

THE USE OF APICAL TRANSLUCENT DENTINE OF THE LOWER CENTRAL INCISORS TO PREDICT AGE IN INDIVIDUAL OR KNOWN GENDER

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ABSTRACT

Apical translucent dentine has been shown to provide accurate results for age estimation but its value in discriminating gender has received little attention. The objective of the current study was to determine the association between apical translucent dentine of the lower central incisors with age and gender. Sixty permanent lower central incisors were collected and were sectioned to a thickness of 5 mm. Apical translucent dentine was measured using callipers. This was followed by the creation of a series of scatter plots and regression line calculation for the association between apical translucent dentine and age. Regression analysis was done to determine the differences between male and female subjects', both as a single and as an interaction term between gender and percentage length of apical translucent dentine. There was no significant difference in the mean age with respect to gender (mean difference -0.17, P-value=0.94). Significant correlations were observed between age and apical dentine translucence (I) (0.95, P-value <0.01). This significant correlation was maintained even after dividing by the root length (L) (0.99, P-value <0.01). In the final model all the variables were retained to give a prediction line described by the equation $Age = 9.96 + 0.52 (I/L * 100) - 0.68 (\text{gender})$. Apical translucent dentine was strongly correlated to age. The ratio between apical dentine translucence (I) and root length increased significantly by 0.52% for every additional year in the age of the participant sampled, which was significantly lower in females than males.

Keywords: Age estimation, apical translucent dentine, forensic odontology.

INTRODUCTION

Age estimation from the structure of adult human teeth has received considerable attention in the fields of anthropology and forensic science (Willems, 2001). Teeth characteristics including their hard enamel and other unique structural

patterns make them useful aids for the identification of individuals following mass disasters like plane crashes or fires (Bagdey et al., 2014). As part of the identification process teeth provide a quick and easier way to estimate

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age compared to other body structures (Singh et al., 2013). This is especially true in individuals under the age of 17-21 years (when the wisdom tooth erupts), by using direct teeth examination, dental radiographs of developing teeth and the knowledge of teeth eruption times (Kutesa et al., 2013; Karadayi et al., 2014).

Beyond 21 years, age estimation becomes a challenge, as there are no more teeth erupting. Several methods have been developed which use changes in the structure of adult teeth to estimate age after teeth eruption. Among them, is the most commonly used Gustafson's method

(Gustafson, 1950) that utilises: attrition, periodontosis, secondary dentine, cementum apposition, root resorption and apical translucent dentine (ATD). Studies on Gustafson's variables found that ATD when used alone is simple and the most accurate method (Acharya, 2010; Acharya, 2014). Hence it is the method used in the current study for age estimation. Though studies to estimate age from teeth using ATD have been used for long, to our knowledge utilising this technique to distinguish between gender has received little attention. The objective of the current study was to determine the association between ATD of the lower central incisors with age and gender.

MATERIALS AND METHODS

This was a descriptive cross sectional study, carried out on teeth obtained from cadavers in the department of Anatomy, Makerere University College of Health Sciences and clinics in Kampala the capital city of Uganda. The department of Anatomy uses about 20 cadavers per year in anatomy dissection demonstrations for health professions students. The cadavers are provided for student use after a two-year processing and preservation procedure. The other teeth were obtained from dental clinics namely old Mulago hospital dental clinic, department of oral surgery (Mulago hospital) and Mengo hospital dental clinic. The teeth from the cadavers were extracted by the study team while those from the clinics were extracted by dentists for clinical reasons. Permission to carry out this study on teeth extracted from the clinics and preserved human specimens was obtained from Makerere University School of Biomedical Sciences Research and Ethics Committee and the Department of Anatomy Makerere University while the dental patients were consented to donate their teeth to the study.

