Dentinal Translucency In Age Estimation By Lamendin's Technique

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Abstract:

Background: *Teeth are durable and morphologically unique structures of the human body. Root dentin translucency shows significant changes with the advancing of age.*

Method: *The present study involves measurement of root dentin translucency in ground sections of 30 collected teeth samples from Kolkata. The ages of the individuals are known to the first investigator and hidden from the second investigator who measured the root translucency and calculated the age using Lamendin's formula. Lamendin had proposed a technique to estimate the age at death by two factors: Periodontosis height and translucency of the root of the tooth. After measuring the translucency and periodontosis height, the calculated ages were compared with the actual ages.*

Result: *A positive correlation was found between the estimated age and the actual age of the samples.*

Conclusion: *The result provided a more or less accurate measure for age estimation in adults. The findings also confirmed that the study needs to be conducted on a larger population to test the efficacy of the formula on a larger scale and thus can be used singly or in collaboration with other techniques for age estimation in forensic science.*

Key Word: *Dentinal Translucency, Forensic Odontology, Age Estimation, Lamendin's method*

I.   Introduction

Teeth are the most indestructible parts of the living body because of its resistivity against most of the environmental abuses. While the rest of the body decays and denatures and does not leave any traces for retrieval of information, the hard tissue remains survive postmortem damage and hence they play an important role in forensic science. [1] They serve as an important factor for identification of criminals or victims in the crime scenes, accidents or for age estimation of people coming from the rural areas who are unaware of their actual ages, for judicial punishment. [2,3]

The importance of teeth in forensic science is increasing day by day.[4] Age determination by teeth is an important part of Forensic Dentistry and Anthropology. The developmental stages of teeth are suitable for age estimation in children. For adults, the methods are often based on the degenerative modifications such as attrition, periodontitis, transparency of the root, secondary dentin, cementum apposition, root resorption.

A lot of methods have been developed over the last century to assess the various dental changes with the advancement of age for example Gustafson's method based on the morphological and histological regressive changes of the teeth namely occlusal attrition, coronal secondary dentin deposition, loss of periodontal attachment, cementum apposition at the apex, root resorption at the apex and dentinal translucency.[5] Studies have reported that dentinal translucency was the best suited for age estimation out of all of the six variables.[6]

With increasing age due to physiologic attrition mainly dentin gets agitated which leads to the deposition of hydroxyapatite crystals in the intertubular dentin and inside the dentinal tubules. The mineralization takes place from the root apex towards the crown. This forms the sclerotic dentin which appears translucent under transmitted light. Thus, with increasing age the root dentinal translucency undergoes some major changes. [7]

Dentinal translucency is conventionally measured with the help of Vernier calipers. [8,9] In recent years with the advancement of technologies the translucency of dentin is measured with the help of digital methods (computer based) so that the chances of manual errors are less. [10,11] However this study has been done with a non-digital approach.

II. Materials And Methods

The present study is a pilot study which was carried out in the Department of Oral and Maxillofacial Pathology and Microbiology, Kusum devi Sunderlal Dugar Jain Dental College and Hospital, Kolkata, India, after approval from the Ethical committee of the institute.

The sample size for the study was 30 freshly extracted, permanent, single or multi-rooted teeth that belonged to 30 different Bengali individuals (Fig. 1). The ages of the patients ranged from 22 to 55 years. The samples were obtained from the patients who reported at the Department of Oral and Maxillofacial Surgery, Kusum devi Sunderlal Dugar Jain Dental College and Hospital, Kolkata.

Fig. 1: Teeth Sample

Teeth extracted for orthodontic purposes, periodontal problems, prosthodontic purposes were included in the study. Teeth affected by caries, abrasion, erosion, fractured teeth, and teeth with external resorption were excluded from the study. Things used for the study were a green cloth, a metal scale, a divider, and a pencil. The study was conducted using natural sunlight.

