amelo-dentiary junction and the line passing through the highest cusp at the molar and premolar level.
- CPCH: corresponds to the measurement obtained between the line passing through the amelodal junc-tion and that passing through the highest pulp horn.
- TCI: is the ratio CPCH/CH *100.

X-ray measurements

All JPEG panoramic radiographs have been converted to DICOM and processed with the Radiant 3D software (Figure 2). The measurements made for the CH and CPCH distances were recorded in millimetres [mm].

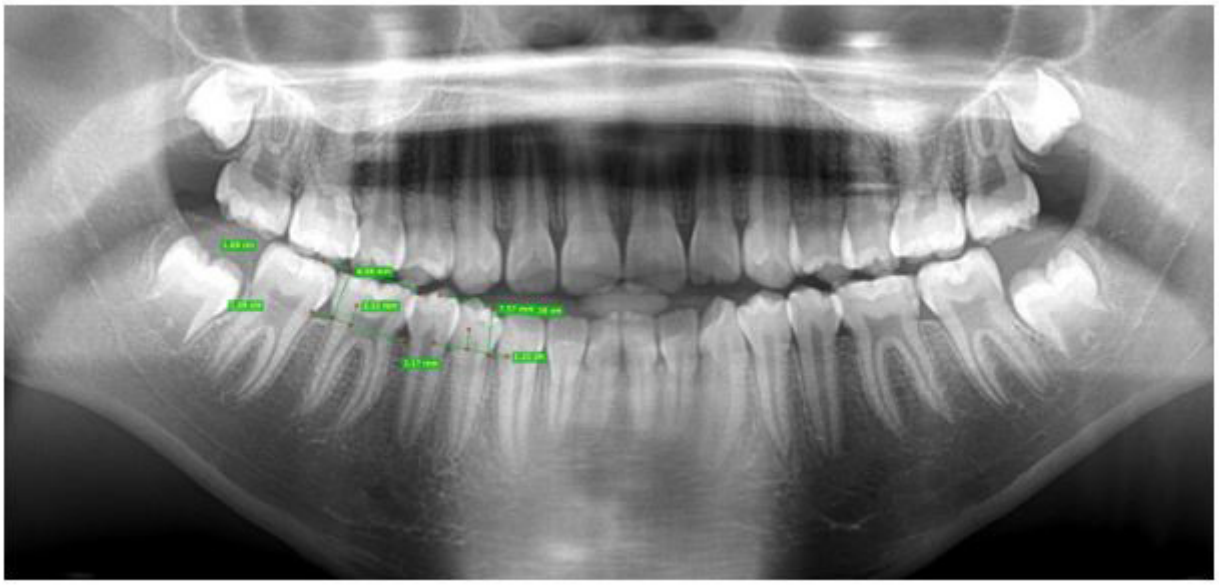

Figure 2: CH and CPCH measurements in the mandibular molar and premolar

Determination of dental age

Dental age is calculated by integrating the TCI value into the equation:

- Y(PM)= 76,073-(1,4576*TCI(PM)), for premolars

- Y(M)=77,617-(1,4636*TCI(M)), for molar

Statistical analyses

The collected data were recorded and processed with the JAMOVI 16.0 software. A descriptive analysis of the data is carried out initially. The relevance of certain factors was tested in a second stage using the mean compa-rison test (Student t test) or the variance comparison test (ANOVA test). Correlations were tested between the quantitative variables by linear regression. The significance threshold $p < 0.05$ was used.

Results

A total of 150 panoramic radiographs were analyzed. The average chronological age was 18.0+/- 7.04 for wo-men and 17.1+/-5.84 for men. Table 1 shows the averages of the CH and CPCH measurements at the level of the first premolar and first mandibular molar. The premolar CH was slightly higher in men 6.85 +/- 0.85 mm than in women 5.60+/- 0.92 mm. No statistically significant differences by sex were noted. Table 2 shows the averages of CH and CPCH measurements at the first mandibular molar. The mean CH value was 6.05-1.03 mm in women and 6.42-1.84 mm in women. The mean CPCH value was 2.38-0.49 mm in women and 2.59-0.75 in men. Table 3 shows the average of molar and premolar ICT in men and women. The mean TCI-M1 was 41.59-4.04 in women and 38.78-487 in men. The student t-test result shows no statistically significant difference (Table 4). The linear regression between the chronological age (AC) and TCI-PM1 a showed a very significant negative correlation $p < 0.001$ (Figure 3). The linear regression between chronological age and TCI-M1 showed a very significant correlation $p<0.001$ (Figure 4).

