SHORT REPORT

Age estimation of a sample of Pakistani population using Coronal Pulp Cavity Index in molars and premolars on Orthopantomogram

Sheikh Bilal Badar, Robia Ghafoor, Farhan Raza Khan, Muhammad Hasan Hameed

Abstract

The aim of the present study was to assess the validity of tooth-coronal index (TCI) in the age estimation. This retrospective charts review was conducted at the Aga Khan University Hospital, Karachi from January 2016 to March 2016, and comprised 315 teeth of 80 individuals. The teeth were analysed on Orthopantomogram. TCI was calculated for unrestored mandibular premolars and molars. Pearson's correlation was applied to assess correlation between chronological age and TCI. Besides, 30(37.5%) subjects were male and 50(62.5%) female, and 140(44.4%) teeth were of male subjects and 175(55.6%) were of females. The mean correlation coefficient between chronological age and TCI was -0.27. The highest negative correlation was observed for tooth No.47 in males (r=-0.72) whereas among females the highest negative correlation was noted for tooth No.36 (r=-0.61).There was very weak correlation between age and TCI of a tooth. Therefore, TCI index could not be predictably used for age estimation in the studied population.

Keywords: Forensic anthropology, Tooth crown, Dental pulp cavity.

Introduction

Considerable attention has been given to the estimation of age in the disciplines of anthropology and forensic sciences. Successful determination of the age of a deceased personal is of substantial importance from legal, ethical and criminal perspective. From the legal standpoint, the utility of accurate age estimation is undeniable in solving law cases and conflicts associated with questions of children adoption, etc.[1]

Literature shows that various techniques have been employed and several parts of body have been studied for accurate age assessment.[2] Many of these techniques use indicators of age related to changes in the skeleton. But the primary limitation of these techniques is that they can only estimate the age till the time of ossification of relevant bones.[2]

Shamim et al.[3] proposed different methodologies for the age estimation, including dental radiographs. In addition to paediatric age group, dental radiographs can assist in prediction of age in adults, too. Researchers have studied extracted teeth for cementum annulations, aspartic acid racemisation, and root transparency as parameters of age estimation.[3] However, these methods entail removal and/or destruction of tooth sample. On the other hand, radiography being a non-destructive method has definite place in forensic dentistry for the predictable determination of age among unidentified deceased individuals.[4]

Secondary dentine formation in teeth causes reduction in pulp cavity size. This phenomenon of deposition of secondary dentine can be used to discern the chronological age.[5] Kvaal et al.[4] correlated the pulp size radiolucency on radiograph with subjects' age. Drusini et al.[6] found correlation among coronal height, height of coronal pulp cavity and coronal pulp cavity height and used these parameters to determine age of Italian population. Karkhanis et al.,[7] used the method described by Drusini et al.,[6] for estimating the age of Western Australian population.

Several studies have been conducted to devise age estimation standards for their representative populations but currently limited data is present that shows the applicability of these standards for Pakistani population. As Pakistanis are distinct ethnic group, result of previous studies cannot be extrapolated on them. The current study was planned to develop age estimation standards for Pakistani population using coronal pulp cavity index, or tooth-coronal index (TCI).

Methods and Results

This retrospective charts review using Orthopantomogram (OPG) was conducted at dental clinics of the Aga Khan University Hospital (AKUH), Karachi from January 2016 to March 2016. Approval was obtained from the institutional review committee. The sample size was calculated by World Health

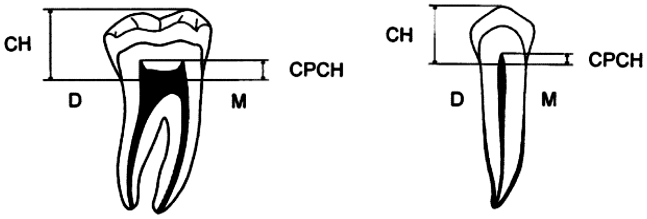
Operative Dentistry, Section of Dentistry, Aga Khan University Hospital, Karachi, Pakistan.

Correspondence: Sheikh Bilal Badar. Email: sheikh.badar@aku.edu

Table: Correlation coefficient (r) between TCI and chronological age for the pooled sex sample and individual sexes.

Tooth # (FDI)	Pooled sex sample	Female	Male
34	-0.20NS	0.002 NS	-0.42 *
35	-0.27 NS	-0.12 NS	-0.35 NS
36	-0.54*	-0.61*	-0.04 NS
37	-0.41*	-0.28 NS	-0.52 *
44	0.13 NS	-0.02 NS	-0.23 NS
45	-0.30 *	-0.28 NS	0.41 NS
46	-0.08 NS	0.41 NS	-0.29 NS
47	-0.49*	-0.20 NS	-0.72*

NS: Not significant
TCI: Tooth-coronal index
FDI: Fédération Dentaire Internationale (World Dental Federation)
n= 315
Pearson correlation
*= p<0.05.



CH: height of the crown
CPCH: coronal pulp cavity height
Adapted from Drusini et al.[6]

Figure: Tooth measurements required for the calculation of the tooth coronal index.

Organisation's (WHO) sample size calculator[7] using the reference of Karkhanis et al.[8] They reported that the mean TCI of lower first molar in 20- to 29-year-old individuals of both genders was 30.76±5.51 and in TCI reported in lower second molar of the same age group in the two genders was 28.17±6.35.Keeping the above difference at the level of significance (α) 5% and power of study (1-β) 95%, the required sample size was 80 molars.

