International Journal of Drug Research and Dental Science
Volume 2 Issue 4 (Page: 1-6), 2020 ISSN: 2582-0826

Cementum Thickness as a Parameter for Age Estimation

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Original Article

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Crossref doi: https://doi.org/10.36437/ijdrd.2020.2.4.A

ABSTRACT

Aim: The aim of the present study was to verify the reliability of the method using a single parameter of cementum thickness in a decalcified section of the tooth stained by a cresyl violet stain.

Materials and Methods: In the present study, 140 extracted teeth from individuals with known age were studied. The decalcified section was stained by a cresyl violet stain and observed under research microscopy. The average thickness of cementum was measured using a digital scale. The age was estimated using a single parameter based on the correlation of cementum thickness with the chronological age.

Conclusion: Estimating age by measuring cementum thickness is a reliable method. The use of a cresyl violet stain for decalcified sections of the tooth makes cementum and the incremental lines more prominent thus helping to measure cementum thickness more accurately.

Keywords: Age Estimation, Cresyl Violet, Cementum Thickness.

Introduction

Age estimation is a suitable discipline of the forensic sciences and it should be an important part of every identification process, especially when information which is related to the deceased is unavailable. When subjects have undergone changes which are so extensive that external characteristics yield no information, teeth are often the only means of identification.[1] Cementum is a connective tissue that surrounds tooth roots in incremental layers, resulting in the appearance of concentric lines in the cementum, which are known as salter lines, which can be equated with years. Each pair of lines corresponds to one year of life and it constitutes a biological record that can be used to estimate the age of an individual.[2,3] The cementum increase represents the most relevant way of exhibiting histological modification that occurs to the teeth during the subject's life.[4,5] Estimation of age at death and determination of sex of the victim or remains are important factors in the identification of an individual in Forensic Odontology. Teeth are among the most reliable tools in the process of identification of age. Teeth are one of the most durable parts of our body, which can withstand more assaults than any other part of the body. This is particularly useful in the identification of bodies in mass disasters and natural calamities.[6] The first scientific technique for age estimation in adults was presented by Gustafson [1950]. It was based on longitudinal sections of teeth cut through the central area. The technique consisted in attributing scores from 0-3 for the presence and amount of age-related changes such as attrition, periodontal ligament retractions, secondary dentin formations, root translucency, and root resorption. The scores were added and regression analysis with age was performed.[7] Dental cementum is a mineralized tissue of continuous apposition and the measurement of its thickness can help estimate the age of an individual.[8] Tooth cementum annulations [TCA] is a microscopic method for the determination of an individual's age based on the analysis of acellular extrinsic fiber cementum [AEFC].[9]

With the above background, the present study was carried out to examine the correlation between chronological age and cementum annulations of a tooth. The aim of the present study was to verify the reliability of the method using a single parameter of cementum thickness in a decalcified section of the tooth stained by a cresyl violet stain.

Material and Methods

The study sample consisted of 140 extracted teeth obtained from the Rural Dental College, Department of Oral and Maxillofacial Surgery. The criteria for teeth selection: Teeth extracted for orthodontic, prosthodontic, and periodontal reasons were collected. No teeth with morphological/developmental abnormalities, caries, fracture/trauma, or erosion/abrasion were included in the study. Clinical data of a patient, i.e. name, age, gender, tooth number, and reason for extraction of the tooth were recorded on a case history performa prior to extraction In the present study 140 extracted teeth from individuals with known age were studied. The decalcified section was stained by cresyl violet stain, sections were cleaned carefully with xylene and mounted on glass slides using DPX mountant and coverslips and observed under research microscopy digital scale. The age was estimated using a single parameter based on the correlation of cementum thickness with the chronological age.

