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RESEARCH ARTICLE

TOOTH CORONAL INDEX RELIABILITY IN AGE ESTIMATION- A PANTAMOGRAPHIC ANALYSIS

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ABSTRACT

The fundamental question in forensic science is identification of a person for legal and ethical issues and declaration of death reports. Even estimation of age in living persons for clarification of criminal and civil liability and social issues is on high pace. Teeth being the hardest part of the body and remains preserved without gross changes for longer period of time after death, it is one of the most reliable method for age estimation. Age estimation from TCI is a precise, non-invasive, not time consuming, not requiring highly specialized equipment and applicable to both living and dead individuals

INTRODUCTION

The fundamental question in forensic science is identification of a person for legal and ethical issues and declaration of death reports. Even estimation of age in living persons for clarification of criminal and civil liability and social issues is on high pace (Ferenandes, 2011; Raiet al., 2010). Usually forensic identification includes processing long bones and teeth for age estimation.Eventhough both teeth and bones are used during postmortem, but inspecting teeth can be helpful to some extent during life (Saxena, 2011). Since, Teeth being the hardest part of the body and remains preserved without gross changes for longer period of time after death, it is one of the most reliable method for age estimation (Cameriere, 2007; Joseph et al., 2015). Several techniques have been developed for dental age calculation. Most common among them is morphological technique which is based on age related criteria such as attrition, secondary dentin, periodontal attachment, translucent apical zone, cementum apposition and root resorption. The other methods being histological and biochemical may require extraction, and preparation of microscopic sections which cannot be performed on living individuals and in cases where it is not possible due to ethical, religious, cultural or scientific reasons (Bosmans et al., 2005). Then , the non- invasive radiographic technique was developed for measurement of reduction in dental pulp cavity associated with advancing age due to secondary dentin formation (Bashet et al., 2010; Manigandan, 2014). The use of tooth radiographs are non destructive and can be applied to both living and deceased persons. More than that digitization of panoramic radiographs and computer assisted image analysis avoid the bias inherent in observer subjectivity and improve reliability accuracy and precision (Vandevoort, 2004). Secondary dentine begins to form once the tooth crown is fully formed; the tooth is in occlusion and the root complete and does continue throughout life. Since regular secondary dentine is laid down at the pulpal end of primary dentine, the pulp cavity decreases in size with age. It is suggested by some authors that age has a greater influence on laying down of secondary dentine than attrition or irritation. When dentine is subjected to acute damage, e.g. dental caries there would be irregular secondary dentin formation, often referred to as tertiary dentine (Drusini, 2008). Kvaal et al introduced a radiographic method in which tooth extraction was not required and was done by indirectly measuring deposition of secondary dentine and correlated to age (Kvaal, 1995). The study of Ikeda et al. measuredthe tooth coronal index (TCI) [TCI= length of coronal pulp cavity /length of the crown X 100] after it was computed to each tooth and regressed on real age.[11] In 1993 , Drusini took soft X-ray photos to measure length (in mm) of the crown (CL) and the length of coronal pulp cavity (CPCL) and computed coronal index for each tooth and regressed to obtain equations that allow in unknown bodies and isolated teeth (Drusini, 1993). Even though several formulas have been developed based on various radiographic and morphological parameters, but the reproducibility of these parameters is uncertain as the values may be different for individuals from different ethnic groups (Saxena, 2011). Several studies have used canine, first premolar, and second premolar on intraoral periapical and panoramic radiograph to estimate dental age asthese teeth have good delineation of pulp chamber. Some studies usedmandibular firstmolarto predict dental age while only few studies used mandibular second molar for the same (Shah, 2016; Veera, 2014; Juneja, 2014).

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This study was carried out on mandibular second premolar and first molar for measuring TCI and evaluating its reliability in estimating the chronological age.

MATERIALS AND METHODS

This analytical cross- sectional study comprised of digital orthopantomographs of 117 subjects collected between June 2016 to February 2018 from the archive of oral medicine and radiology department of Azeezia College of Dental Science and Research, kollam. In this study digital panoramic radiographs of subjects aged 20-70 years, obtained through SINORA ORTHOPHOS XG Panoramic Machine through systemic random sampling.