SEXE	mean-SD		
	F	H	P-value
CH	5,60-0,92	6,85-0,85	0,266
CPCH	2,28-0,92	2,64-1,88	0,117

Table 1: Means CH, CPCH and premolar TCI

SEXE	Means-SD		
	F	H	P-value
CH	6,05-1,03	6,42-1,84	0,136
CPCH	2,28-0,49	2,59-0,75	0,047*

Table 2: Means CH, CPCH and TCI (molar)

SEXE	Means-SD		
	F	H	P-value
TCI-MI	4,59-4,04	38,78-487	0,248
TCI-PMI	42,33-/+3,98	40,59-0-/+4,89,75	0,269

Table 3: Means TCI premolar and molar

AC		
TCI-MI	Pearson's r	-0.899
	P-value	<.001
TCI-PMI	Pearson's r	-0.800
	p-value	<0.001

Table 4: TCI and AC correlation

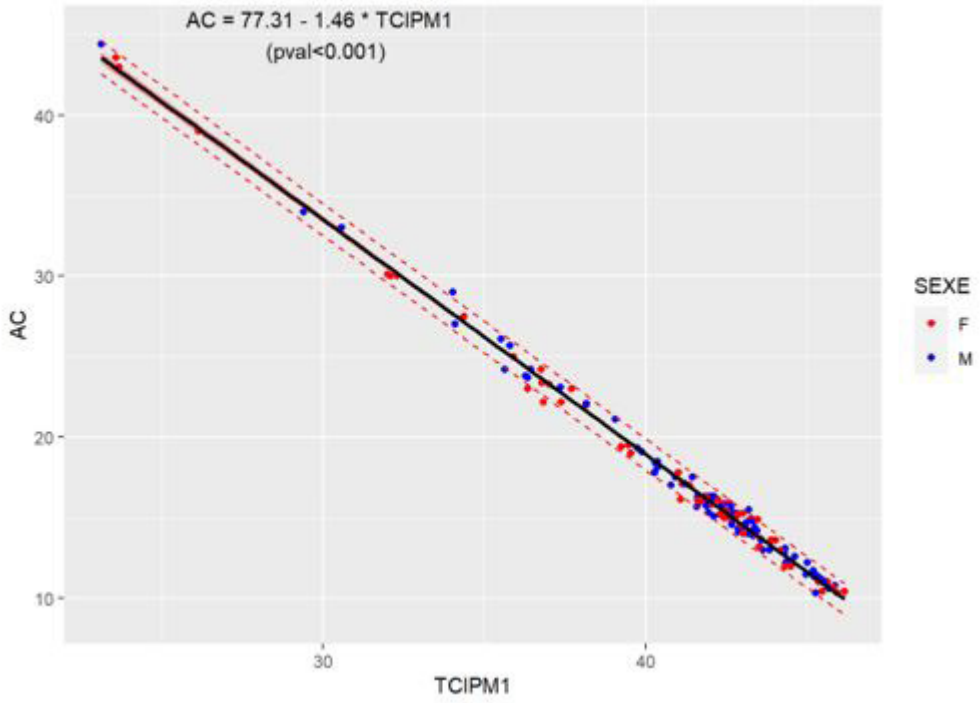

Figure 3: AC-TCI-PM1 regression

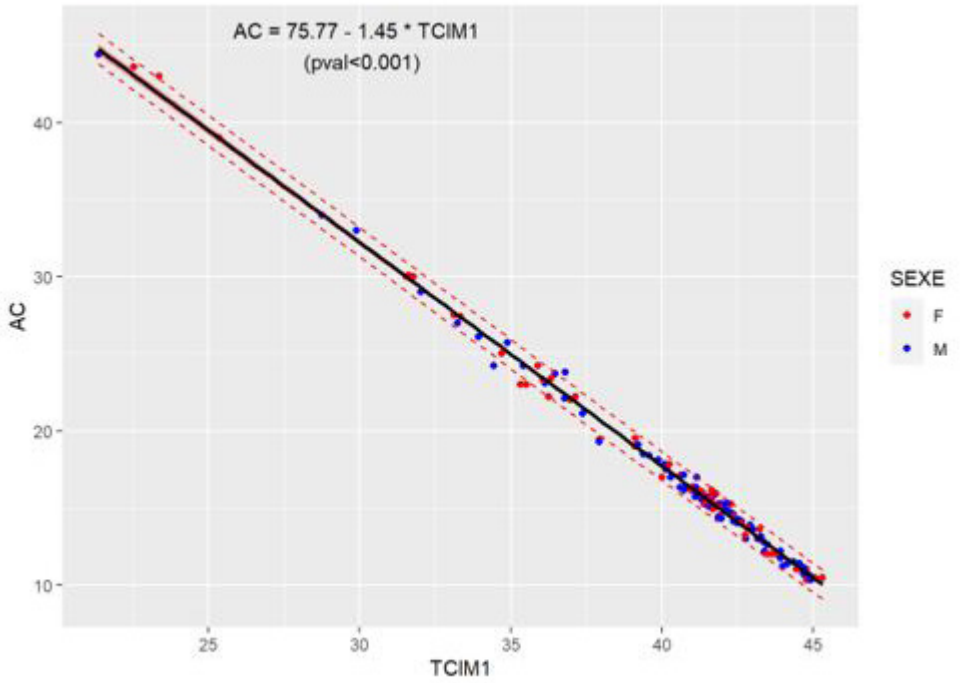

Figure 4: AC-TCI-M1 regression

Discussion

Reduction in pulp cavity volume due to secondary dentin deposition could be used as an indicator of age [11]. This morphological change can be observed and analyzed by three-dimensional (3D) and two-dimensional panoramic radiological techniques.

The method consisted of evaluating the dimensions of the pulp chamber (CPCH) and the crown (CH) using the Radiant 3D software.

The mean value obtained for CH-molar (CH-M1) was 6.05 mm for women and 6.42 mm for men. For CPCH-molar (CPCH-M1),

the average value was 2.38 mm for women and 2.59 mm for men. At the level of CH-premolar (CH-PM1), the average was 5.60 mm in women and 6.85 mm in men.

The mean CPCH-PM1 value was 2.64 mm in men and 2.28 mm in women. The result of the student test showed no statistically significant difference was noted p<0.001. The mean TCI-M1 value was 38.78 +/-4.87 mm for men and 41.59+/-4.04 mm for women. The mean TCI-PM1 value was 40.59+/-4.89 mm for men and 42.33+/-3.98 mm for women.

The result of the Pearson's correlation test shows a very significant negative correlation between molar ICT and chronological age p<0.001.

The mean dental age determined from the Drusini et al prediction equation was 17.1 in men and 18.0 in women. The correlation coefficient between TCI-PM1 and AC was -0.800 and TCI-M1 -0.899.

The linear regression calculated between TCI and AC was AC=75.77-1.45*TCI(M1) and AC=77.31-1.46*TCI(PM1).

The results of this study are similar to those of the Vaishali Vasant Koranne et al study in Indian subjects aged 20-60 years. In their study, Vaishali et al obtained a strong correlation r= -0.86 for TCI-PM1 and a r of -0.85 for TCI-M1.