The study was a double blinded study where investigator I was unaware of the calculated ages and investigator II was unaware of the actual ages of the collected samples. Investigator I collected the samples and noted down their respective ages. The samples were washed with normal saline, detergent and cleaned with ultrasonic cleaner to remove any soft tissue debris and then handed over to Investigator II, unaware of the respective ages of the samples. Investigator II then carried out the study with the help of Lamendin's technique.

Lamendin's technique:

Lamendin et al. (J Forensic Sci 1992;37:1373) developed a general technique to estimate age of adults at death using two dental features: periodontosis(term used earlier) and translucency of the tooth root. They derived the following formula by statistical analysis:

$A = (0.18 \times P) + (0.42 \times T) + 25.53$

A = Age in years,
P = (Periodontosis height x 100)/root height,
*T = (Translucency height x 100)/root height.*
Lamendin et al. were able to estimate age at death with a mean error of +/- 10 years on their working sample and +/- 8.4 years on a forensic control sample. They found this technique to work well with a French population, but did not test it outside of that sample area.[9]

Procedure:
Step I:
Measurement of the Periodontosis height:

Periodontosis height (as given by Lamendin et al.) is the maximum distance between the cementoenamel junction and point of attachment of soft tissue.[12] (Fig. 2) The limits were marked with a pencil and then the periodontosis height was measured with the help of a divider and metal scale for each sample.
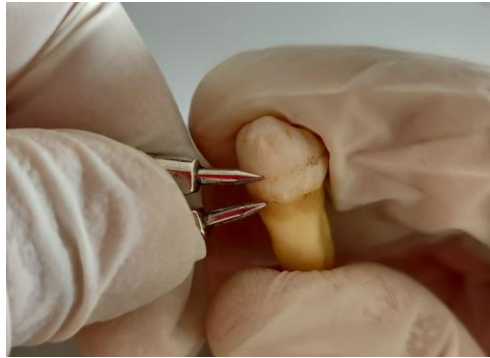
Fig. 2: Measurement of Periodontosis height

Step II:
Measurement of the root height:
   The length of the root of the tooth sample is measured from the cervical line till the apex. In case of multi rooted teeth the length of the longest root was taken into consideration. (Fig. 3) The limits of the root height were marked with a pencil and then measured with the help of a divider and a metal scale for each sample.
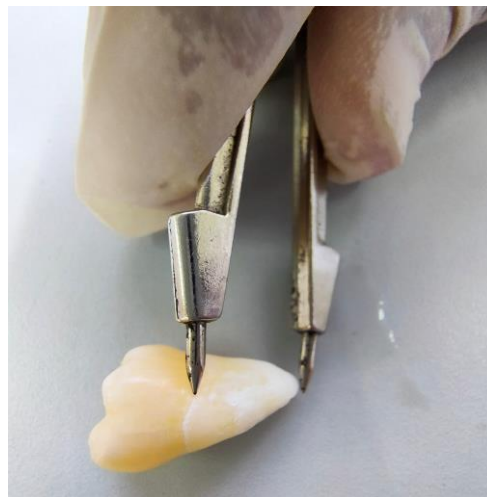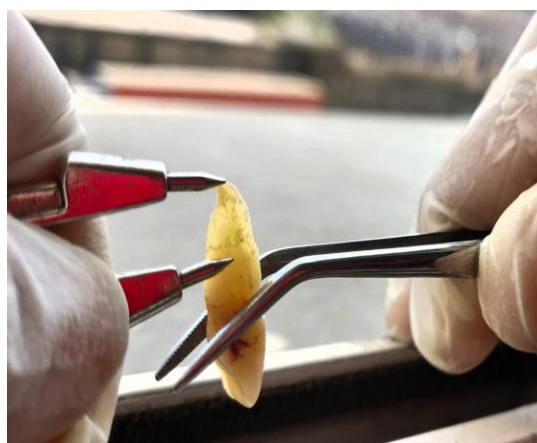

Fig. 3 : Measurement of root height

Step III:
Measurement of translucency height:
   The translucent area of the root of the tooth sample was measured by keeping it against sunlight (Fig. 4,5). The limits of the translucency height were marked with a pencil and then measured with the help of a divider and metal scale for each sample. In case of multirooted teeth, the longest root was taken into consideration.

