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Estimation of Age Using Cementum Annulations

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Abstract

Background: Age determination is an important factor in the identification of an individual in forensic science.The hard tissues of the human dentition are able to resist decay and degradation, long after other tissues are lost. This resistance has made teeth useful indicators for age calculation.Tooth Cementum Annulations (TCA) may be used more reliably than any other morphological or histological traits of the adult skeleton, for age estimation.The amount of secondary dentin can also be an indicator of age of an individual.

Methods : The study sample consists of 20 teeth. Teeth extracted because of periodontal disease and orthodontic, and prosthetic reasons will be used in the study.The exclusion criterion will be teeth with carious lesions.Longitudinal ground sections of each tooth will be prepared and examined.

Rationale: Age determination plays an important role in forensic medicine, not only in identification of bodies, but also in connection with crimes.

Conclusion: Countable cemental annulations are present in human teeth. Quantification of cemental annuli is a reliable means used for age estimation in humans.Secondary dentin is also an indicator of age.

INTRODUCTION

Identification of living and dead persons is of paramount importance in routine forensic odontology. Age determination plays an important role in forensic medicine, not only in identification of bodies, but also in connection with crimes[1]. When the subjects have undergone changes so extensive that external characteristics yield no information, the teeth are often the only means of identification[2].Age estimation is of great importance for the identification of unknown bodies or skeletal remains of accidents and crimes as well as in disaster victims[3].There are instances in which teeth are the only preserved human remains and present the only means for age determination.Teeth have the benefit to be preserved long after other tissues, even bone, have disintegrated and also unlike bones they can be examined directly in living individuals[4]. Various methods of age estimation are in practice, the first technique being Gustafson's (1950) wherein cementum apposition is also a factor[2]. From then, many methods have been introduced with various accuracy, prediction and reliability..Kvaal and Solheim had found a positive correlation of 0.73 between the estimated and actual age of an individual. Aggarwal P et al also found a relatively strong positive correlation between the two variables of estimated age and actual age[1]. We set out to study if a formula based on cemental annulations could give us an approximate age estimate with a fair degree of accuracy.

MATERIALS AND METHODS

The present study was carried out in the Department of Oral Pathology, Saveetha Dental College, Chennai and in the Department of Oral Pathology, SRM Dental College, Chennai.The study sample consisted of 20 teeth obtained from different individuals of known ages. The exclusion criterion was teeth with carious lesions. Longitudinal ground sections of each tooth was prepared and examined under the microscope. In each section, the area at the junction of apical and middle third of root, regardless of whether the cementum was cellular or acellular, was selected for counting.These areas were photographed using a polarising microscope, images were transmitted from the microscope to a computer monitor, and counting was done with the help of image analysis software. First, the width of the cementum from the dentin-cemental junction to the surface of the cementum was measured in an area where the lines seemed to run approximately parallel. Then, measurement of the width which was occupied by the two adjacent incremental lines which were most easily recognisable was made, and the number of incremental lines in the total cementum width was calculated. Where, X is the total width of cementum (from dentinocemental junction to cementum surface) and Y is the width of cementum between the two incremental lines. Number of incremental lines (n) = X / Y. By adding average age of eruption in years for each tooth, from the counted number of incremental lines, the chronological age of the individual was obtained as E = n + t, where Estimated age (E) = number of incremental lines (n) + and eruption age of tooth= (t).

OBSERVATION AND RESULTS

TABLE 1:CALCULATION OF ESTIMATED AGE OF TOOTH (E).

Name	Sex	Actual age	X	Y	n	Eruption age of tooth (t)	Estimated age of tooth E= n+t
Ulagammal2	F	50 yrs	475.8655	8.944272	53.2033	7yrs	60.2033
Ammul	F	35 yrs	201.3157	43.26662	4.6529	10yrs	14.6529
Anjaneyulu	M	65 yrs	389.0090	32.24903	12.0626	11yrs	23.0626
Babu	M	54 yrs	300	32	9.375	13yrs	22.375
Kumari	F	38 yrs	348	32	10.875	12yrs	22.875
Lakshman	M	58 yrs	408	24	17	13yrs	30
Manigandan	M	72 yrs	314.8587	23.32381	13.4994	7yrs	20.4994
Parvathi	F	48 yrs	122	29.12044	4.18949	13yrs	17.18949
Samuel	M	72 yrs	264	26.22154	10.06805	13yrs	23.06805
Sankar	M	55 yrs	680	36.22154	18.77335	13yrs	31.77335
Seshamma	F	32 yrs	176	32.24903	5.45752	11yrs	16.45752
Samuel 2	M	72 yrs	535.7308	40.79216	13.1331	13yrs	26.1331
Ulagammal	F	50 yrs	376	32.24903	11.65926	9yrs	20.65926
Anjaneyulu2	M	65 yrs	224.3569	63.81450	3.5157	7yrs	10.5157
Lakshman 2	M	58 yrs	84	20.39608	4.11843	13yrs	17.11843
Samuel 3	M	72 yrs	203.68	40.19950	5.06672	12yrs	17.06672