The sample size was calculated based on the formula: The inclusion criteria include panoramic radiographs showing good morphological features of the study teeth i.e. mandibular second premolar and first molar. Exclusion criteria include teeth with extensive dental caries or restorations, root resorption, incomplete root development, severe crowding, considerable attrition, intrabony lesions attached to root, hypercementosis and dilacerations were excluded.. Radiographs of the patients with a medical history of head and neck irradiation, chemotherapy, genetic disorders related to developmental tooth anomalies (such as Down and Turner syndromes), trauma, cleft lip, and cleft palate were not assessed. All 117 panoramic radiographs were subjected to radiographic measurements.

They were exported to JPEG image format by using trophy Sidexis, Digital Image and Communications in Medicine (DICOM) software (Dentsply, Sirona). The measurements were performed on these JPEG images by using Adobe Photoshop 7.0 software (Adobe, California). All the measurements were recorded in millimeters (mm). Since the cemento-enamel junction (CEJ) level is not clearly visible on panoramic radiographs for measuring the crown height and root length of each tooth, modified Lind technique was adopted to determine the midpoint of crown and root .[17] The crown height was measured vertically from the cervical line to the tip of the highest cusp[18] and the coronal pulp cavity height was measured vertically from the cervical line to the tip of the highest pulp horn as shown in figure 01 and 02.[11] All measurements were carried out thrice bythree observers and the mean was recorded to minimize intra and inter- observer errors. This measurement provided the TCI which was calculated by: TCI= CPCH*100/CH.

Statistical Analysis: Data analysis was done using SPSS (Statistical Package for the Social Sciences) version 20.0. Pearson's correlation coefficient (r) was used to find the correlation between the TCI values of mandibular second premolar and first molar and age. p value $\leq$ 0.05 was considered statistically significant correlation between TCI and age.

RESULTS

Digital panoramic radiographs of 117 subjects were analysed tostudy the degree of relationship between age and TCI in mandibular firstmolars and second premolars. Descriptive statistics of the premolars of the studied subjects by means of age(N=117)are summarized in Table 1.

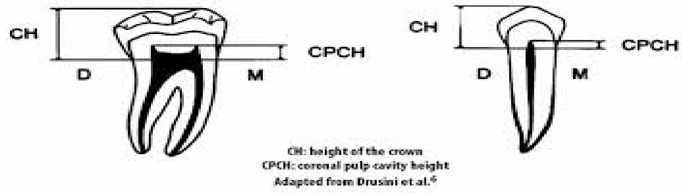

Figure 1. Schematic representation of measurements taken of a panoramic radiograph with a digital caliper to 0.01 mm

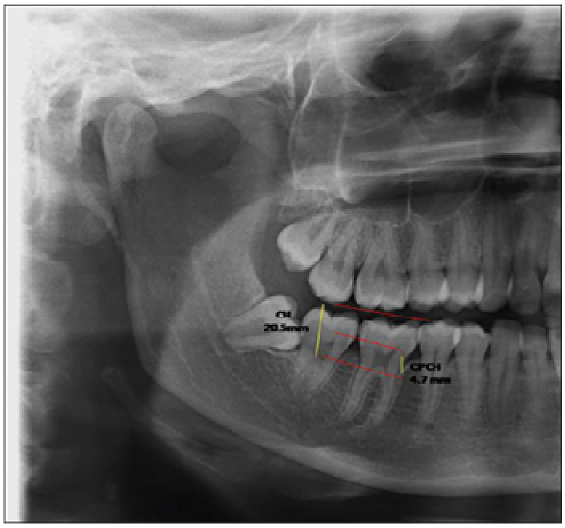

Figure 02. The method of calculation for crown height (CH) and coronal pulp cavity height (CPCH) of a mandibular first molar tooth