Fig. 4: Measurment of translucency height

Fig. 5: The translucency height measurements were taken against the natural sunlight.

Step IV:
Comparing the estimated ages with the actual ages:
The Investigator I and Investigator II came together and compared the calculated ages with their respective actual ages.

SAMPLE NUMBER	ESTIMATED AGE	CHRONOLOGICAL AGE
SAMPLE 1	30.8	22
SAMPLE 2	41.4	47
SAMPLE 3	46.76	55
SAMPLE 4	43.83	45
SAMPLE 5	47.78	45
SAMPLE 6	45.53	50
SAMPLE 7	45.93	47
SAMPLE 8	37.09	40
SAMPLE 9	56.43	46
SAMPLE 10	39.14	44
SAMPLE 11	57.09	48
SAMPLE 12	36.67	41
SAMPLE 13	44.65	42
SAMPLE 14	51.01	46
SAMPLE 15	53.2	49
SAMPLE 16	39.26	42
SAMPLE 17	41.89	44
SAMPLE 18	44.91	40
SAMPLE 19	37.13	46
SAMPLE 20	35.3	33
SAMPLE 21	28.89	26
SAMPLE 22	36.11	41
SAMPLE 23	49.38	50
SAMPLE 24	27.96	25
SAMPLE 25	58.02	52
SAMPLE 26	44.69	40
SAMPLE 27	44.2	46
SAMPLE 28	52.1	48
SAMPLE 29	56.6	54

SAMPLE 30	49.24	52

Table 1: Comparing estimated ages with the chronological ages of the teeth samples

Step V:
Statistical analysis:

        Student's t test (paired sample t test) has been used to find the significance of study parameters between Estimated age & Chronological Age. The statistical software, namely, SPSS 11.0 and were used for the analysis of the data and Microsoft Word and Excel have been used to generate tables.

III.   Results

A paired-samples t-test was conducted to compare the estimated age with the calculated age.
There was a significant difference in both groups (p=.000) (Table 3).
Estimated Age: Mean = 43.9224, Standard deviation = 8.32992.
Actual Age: Mean = 43.2414, Standard deviation = 8.01184.

Paired Samples Statistics		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Estimated age	43.9224	29	8.32992	1.54683
	Actual age	43.2414	29	8.01184	1.48776

Table 2 showing the paired sample statistics

Paired Samples Correlations		N	Correlation	Sig.
Pair 1	Estimated age and Actual age	29	.805	**.000**

Table 3 showing the paired sample correlations

Paired Samples Test		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Estimated age - Actual age	.68103	5.11292	.94944	-1.26382

Table 4 showing the paired sample T test

Paired Samples Test				t	df	Sig. (2-tailed)
		Paired Differences				
		95% Confidence Interval of the Difference				
		Upper				
Pair 1	Estimated age - Actual age	2.62588		.717	28	.479

Table 5 showing the paired sample T test

There was a significant difference in both groups (p=.000) (Table 3). Hence in this case, the study was significantly correlated.

