Estimation of Age by Assessment of Dentin Translucency

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Abstract

Introduction: Several methods have been advocated for age estimation. Dentin translucency has been considered one of the non-invasive methods for age estimation, and it can be measured using the digital method. **Aim:** The aim of this study is to estimate the age by evaluating the length of dentin translucency. **Materials and Methods:** Ground section of 30 freshly extracted single-rooted permanent teeth from different individuals of known age and gender were performed dentin translucency was measured using a digital scanner. It was correlated with the age of these patients. **Results:** A linear regression analysis was performed to find the relationship between age and length of dentin translucency, and the Pearson correlation coefficient revealed a positive correlation (r = 0.59, P = 0.001). **Conclusion:** Dentin translucency can be considered a reliable parameter for age estimation.

Keywords: Dentin Translucency, Sclerotic Dentin

Introduction

Forensic odontology is the branch of forensic science that deals with the examination and evaluation of dental tissues as they remain unchanged for a long period of time[1]. Teeth typically survive post-mortem destruction and play a major role in comparative and reconstructive identification[2].

Gustafson's technique, based on the morpho-histologic method, is one of the commonly used methods for age estimation. In this method, six parameters such as degree of attrition, secondary dentine deposition, loss of periodontal attachment, cementum apposition, root resorption and dentin translucency are considered. Dentin translucency is considered a significant parameter for age estimation among all of these variables[1,3].

During the third decade of life, root dentin becomes translucent, starting at the apex of the root and advancing coronally.

Increased intratubular calcification reduces the diameter of dentinal tubules, which increases the translucency of root dentin[4]. Dentin translucency, according to Johanson, is more closely related to age than pathological changes and environmental factors[5,6]. Initially, Vernier callipers were used to measure dentin translucency. In recent years, dentin translucency has been measured by commercially available computer hardware and software and has been significant in estimating the age of an individual[1,3].

The purpose of this study is to estimate the age of an individual by evaluating the length of dentin translucency in ground sections of extracted single-rooted permanent teeth using a digital scanner (HP Inkjet).

Materials and Methods

Ethical clearance has been obtained from the institutional ethical committee.

Thirty freshly extracted single-rooted permanent teeth from different individuals with known ages and gender were obtained.

Teeth extracted for various reasons, such as orthodontic treatment, periodontal disease, caries teeth and tooth wear, have been included in the study. Multi-rooted teeth, root caries, grossly decayed teeth, impacted teeth and internal and external resorption were excluded from the study. The identity of the individuals who contributed extracted teeth has been masked.

Extracted teeth are cleaned and soft tissue remnants are removed from the tooth surface. Teeth were sectioned longitudinally to 100 μm in the buccolingual plane using a micromotor and an Arkansas stone (Figure 1). Teeth sections were placed on HP Inkjet scanner and scanned using normal scale without mounting over it. After scanning the image, the distance between the apical and coronal extents of dentin translucency on both sides was measured (Figure 2). In some cases, the measurements will not be the same on both sides. In such cases, average has to be obtained by adding the measurements obtained on both sides of the tooth. The obtained value is then averaged to get the dentinal translucency of the tooth. The measurements that have been obtained are then compared with the chronological age of the corresponding tooth.

Figure 1. Longitudinal section of the tooth.

Figure 2. Measurement of root dentin translucency (TD length) on scanned image.

Statistical Analysis

The measurements that were obtained were subjected to statistical analysis. Regression analysis was performed based for comparing the chronological age with obtained Translucency of Dentin (TD) length. The Pearson correlation coefficient was done to find out the correlation between chronological age and TD length.

Results

Pearson correlation coefficient showed that there is a positive correlation between chronological age and TD length ($r = 0.59$, $P = 0.001$). The correlation coefficient ($r = 0.59$) denotes the degree of correlation between chronological age and length of translucency, which implies that the translucency of the root dentin increases as age advances. Coefficient of determination ($r^2 = 0.348$): 35% is a proportional variability explained by the equation and denotes that this study is accurate (Table 1).

Based on regression analysis, there is a linear relationship between chronological age and TD length. The regression equation derived from the available data (Table 1) is,

Predicted age = 37.932 + 27.319 × TD length

Table 1. Regression analysis of age

Model	R	R square	Standard Error of the estimate	Equation	T	P value
1.	.590	.348	11.717	Age = 37.932 +27.319 × TD length	3.649	.001

Discussion

Dentin, which determines the shape of the crown, undergoes sclerosis due to a physiological change (aging) or a pathological change (caries, tooth wear, deep fillings) in the existing dentin. Collagen fibres and apatite crystals commence to appear in dentinal tubules obliterated with calcified substances and become highly mineralized, having the same refractive index as peritubular dentin. More prevalent in older age groups and found especially in roots.

Tomes was the first investigator to describe that translucent dentin occurs due to consolidation of dentinal tubules due to various factors like equalization of the normally different indices of refraction of dentinal tubules and calcified dentin matrix[3,7]. Previous studies have reported that root dentin translucency can be a reliable indicator for predicting age[4,6].

It has been figured out that there is a moderate increase in dentinal translucency as age increases. This is due to the formation of sclerotic dentin at the apex of the root between 20 to 75 years of age. Few studies have reported the formation of root dentin translucency in young people aged 12 to 19, and the reason for the formation of translucent dentin is still unknown[10,11].

In this study, individuals below the age of 20 had a minimal formation of sclerotic dentin (Figure 3). In the present study, dentinal translucency increased with an increase in age; however, in some older individuals, a lesser extent of dentinal translucency was observed. This can be due to a reduction in stimulus for the formation of sclerotic dentin or obstruction of dentinal tubules in that area, thus providing a static value of translucency after a particular age[13].

According to Bang, Ramm and Miles, translucency measurements are simple and age can be estimated even by an inexperienced examiner. Sectioned teeth provide better results and can be scanned easily when compared to intact teeth[4,8].

Figure 3.   Scanned image of longitudinal section of 18 years of age.

De Jonge stated that the average width of dentinal tubules is around 3.2 micron in young adults, narrowing to about 1.5 micron at 50 years of age and 1.2 micron at 70 years of age. Dentin translucency increases as age advances[9].

Compared to the area and length of the translucency, length is considered most reliable parameter compared to that of the translucent area of the tooth[3,9]. In this study, length has been considered for measuring dentinal translucency in ground sections of the tooth.

Previous studies reported various correlation coefficients to the extent of dentin translucency with age; r = 0.65-0.83 (Bang and Ramm 1970); r = 0.86 (Johanson, 1971); r = 0.73 (Miles, 1983); r = 0.75 (Azaz, 1977) r = 0.81(Singhal, *et al.*, 2016); r = 0.92 (Puneeth, *et al*, 2016) respectively[4,5,8,11-13].

In this study, the correlation coefficient (r = 0.59) has been obtained which is statistically significant (P = 0.001) showed a positive correlation between chronological age and TD length.

Linear regression analysis has been done based on chronological age as a dependent variable and TD length as an independent variable. The formula generated from this linear regression analysis test is as follows:

Age = 37.932 + 27.319 × TD length and can be used for forensic purpose.

The limitations of this study is that multi-rooted teeth are not preferred because they create bias when calculating multiple values. Puneeth, *et al.,* used multi-rooted teeth in their study using a microtome. In this study, the digital method has been used over the conventional method as it allows better visualization between translucent and non-translucent zones[1,12].

In conclusion, dentin translucency occurring in the apical part of the root is considered a reliable parameter for age estimation. A digital method has been used to measure root dentin translucency and results convey a positive correlation between age and length of dentin translucency.

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