Lower central incisors were obtained from cadavers and clinics (30 males and 30 females), age range 19 to 51 years and mean \pm SD 30.47 \pm 8.44 . Only specimens whose reported

age and gender were known; and had relatively straight roots on visual inspection after extraction were included. Additional exclusion criteria were teeth, which were grossly decayed, with severe attrition, with root caries and those with internal resorption. One tooth was obtained from each individual (see Figure 1). Each tooth was then placed in a well-labelled specimen bottle with a specimen number (the teeth from dental clinics were stored in 10% formalin). The specimen number was subsequently recorded on a data form to collate with demographic data like; age, gender, address and tribe. Within two weeks in 10% formalin for uniformity with the teeth from cadavers, for infection control and to conserve micro hardness of the dentine (Lee et al., 2007; Salem-Milani et al., 2015) the teeth were taken to the dental laboratory and ground to five millimetres thickness in the central axis using carborundum stones as previously reported (Azaz et al., 1977). The thickness was progressively checked. The apical translucent dentine (I), was measured using a dial calliper type 6921 under illumination with a cold light illuminator (Selvamani et al., 2013). The vertical distance from the apex of the tooth to the coronal most point of the ATD was marked on a piece of paper and this distance was measured using callipers in mm. Measurement of ATD was

done according to the method described before (Singh et al., 2013). The use of ATD to estimate age has been described as simple, accurate, does not need an expert and ATD is seen bilaterally even better in sectioned teeth (Singh et al., 2013). The root length (L) was measured in a similar manner without the background illumination. Then percentage length of ATD ($I/L*100$)% was determined.

Analysis using STATA version 13, involved the calculation of the ATD (I) divided by the root

length (L) X 100. This was followed by the creation of a series of scatter plots and regression line calculation for the association between the different study measurements and age. Regression analysis was done to determine the differences between male and female subjects', both as a single and as an interaction term between gender and percentage length of ATD. For all tests the level of significance was set as 0.05.

RESULTS

Table 1 shows a summary of the participants' gender and tribes from which the teeth were collected. Table 2 provides a summary of the various study measurements from the selected teeth. In this table note that there was no significant difference observed in the means of apical dentine translucence (I), root length (L) and $I/L*100$ with respect to gender. Although the female subjects were slightly older, there

was no significant difference in the mean age with respect to gender (mean difference -0.17, std error 2.13, t-test statistic -0.08, P-value=0.94). Significant correlations were observed between age and apical dentine translucence (I) (0.95, P-value <0.01). This significant correlation was maintained even after dividing by the root length (L) (0.99, P-value <0.01).

Table 1 Descriptive statistics of the participants from whom teeth were obtained

Variable	Frequency/(Mean)	Per cent /(SD)
Gender	(0.5)	(0.50)
Tribe	60	100
1. Ganda	39	65.00
2. Gisu	5	8.33
3. Soga	4	6.67
4. Acholi	3	5.00
5. Others	9	15.00