Sample included undistorted OPGs from the AKUH database showing sound and unrestored mandibular premolars and molars belonging to subjects aged between 9-79 years. OPGs that showed teeth with radio-opaque filling, crown or any pathological processes visible on the radiograph and teeth with large areas of enamel overlap between neighbouring teeth were excluded.

TCI for right and left mandibular premolars and molars was calculated using digital calliper with the method described by Drusini et al.,[6] (Figure). TCI of 30(37.5%) random teeth were again calculated after one month by the same investigator for intra-examiner reliability which came out to be excellent (0.79).

Data was analysed using SPSS 20. Intra-examiner reliability was assessed using Pearson's correlation coefficient. Paired sample t-test was used to assess bilateral symmetry in TCI values. To assess relationship between chronological age and TCI, Pearson's correlation coefficient was used. P<0.05 was taken as significant.

Of the 80 subjects, 30(37.5%) were males and 50(62.5%) females. A total of 315 teeth were studied, out of which 140(44.4%) were from male subjects and 175(55.6%) were from females subjects. For bilateral asymmetry, paired sample t-test showed no statistically significant difference between right and left mandibular premolars and molars. Linear correlation between TCI and age was ascertained using Pearson's correlation coefficient which showed that only teeth number 36 (r=-0.54), 37 (r=-0.41), 45(r=-0.3) and 47 (r=-0.49) showed negative correlation. The overall correlation between TCI and chronological age turned out to be -0.27. In females, only tooth number 36showeda significant correlation (r=-0.61).In male subjects, teeth number 34, 37 and 47 showed some significant negative correlation (-0.42 to -0.72) (Table).

Conclusion

TCI represents the radiographic area occupied by the pulp tissue in the tooth above the cemento- enamel junction (CEJ). Thus, with the advancing age and physiological deposition of secondary dentin, the TCI should decrease. Hence, TCI and age should ideally be negatively correlated. The present study showed a negative correlation, too, between these two variables. This finding is in agreement with studies conducted by Drusini et al.[6] and Karkhanis et al.[8] However, the magnitude of correlation between age and TCI in our study came out to be weaker than those of the Italian[6] and Western Australian population.[8] Contrary to this, Morsi et al.[9] reported a positive correlation between age and TCI in the Egyptian population. They speculated that the sample size and population are responsible for this discrepancy.

In our study, molars demonstrated a higher correlation than the premolars. The probable reason could be explained by natural variation in the secondary dentine deposition. Another reason could be the fact that pulp space and secondary dentine deposition among mandibular molars are better visualised on radiographs than premolars.[10]

The two genders showed a significantly different correlation of TCI with age for different teeth. This gender difference is in contrast to the findings of other

studies.[6,8,9] These studies showed that both genders have somewhat similar TCI-age correlation. However, our data corresponds more to the study done by Igbigbi & Nyirenda[11] who studied Malawian population and reported that different formulas for age estimation should be used for the two genders. They also concluded that TCI among males has higher correlation with age compared to females which is in agreement with our study.

In our study, we used digital panoramic radiographs originally taken for routine diagnosis and management of subjects presenting to our centre for dental evaluation and treatment. Thus, there was no unnecessary harm of repeated radiation exposure or cost involved. We employed mandibular premolars and molars in our study as anterior teeth are often appeared distorted on the OPG. The pulp space of molar is reported to be evaluated far better on the OPGs.

We used digital calliper on the OPG for quantification of TCI. However, one of the limitations of the study was that the accuracy of digital calliper measurements might be affected by observer's judgment of the reference points on the radiographic image. A subset of 30 teeth was evaluated to assess intra-examiner reliability which turned out to be good (0.79).

The molars and premolars of Pakistani subjects showed a weak correlation between the chronological age and TCI. Therefore, the coronal pulp index cannot be predictably used for the age estimation in the studied population.

References

1. Cunha E, Baccino E, Martrille L, Ramsthaler F, Prieto J, Schuliar Y, et al. The problem of aging human remains and living individuals: a review. Forensic Sci Int 2009; 193: 1-13.
2. Davies C, Hackman L, Black S. The epiphyseal scar: changing perceptions in relation to skeletal age estimation. Ann Hum Biol 2015; 42: 348-57.
3. Shamim T, Ipe Varghese V, Shameena PM, Sudha S. Age estimation: a dental approach. J Punjab Acad Forensic Med Toxicol 2006; 6: 14-6.
4. Kvaal SI, Kolltveit KM, Thomsen IO, Solheim T. Age estimation of adults from dental radiographs. Forensic Sci Int 1995; 74: 175-85.
5. 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: 317-9.
6. Drusini AG, 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.
7. Lemeshow S, Lwanga SK. Sample size determination in health studies. Version 2.0.21., World Health Organization, Geneva, Switzerland.
8. Karkhanis S, Mack P, Franklin D. Age estimation standards for a Western Australian population using the coronal pulp cavity index. Forensic Sci Int 2013; 231: 412 e1-6.
9. El Morsi D, Rezk H, Aziza A, El-Sherbiny M. Tooth Coronal Pulp Index as a Tool for Age Estimation in Egyptian Population. J Forensic Sci Criminol 2015; 3: 1-8.
10. Mathew DG, Rajesh S, Koshi E, Priya LE, Nair AS, Mohan A. Adult forensic age estimation using mandibular first molar radiographs: A novel technique. J Forensic Dent Sci 2013; 5: 56-9.
11. Igbigbi PS, Nyirenda SK. Age estimation of Malawian adults from dental radiographs. West Afr J Med 2005; 24: 329-33.