Results

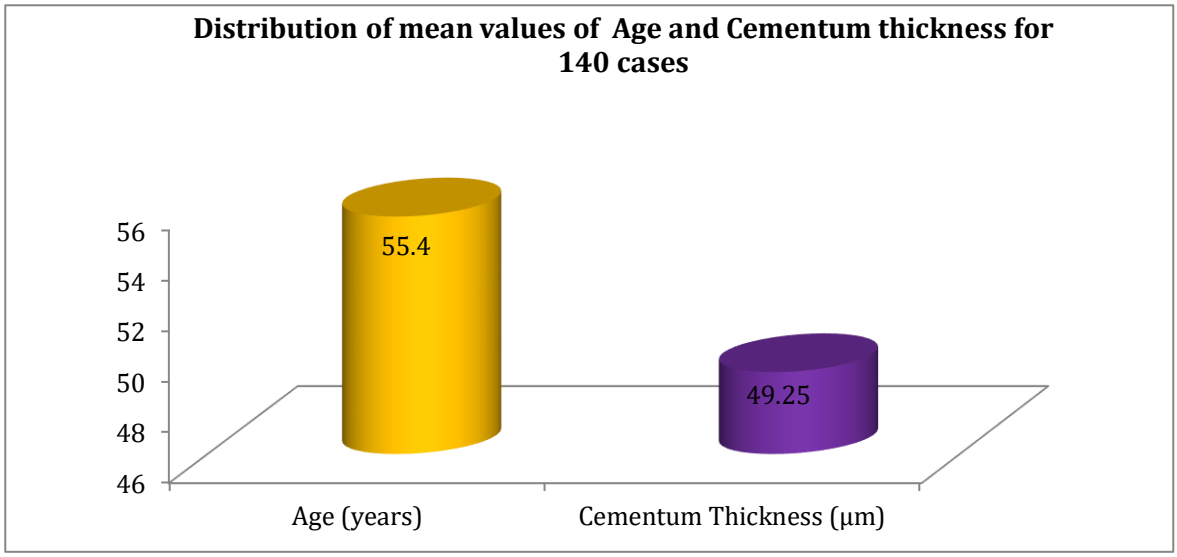
The resulting sample included 140 teeth from 140 individuals with known ages between 40 to 73 years, with a mean age of 56 years Average thicknesses [in micrometers] for teeth Extracted is 50.25 micrometers [Table-1]

Age [years]	Cementum Thickness [µm]
Mean ± SD	Mean ± SD

International Journal of Drug Research and Dental Science
Volume 2 Issue 4 (Page: 1-6), 2020 ISSN: 2582-0826

55.40 ± 10.63	49.25 ± 9.29

Table No.1: Distribution of Mean and SD Values of Age and Cementum Thickness for 140 Cases.



Graph No: 1

Correlation Analysis

Karl Pearson's correlation coefficient [r] between age and cementum thickness is +0.3625. It means that the correlation between age and cementum thickness is positive i.e. if age increases [or decreases] cementum thickness is also increases [or decreases].

By applying Student's 't' test the correlation between age and cementum thickness is highly significant [i.e. value of 't' = 55.114, d.f. =99, $p<0.001$]

Regression Analysis: [Age Estimation]

To estimate age when cementum thickness is known the following two lines of regressions were drawn:

1. Line of regression of age [years] on cementum thickness [µm]

Age = 0.3603 Cementum thickness + 38.087

From the above line of regression it is clear that, for every 1µm increase in Cementum thickness, the Age increases by 0.3603 years.

2. Line of regression of Cementum thickness [µm] on age [years]

Cementum thickness = 0.2453Age + 36.48

This line of regression can be used to estimate cementum thickness when age is known. From the above line of regression, it is clear that, for every 1year increase in Age, the Cementum thickness increases by 0.2453 µm.

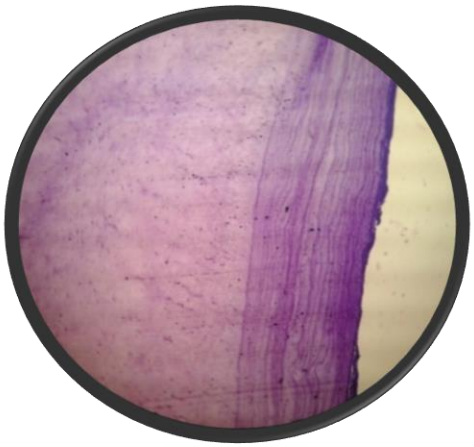
Discussion

International Journal of Drug Research and Dental Science
Volume 2 Issue 4 (Page: 1-6), 2020 ISSN: 2582-0826