The authors concluded that the Drusini method is simple, non-invasive, inexpensive and of good applicability [12]. Similarly, Igbigbi PS et al in their study of the estimated age of 134 adults, including 77 men and 57 wom-en aged 20 to 80, concluded that the Drusini method was valid. The results of their study show a strong correla-tion in both men (r= -0.650) and women (-0.799) between chronological age and molar and premolar ICT [13].

In Australia, Shalmira Karkhanis et al in a large sample, 220 women and 230 men indicate that the method may be applicable for forensic purposes [14]. Results of Ranjdar and Talabani et al [15] from 96 subjects cor-roborated the results of this study and those of Shalmira Karkhanis et al and Vaishali Vasant Koranne et al [11].

The study by Raghavendra Havale et al, with 100 children aged 5 to 10, confirms the results of this study. With a correlation coefficient r = -0.59, found between chronological age and ICT, the authors conclude that the Drusini method is well applicable [16].

Drusini et al, out of a sample of 433 subjects, had a strong correlation of -0.92 chronological age and ICT [16]. With an error of +/- 5 years in 81.4% of cases at the level of molar ICT in men, Drusini et al estimate that this method, based on pulp aging, can be easily applied in the determination of the age of living and deceased indi-viduals.

The congruence of the Drusini method is also highlighted by Swati Shrikant Gotmare et al's study of 88 subjects (54 men and 34 women).

The results concluded that TCI is a reliable, accurate, non-invasive and easy-to-use biomarker for age estima-tion and may be applicable to living and deceased individuals [18].

The results of this study are different from those of Jain S et al. In their study Jain S et al, involving 180 subjects of Chhattisgarh aged 15 to 70 years, it was shown a very low correlation with TCI-M1 r=-0,178 and TCI-PM1 r=-0,187. The authors conclude that the method was not valid [19]. Gok et al, also concluded that the Drusini et al method was not applicable in a sample of 9,059 Turkish subjects aged 15 to 40 years [20].

Another Pakistani study by Sheikh, Badar et al, on 80 subjects concluded that ICT could not be used for age estimation [21]. In short, the method used in this study a is simple and inexpensive. The results obtained showed good congruence and applicability. However, further studies with a larger sample are needed.

