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ORIGINAL ARTICLE

Secondary dentine as a sole parameter for age estimation: Comparison and reliability of qualitative and quantitative methods among North Western adult Indians

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Abstract The indestructible nature of teeth against most of the environmental abuses makes its use in disaster victim identification (DVI). The present study has been undertaken to examine the reliability of Gustafson's qualitative method and Kedici's quantitative method of measuring secondary dentine for age estimation among North Western adult Indians. 196 (M = 85; F = 111) single rooted teeth were collected from the Department of Oral Health Sciences, PGIMER, Chandigarh. Ground sections were prepared and the amount of secondary dentine formed was scored qualitatively according to Gustafson's (0–3) scoring system (method 1) and quantitatively following Kedici's micrometric measurement method (method 2). Out of 196 teeth 180 samples (M = 80; F = 100) were found to be suitable for measuring secondary dentine following Kedici's method. Absolute mean error of age was calculated by both methodologies. Results clearly showed that in pooled data, method 1 gave an error of ±10.4 years whereas method 2 exhibited an error of approximately ±13 years. A statistically significant difference was noted in absolute mean error of age between two methods of mea suring secondary dentine for age estimation. Further, it was also revealed that teeth extracted for periodontal reasons severely decreased the accuracy of Kedici's method however, the disease had no effect while estimating age by Gustafson's method. No significant gender differences were noted in the absolute mean error of age by both methods which suggest that there is no need to separate data on the basis of gender.

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1. Introduction

Aging a dynamic phenomenon is a continuation of physiological processes that takes place from conception to death.[1] Determining age at death is a central issue in correct identification of an unknown body. Teeth are unique in structure and follow a well-defined sequential developmental pattern.[2] Moreover, teeth are most indestructible components of the body because of its resistivity against most of the environmental abuses.[3] In children, age estimation can be achieved on the basis of developmental changes occurring in tooth. But, in adults; changes in dental hard tissues (enamel, dentine and cementum) provide a means for age estimation. Regressive changes like attrition, secondary dentine formation, cementum apposition, and root dentine translucency can be used to estimate age of an individual. For age estimation, factors like attrition and cementum apposition are highly influenced by the life style of an individual so cannot be regarded as reliable parameters. However, secondary dentine deposition and root dentine translucency are found to be reliable by many authors.[4–6] Secondary dentine is a narrow band of dentine bordering the pulp and representing the dentine that is formed after the root completion. Deposition of secondary dentine is continuous but much slower in formation than primary dentine. It has tubular structure which is almost continuous with primary dentine but contains fewer tubules than primary dentine. It is not formed uniformly but is more obvious on the roof and floor of pulp chamber so as to protect the exposure of pulp in older teeth. Whereas, in response to abrasion, caries and increasing age, there is obliteration of the dentinal tubules with mineralized substance that leads to the formation of glass like dentine – transparent or sclerotic dentine.[7] There are many published studies for age estimation based on length of root dentine translucency as a sole factor[7–12] and as well as with the combination of other physiological changes.[13–15] Likewise, secondary dentine has also been used in combination with other parameters by many researchers[16,17] however; a few studies have been conducted to formulate the regression equations using secondary dentine as a sole parameter.[18–20] Estimation of age can be achieved using secondary dentine, qualitatively on ground sections of teeth by employing Gustafson's[21] (0–3) scoring system and quantitatively in the form of micrometric measurements suggested by Kedici et al.[22] However, it is also possible to quantify secondary dentine on radiographs – a technique developed by Kvaal et al.[23]

Published data on age estimation from these morphological changes in Indians are based either on Gustafson's scoring system[6,24–28] or the measurements of pulp/width ratio on radiographs[29–34], whereas; a quantitative measurement of these regressive changes on thin ground sections has yet not been done. Qualitative methods are always subjective in nature so there is need to standardize the quantitative method of age estimation.

Aim of the study: The present study was designed to compare the quantitative and qualitative methods for age estimation using ground sections of teeth among North Western adult Indians.

2. Material and methodology

The data were based on 196 samples of extracted teeth (M = 85; F = 111) belonging to different regions of North-Western India ranging in age from 18 to 75 years. The samples were collected from the Department of Oral Health Sciences, PGIMER, Chandigarh, India. Freshly extracted single rooted permanent teeth (incisors, canines and premolars) were selected for the present study. Before sample collection permission of institutional ethics committee was taken. Collected teeth were extracted for the valid clinical reasons like periodontal disease, caries, prosthetic and orthodontic. Single rooted teeth were chosen to reduce the complications that may occur due to difference between morphology, anatomy, and functions of bicuspid and molar teeth. Moreover, in these teeth there is a low incidence of caries and thus tend to survive longer in mouth than other teeth. Grossly decayed, multi-rooted, root canal treated and filled teeth were excluded from the study. Information regarding name, age, sex and reason of extraction was obtained. Before extraction, periodontal status was noted with the help of periodontal probe. The teeth were divided into four age groups with 15 years of interval i.e. $\leqslant$30 years, 31–45 years, 46–60 years and 61–75 years. After fixation, in 10% buffered formalin teeth were cleaned in hydrogen peroxide (for 2 h) and further in running tap water for 24 h.

196 (M = 85; F = 111) samples were examined for scoring secondary dentine as described in Gustafson's method. However, for Kedici's method, 16 teeth were found to be unsuitable to quantify all the 5 micrometric measurements; thus this technique was based on 180 (M = 80; F = 100) samples.

2.1. Section Preparation

Cleaned teeth were sectioned Labiolingually with the help of micro motor up to the thickness of 5 mm which were further thinned down to 2 mm on carborundum stone. Water was used as a coolant to avoid generation of excessive heat and to minimize the damage. Finally, the sections were cleaned in distilled water for 30 s in ultra sonicator. Cleaned and unstained dried sections were mounted on slide using DPX (Diphthalate butyrate xylene). After the preparation of sections, the microscopic analysis was carried out and viewed at 200–400× magnification using light microscope (Olympus CH30). The prepared slides were studied for amount of secondary dentine formation by two methodologies i.e. method 1 – Gustafson's method[21] (Qualitative) and method 2 – Kedici's[22] micrometric measurement method (quantitative).

2.1.1. Gustafson's method

All the prepared sections were scored for the extent of formation of secondary dentin according to Gustafson's 0–3 point scoring system (Cited in Vij, 2002)[35] (Table 1, Fig. 1). These scores were subjected to regression analysis for estimating the age of an individual.

2.1.2. Kedici method

Kedici et al. (2000) studied various age related changes of teeth in the form of 18 micrometric measurements to estimate age of an individual. For the present, out of 18, five (5) measurements representing the amount of secondary dentine formed were chosen (Fig. 2). Measurements were taken under light microscope (Olympus CH 30) using measuring eye piece following Kedici et al. (2000). Finally, the scalar divisions were converted to millimeters and were used to estimate age by formulating multiple regression equation.