IV.   Discussion

        Dentin forms the bulk of the tooth tissues and occupies both the crown and the root. It is surrounded by enamel in the crown and cementum in the root. It consists of 65% inorganic and 35% organic material. The organic substance constitutes Type I collagen fibers embedded in a ground substance made up of mucopolysaccharides. The inorganic component consists of plate shaped hydroxyapatite crystals. Dentin is composed of dentinal tubules. Intertubular dentin is present between the dentinal tubules and intertubular dentin lies inside the dentinal tubules as the names suggest. (Fig. 6) Inside the dentinal tubules are odontoblastic processes. [13]
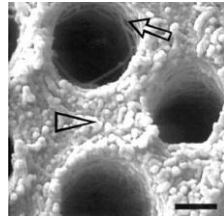
Fig. 6: Cross section of dentin

showing dentinal tubules surrounded by peritubular dentin(arrow) and intertubular dentin (arrow head). [14]

Agitation of dentin due to various physiological, mechanical, chemical or even mild trauma results in
● Fatty degeneration of odontoblasts inside the dentin
● Deposition of hydroxyapatite crystals in the peritubular or intratubular dentin.
● Deposition of hydroxyapatite inside in the dentinal tubules

Which results in the formation of Sclerotic dentin that blocks the entry of bacteria into the tubules.[13] The sclerotic dentin looks translucent under transmitted light. Azaz et al proved that the increase in the dentinal translucency is generally due to the physiological change with the normal aging process.[15]

Gustafson had used root dentin translucency as one of the most reliable parameters for age estimation. It starts in the apical part of the root and increases with age in the coronal direction. It shows a symmetrical distribution on both sides of the jaws. [5]

Tomes was the first to describe the translucent dentin. He said that the translucency resulted from the consolidation of the dentinal tubules and he also noticed that if the air in the dentinal tubules is replaced by water, the tooth becomes even more translucent. He opined that the translucency arose because of an equalization of the normally different indices of refraction of the tubules and of the calcified dentin matrix. [16]

According to Miles and Bang and Ramm, an advantage of translucency measurements is that a relatively inexperienced examiner can use it with ease. [8,17] Dentinal translucency can be assessed macroscopically on intact teeth although tooth sections provide better details. Translucent length shows more reliability as compared with translucent area of the tooth in the age estimation. [18]

Dentin translucency has been measured with the help of Vernier calipers in the conventional techniques. [8,9]

In the present study the tooth samples from the patients of the age range between 22 to 55 years had been obtained with the mean age of 43.24 years. Paired sample t-test used to compare the actual age with the estimated age showed that there was a significant statistical correlation ($p < 0.05$) between the estimated age and the actual age, with a correlation coefficient of 0.805. The data demonstrates that dentinal translucency measured by Lamendin's technique [9] can be used as a reliable method for age estimation of adults.

However, in some of the teeth in this study, teeth of younger individuals showed more translucency length resulting in overestimation of age. This may be due to the presence of periodontal infections and pulpal diseases. The chronic periodontal infection stimulates far more mineralization resulting in the increased translucency in the root dentin.[18]

Similarly, a few teeth belonging to older individuals showed a lesser amount of translucency resulting in underestimation of age. This may be due to the slowing down of the process of sclerotic dentin formation in some of the individuals due to various reasons. Moreover, it may happen that the dentinal tubules have already achieved their maximum blocking, thus leading to a flaw in the age estimation.[18]

Recently attempts have been made to quantify translucency digitally. [10,11] Computer-based methods use custom-built software programs and require capturing of tooth images on camera, converting the analog signal to a digital signal, and subsequent image processing. It's a semi-automatic approach since limits of translucency are set manually. Acharya suggested a newer, simpler, digital translucency measurement technique. Apart from a more detailed measurement of the translucency height, one of the positive aspects of the digital method includes storage and convenient retrieval of the image for future use.[1]

V. Conclusion

After having successfully conducted the study it may be concluded that root dentin translucency can be used for age estimation of an adult individual in a Bengali population, using Lamendin's technique. The statistically significant result showed that there was a positive correlation between the estimated ages and the actual ages. It also proved that Lamendin's technique can be applied on multi rooted teeth as well, taking the longest root into consideration.

The study needs to be carried out on a larger sample for further validation of this technique. Hence it

may be said that this technique may be used singly or in collaboration with other techniques for age estimation in forensic science.

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