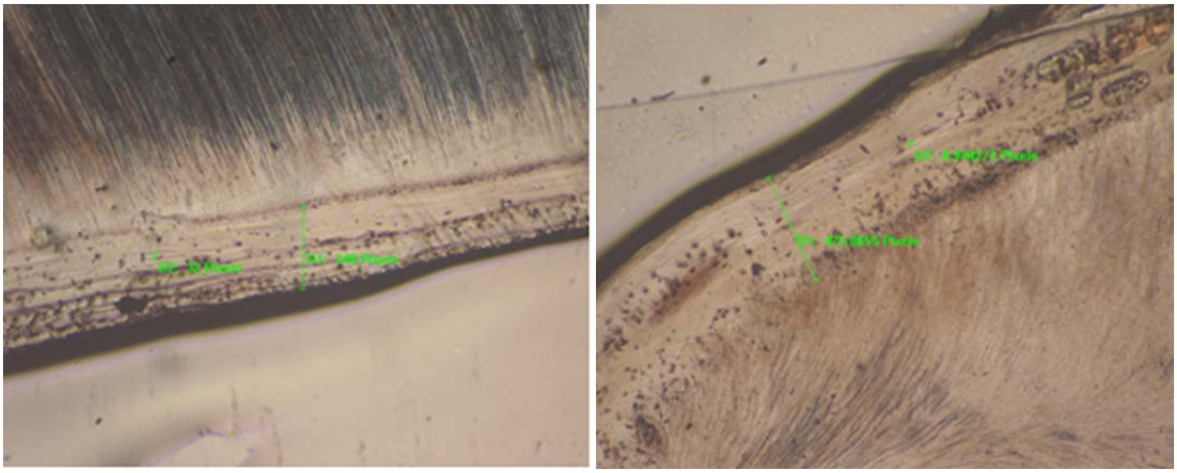
TABLE 2:PEARSON CORRELATION BETWEEN ACTUAL AGE AND ESTIMATED AGE OF TOOTH.

		Actual age	Eruption age of tooth (t)	Estimated age of tooth E=n+t
Actual age	Pearson Correlation	1	-.025	.037
	Sig. (2-tailed)	.	.930	.896
	N	15	15	15
Eruption age of tooth (t)	Pearson Correlation	-.025	1	-.160
	Sig. (2-tailed)	.930	.	.568
	N	15	15	15
Estimated age of tooth E=n+t	Pearson Correlation	.037	-.160	1
	Sig. (2-tailed)	.896	.568	.
	N	15	15	15

TABLE 3:INDEPENDENT 't' TEST CORRELATION.

	SEX	N	Mean	Std. Deviation	Std. Error Mean	't'	Sig
Eruption age of tooth (t)	M	9	11.44	2.603	.868	.863	0.404
	F	6	10.33	2.160	.882		Not Significant
Estimated age of tooth E=n+t	M	9	22.7273	6.44420	2.14807	.417	0.683
	F	6	25.3396	17.33770	7.07808		Not Significant

GROUND SECTIONS OF TEETH SHOWING CEMENTAL ANNULATIONS.



DISCUSSION

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 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 each 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 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[1]. Estimation of chronological age in living human beings as well as dead persons has been performed by forensic dentists for more than 50 years. Along the axis of the tooth root there are two zones of different cementum types: the acellular cementum that grows close to the cervical part of the root, and the cellular cementum that mainly covers the apical part of the root. Variations in cementogenesis that change the appearance of lines may be induced by different factors, including biomechanical forces, nutrition, hormonal cycle, or ecological conditions such as temperature, ultraviolet light, humidity, altitude, or pollution.

Cemental annulations cannot be used as a reliable age criteria. The articles‘Cementum annulations and age determination’ and ‘Cementum Annulation and Age Determination in Homo sapiens.11.Estimates and Accuracy’ tell us that cemental annulations are not always a reliable means of age determination.Out of the 20 samples used in the study 16 samples showed cementum annulations under polarized microscopy.4 samples did not show any visible cementum annulations due to the overcrowding of cementocytes in the cementum.Inaccurate age estimation was obtained in 15 samples. There is no significant correlation between the ages among the overall 20. Similarly, among the males and females.Thus, cemental annulations cannot be used as a reliable age criteria.

CONCLUSION

The rationale is that by proper sectioning and use of polarized microscopy and image analysis, counting the cementum annulations could potentially be used as a means of age estimation.In this study errors may have persist in the present study which did not allow us to conduct a detailed investigation.The TCA method of age estimation is not always a reliable means but a large scale study could throw light on this issue.

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