Cementum is the calcified tissue that surrounds the root portion of dentin and it forms the attachment site for the periodontal fibres that link the tooth to the alveolar bone. In cementum formation, hypermineralized layers of extracellular matrix alternate with less mineralised layers. The dark lines were the stop phases of mineralization during the continual growth of the fibroblasts, which led to a change in mineral crystal orientation. This pattern is visible under the microscope as a series of alternating light and dark lines or bands. The dark lines have been referred to as incremental lines and the cementum between every two lines has been referred to as incremental bands. It was shown that each pair of lines corresponded to one year of life and that it constituted a biological record that could be used to estimate the age of an individual. The first use of cementum in human age estimation began with measurements of the width of the total cementum layer, rather than the number of incremental lines, Tooth Cemental Annulations [TCA], were used as an age estimation method in humans and these annulations which were counted from a photograph provided a close estimate of the actual age of the individual from which the tooth was extracted.10 The first use of cementum in human age estimation began with measurements of the width of the total cementum layer, rather than the number of incremental lines.[11] Stott et al., first used Tooth Cemental Annulations [TCA], as an age estimation method in humans and concluded that these annulations which were counted from a photograph provided a close estimate of the actual age of the individual from which the tooth was extracted.[12,13]

In the present study, the very distinct demarcation between dentin and cementum can be made using cresyl violet stain. Cresyl violet showed better contrast of cementum than H & E stain. In decalcified sections under light microscopy. Incremental lines are clearly seen with cresyl violet which could also be used in forensic science.

Figure 1



The use of a cresyl violet stain for decalcified sections of the tooth makes cementum and the incremental lines more prominent thus helping to measure cementum thickness more accurately.
The statistical analysis showed a positive correlation between age and cementum thickness. [Karl Pearson's correlation coefficient +0.3625].

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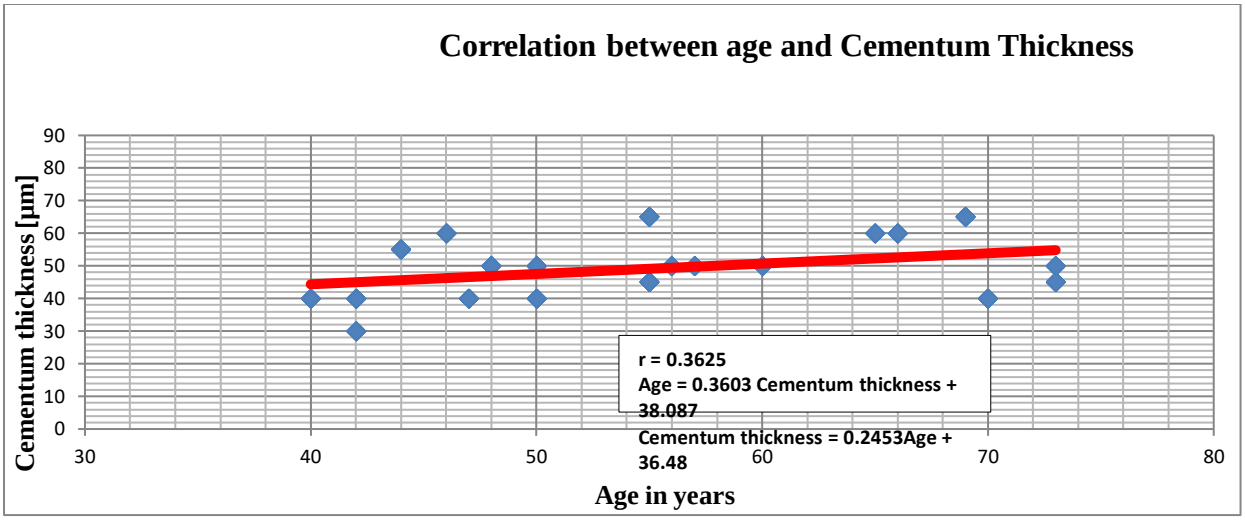

This line of regression can be used to estimate age when cementum thickness is known.
Age = = 0.3603 Cementum thickness + 38.087
The age estimated by this formula was highly significant.

Conclusion

Estimating age by measuring cementum thickness is a reliable method. The use of a cresyl violet stain for decalcified sections of the tooth makes cementum and the incremental lines more prominent thus helping to measure cementum thickness more accurately.

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How to cite this Article: **Sanjay G Thete, Deepak M Vikhe, Rahul B Patil, Saurabh L Sabnis, Neha Mahajan, Astha Bramhecha, Kalyani Misal;** *Cementum Thickness as a Parameter for Age Estimation;* Int. J. Drug Res. Dental Sci., 2020; 2(4): 1-6, **doi:** *https://doi.org/10.36437/ijdrd.2020.2.4.A*
Source of Support: Nil, **Conflict of Interest:** Nil.
Received: 4-8-2020 **Revised:** 8-9-2020 **Accepted:** 14-9-2020