Conclusion

The Drusini et al method used in this study is simple, non-invasive. The results obtained show a highly accepta-ble congruence for estimating age.

It can be used in forensic medicine for the estimation of age especially in a Senegalese context marked by the problem of «ghost pupils.

References

1. Fronty P, Sapanet M, Georget C (2005) Guy Collet. Forensic odontology notebooks, volume 2 - The estimat-ed identification: the search notice, the digital odontogram [Guy Collet. Cahiers d'odontologie médico-légale, tome 2 – L'identification estimative :l'avis de recherche, l'odontogramme numérique], Atlantic.

2. De Salvia A, Calzetta C, Orrico M, De Leo D (2004) Third mandibular molar radiological develop-ment as an indicator of chronological age in a European population. Forensic Sci Int 146.

3. Bodecker CF (1925) A consideration of some of the changes in the teeth from young to old age. Den-tal Cosmos 67: 543-9.

4. Ikeda N, Umetsu K, Kashimura S, Suzuki T, Oumi M (1985) Estimation of age from teeth with their soft X-ray findings. Nihon Hoigaku Zasshi 39: 244-50.

5. Drusini AG (1993) Age estimation from teeth using soft X-ray findings. Anthropol Anz 51: 41-6.

6. Drusini AG, Toso O, Ranzato C (1997) The coronal pulp cavity index: a biomarker for age determina-tion in human adults. Am J Phys Anthropol 103: 353-63.

7. Cameriere R, De Luca S, Alemán I, Ferrante L, Cingolani M (2012) Age estimation by pulp/tooth ratio in low-er premolars by orthopantomography. Forensic Sci Int 214: 105-12.

8. Babshet M, Acharya AB, Naikmasur VG (2010) Age estimation in Indians from pulp/tooth area ratio of mandibular canines. Forensic Sci Int 197: 1-3.

9. Shrestha M (2014) Comparative evaluation of two established age estimation techniques (two histolo-gical and radiological) by image analysis software using single tooth. J Forensic Res 5: 1-6.

10. Ngom PI, Faye M, Ndoye NF, Diagne F, Yam AA (2007) Applicability of standard of Demirjian's Method for dental maturation in senegalese children. Dakar-Med 52: 196-203.

11. Landa MI, Garamendi PM, Botella MC, AlemánInt I (2009) Application of the method of Kvaal et al. to digital orthopantomograms. J Legal Med 123: 123-8.

12. Koranne VV, Mhapuskar AA, Marathe SP, Joshi SA, Saddiwal RS, et al. (2017) Age estima-tion in Indian adults by the coronal pulp cavity index. J Forensic Dent Sci 9: 177.

13. Igbigbi PS, Nyirenda SK (2005) Age estimation of Malawian adults from dental radiographs. West Afr J Med 24: 329-33.

14. Karkhanis S, Mack P, Franklin D (2013) Age estimation standards for a Western Australian popula-tion us-ing the coronal pulp cavity index. Forensic Sci Int 231: 412-6.

15. Talabani RM, Baban MT, Mahmood MA (2015) Age estimation using lower permanent first molars on a panoramic radiograph: A digital image analysis. J Forensic Dent Sci 7: 158-62.

16. Havale R, Rao DG, Latha AM, Nagaraj M, Karobari NM, et al. (2020) Coronal pulp: An age biomarker - A cross-sectional radiographic study in children. J Oral Maxillofac Pathol 24: 389-94.

17. Drusini AG (2008) The Coronal Pulp Cavity Index: A Forensic Tool for Age Determination in Human Adults. Cuad Med Forense 14: 53-4.

18. Gotmare SS, Shah T, Periera T, Waghmare MS, Shetty S, et al. (2019) The coronal pulp cavity index: A fo-rensic tool for age determination in adults. Dent Res J 16: 160-5.

19. Jain S, Nagi R, Daga M, Shandilya A, Shukla A, et al. (2017) Tooth coronal index and pulp/tooth ratio in dental age estimation on digital panoramic radiographs-A comparative study. Forensic Sci Int 277: 115-21.

20. Gok E, Fedakar R, Mustafa Kafa I (2020) Correction to: Usability of dental pulp visibility and tooth coronal index in digital panoramic radiography in age estimation in the forensic medicine. Int J Legal Med 134: 1265.

21. Badar SB, Ghafoor R, Khan FR, Hameed MH (2016) Age estimation of a sample of Pakistani po-pulation using Coronal Pulp Cavity Index in molars and premolars on Orthopantomogram. J Pak Med Assoc 66: S39-41.