Figure 1: Recruitment diagram

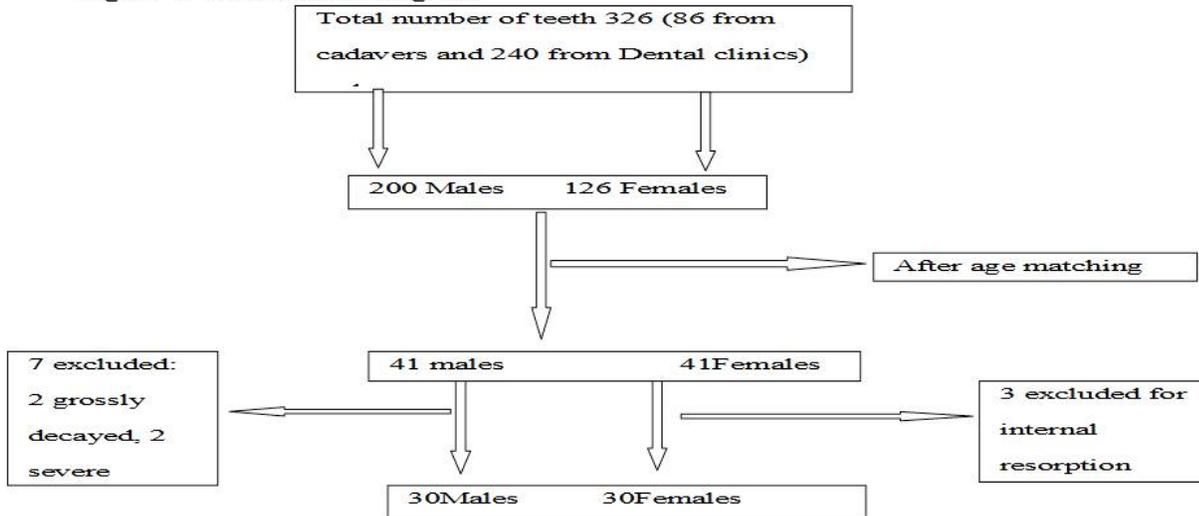


Table 2: Summary of the various study measurements from the teeth.

Variable	Overall comparisons			Gender (Males=30, female = 30)	
	Number	Mean	SD	Mean difference (std err)	T-statistic (P-value)
Apical translucence (I)	60	5.33	2.23	0.19 (0.58)	0.32 (0.75)
Root length (L)	60	13.51	1.72	0.85 (0.43)	1.96 (0.06)
I/L*100	60	38.90	15.45	-1.62 (4.02)	-0.40 (0.69)

Table 3: Regression analysis to predict Age

Predictor variable	Univariable coefficient (95% CI, pvalue)	Adj. coefficient (95% CI, Pvalue)	Beta
(I/L*100)%	0.52 (0.50 to 0.54, P<0.01)	0.52 (0.50 to 0.54, P<0.01)	0.99
Gender	0.17 (-4.09 to 4.42, P=0.99)	-0.68 (-1.30 to -0.06, P=0.03)	-0.04
Constant	-	9.96 (9.06 to 10.85, P<0.01)	

Table 3 provides a summary of the regression analysis for $(I/L*100)\%$ and gender in relation to the age. In the final model all the variables were retained to give a prediction line described by the equation $Age = 9.96 + 0.52 (I/L*100) - 0.68 (gender)$. It is important to note that gender was coded as Male=0 and Female = 1.

DISCUSSION

We set out to determine the association between the ATD of the lower central incisors with age and gender. This is because ATD is the simplest of Gustafson's six variables to use (Acharya, 2010), is least affected by environmental factors (Singhal et al., 2010) and is symmetrically distributed on both sides of the jaws (Solheim, 1989) but has never been considered for its discrimination of the gender of an individual.

We found that ATD was strongly correlated to age (0.99), this was in agreement with 0.81 (Singhal et al., 2010) and 0.68-0.86 (Solheim, 1989), but in contrast with 0.47 (Singh et al., 2013). The lower correlation observed in the paper by Singh et al, may be due to pooling single rooted teeth together instead of the one type single rooted teeth used for the current study (Singh et al., 2013).

The ratio between apical dentine translucence (I) and root length increased significantly by 0.52% for every additional year in the age of the participant sampled. This was significantly lower in females than males (see table 3). Overall the length of the ATD in this study increased with age for both male and female subjects. Confirming the findings of many previous studies (Gustafson, 1950; Johnson, 1968; Singhal, et al., 2010; Solheim, 1989; Whittaker and Bakri,

1996), which was significantly lower in females than males.

The current study used the conventional callipers method instead of the digital method (Acharya, 2010). Although the conventional method had been shown to provide comparable results in predicting age (Chopra, et al., 2015), more accurate data may be obtained with the digital method.

Conclusions

Apical translucent dentine was strongly correlated to age. The ratio between apical dentine translucence (I) and root length increased significantly by 0.52% for every additional year in the age of the participant sampled, which was significantly lower in females than males.

Conflict of interest

The authors declare that they have no conflict of interest.

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