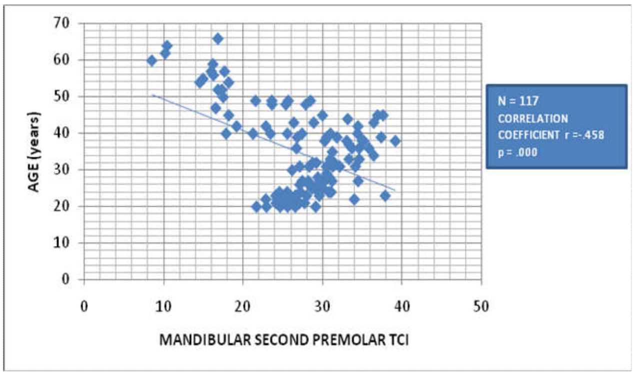

Figure 1. TCI Vs Age for mandibular second premolar

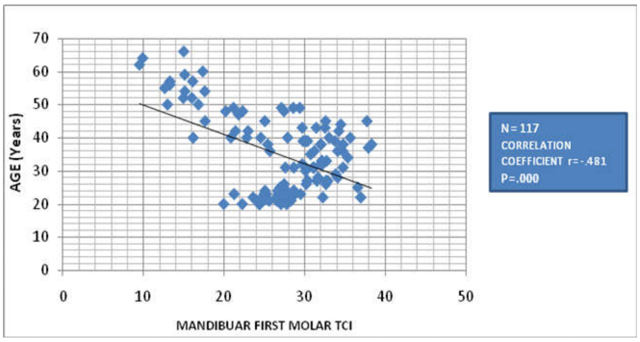

Figure 2. TCI Vs Age for mandibular first molars

The mean of TCI± SD of 20-29 age group is 27.53±3.16,of 30-39 age group is 32.01±3.34,of 40-49 age group is 27.05±6.10,of 50-59 age group is 16.39±1.20,of 60-69 age group is 9.47±1.35. Descriptive statistics of the molars of the studied subjects by means of age(N=117)are summarized in Table 2.

Table 1. Descriptive statistics for tci index for mandibular second premolars with age group

AGE GROUPS	N	MEAN	STANDARD DEVIATION(SD)	MINIMUM	MAXIMUM
20-29	47	27.53	3.16	21.66	37.84
30-39	29	32.01	3.34	26.15	39.13
40-49	27	27.05	6.10	16.54	37.58
50-59	11	16.39	1.20	14.54	18.17
60-69	02	9.47	1.35	8.51	10.42

Table 2. Descriptive statistics for tci index for mandibular first molars with age group

AGE GROUP	N	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
20-29	47	27.82	3.74	19.95	36.92
30-39	29	31.72	3.01	25.40	38.27
40-49	27	27.14	5.98	16.17	37.68
50-59	11	14.91	1.65	12.66	17.60
60-69	02	13.65	5.25	9.93	17.36

The mean of TCI ± SD of 20-29 age group is 27.82±3.74, of 30-39 age group is 31.72±3.01,of 40-49 age group is 27.14±5.98,of 50-59 age group is 14.91±1.65,of 60-69 age group is 13.65±5.25. The correlation coefficient (r) of premolar TCI and age was -.458,which means there was a negative correlation between age and TCI. The correlation coefficient (r) of molar TCI and age was -.481,which means there was a negative correlation between age and TCI. This shows that with increasing age, there will be decreasing TCI value.Based on our study, mandibular second premolar seems to be more predictable for age estimation.

DISCUSSION

Assessment of the pulp/tooth index is an indirect quantification of secondary dentin deposition. The aim of the study is to assess the accuracy of age estimation from tooth coronal index of mandibular second premolars and molars of both sides using panoramic radiographs. In our study we have used digital orthopantamographs for assessment of age as several measurements can be performed on the same x-ray, moreover it is a standard technique with high reproducibility, with the acceptability of intra oral radiographs being dependent on the techniques used and the practical training of the personnel (Chandramala, 2009). In this study, we have used Modified Lind's technique for approximating the position of CEJ for determining the coronal height and coronal pulp height. The present study shows a significant negative correlation of the TCI of the coronal pulp cavity with advancing chronological age similar to the studies conducted byDrusini,Igbigbi and Nyirende and Veera. While there have been studies similar to Shrestha (Shrestha, 2014) Study conducted in India, which mention that TCI significantly increase with increasing age. The result of our study could be explained by the age of the work sample (20-70 years) with the mean age of 35±12;so the decrease in pulp cavity due to dentin deposition is evident. Moreover, the current result stated that second premolar tooth is more significant in the study group($p \leq 0.01$).This is inconsistent by studies done in Italy by Drusini[12],who mentioned that there was a strong correlation for molars than premolars while Afify[23]in Egypt revealed that second premolar was closely related with age. Also Igbigbi and Nyirenda[21] postulated that correlation was higher for premolar than molar.This may be an expression of overall pulp cavity. The variation among individuals could be attributed to socio-economic status, cultural and racial differences, genetic differences, difference in behavior, environmental factors, diet and disease (Slaus, 2003).

The difference in the result of the present study could be explained by difference in studied population ,difference in sample size and teeth examined in each study.

Conclusion

It can be concluded that age estimation from TCI is a precise, non-invasive, not time consuming, not requiring highly specialized equipment and applicable to both living and dead individuals. Also TCI having a negative association with age and mandibular second premolar being more reliable for age estimation.

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