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REVIEW OF AGE ESTIMATION TECHNIQUE USING INCREMENTAL LINES OF CEMENTUM

[1]*Dr. Shrikant Sonune, [2]Dr. Pratibha Singh, [3]Dr. Prasad Karande, [4]Dr. Mrinal Shete and [5]Dr. Deepak Nagpal

[1,2,4]Assistant Professor, Dept of Oral Pathology, D Y Patil Dental School, Lohegaon, Pune, Maharashtra, India.
[3]Reader, Dept. Oral Pathology & microbiology, D Y Patil Dental School, Lohegaon, Pune, Maharashtra, India.
[5]Professor, Dept of Oral Pathology, D Y Patil Dental School, Lohegaon, Pune, Maharashtra, India.

***Corresponding Author: Dr. Shrikant Sonune**
Assistant Professor, Dept of Oral Pathology, D Y Patil Dental School, Lohegaon, Pune, Maharashtra, India.

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Forensic dentistry, from its earliest conception, is more or less an off shoot of forensic medicine, the dental surgeon being consulted only in cases where dental data and details are evident. As with the passage of time, the role of dentistry in forensic context has been increased.[1]

It is often necessary to estimate an individual's age due to certain questions related to legal requirements or in a forensic context.[2] A variety of physiological systems has been used for age estimation like long bones, skull bones and teeth. Teeth are one of the strongest structures in the human body and are known to be preserved for long after most of the other tissues, even bone, have disintegrated. The dentition's integrity usually facilitates its preservation irrespective of decomposition, incineration and high-impact trauma.[3]

Historically, ***Thomson (1836)*** who was one of the pioneers of medical jurisprudence noticed that first molar erupts at six to seven years of age and so he claims that those children in whom first permanent molars had not erupted, they must not have reached the age of seven.[4]

Scientific study of Age assessment using teeth was first published by ***Edwin Sunders(1837)***, who claimed that teeth provided the most reliable guide to age compared to age estimation from height which was a standard method used during that time. ***Wedl(1872)*** made the first observation of changes with age in the permanent dentition and described degenerative changes in pulp and notable diminution in the size of pulp cavity due to continued deposits of new dentinal layers.[4]

Gustafson (1950) introduced cementum for human age estimation.[5] ***Zander and Hurzeler(1958)*** were the first to discover a linear relationship between the growth of cementum and chronological age. The quantification of layers in human tooth cementum as a technique for age at death estimation has origins in wildlife biology where the cementum layering was routinely used as an aging method.[6]

Stott GG, Sis RF, Leavy BM, (1981) done study on tooth cementum annulations involving tooth from cadever of age 57, 67, and 76 years. They used the cross section of approximately 100- 150 µm. sections were stained by using 1% alzerian red solution. They concluded that tooth cementum annualtion can be counted in human teeth. This counting of incremental lines provided a close estimate of actual age of an individual from which the tooth was extracted. Also they further suggest that the usual number of years for eruption of any tooth were added to the annulations count was giving estimated age. The estimated age was in close proximation to the actual age.[7]

Renz H, Schaefer V, Duschner H, Radlaanki RJ (1997) conducted study to find out ultrastural fetures of cemental annulations. They used the light microscopy, confocal laser scanning microscopy, transmission electron microscopy and electron microscopy and scanning microscopy. They found that in bright field microscopy in every sample cemental annulations may not be found, their visibility differ from specimen to specimen. Also they suggested that existing annulations in root cementum could be visualized without demineralization and without any staining. The thickness of polished ground sections, the medium in which sections were examined, the selected focus plane and adjusted illumination were main factors affecting visibility of cemental annultions. In case of the transmission electron microscopy indicated that different orientation and difference in packing density may be the cause for the light optical phenomenon. This aggrement with postulate that an abrupt change in course of sharpey's fibre could be the cause for the incremental lines in acellular, extrinsic fibre cementum. Possibly there are also difference in degree of mineraliztion or in the composition of mineralized and organic components.

They concluded that application of different methods to demonstrate the nature of cemental line was incomplete. So the ultrastructural nature of the incremental lines is still an open question.[8]

SOLHEIM T (1990) conducted study to examine various ways of measuring cementum thickness, to study its relationship with age, and to consider what contribution this factor might offer in methods for age estimation. The study involved assessment of the amount of dental cementum apposition in 1000 teeth, excluding molars, from a Caucasian population. Cementum thickness was estimated according to the scoring methods suggested by GUSTAFSON and by JOHANSON. In addition, the width of the cementum was measured at the apex and also at approximately one third of the root length from the apex. Statistical analysis indicated a symmetric left/right distribution of cementum thickness. The sum of the cementum thickness on vestibular and lingual surfaces, measured at the junction of apical one third and middle one third of the root. The results showed the strongest correlation with age (r = 0.40 to 0.65). A reduced rate of cementum apposition was observed in the elderly. Also, maxillary teeth had more cementum on the lingual than on the vestibular surfaces. A tendency was noted for less cementum to occur in women than in men and on teeth removed from deceased persons or extracted for pathologic reasons. Correlation coefficients indicated that, for at least some types of teeth, the cementum thickness might give a significant contribution to statistical methods of age assessment.[9]

Kagerer P,Grupe G (2001) conducted study to determine under which pathological conditions the acellular extrinsic fibre cementum still permit a valid chronological age at death diagnosis. Life history parameters were preserved in acellular extrinsic fibre cementum and could serve as a valuable identification aid. They used 80 extracted tooth specimen. They found that various periodontal diseases leads to reduced number of incremental lines while teeth with sufficient nutritional support of their root showed deviation of the histological age from known actual age. Further they emphasized that life history parameters like pregnancies and renal diseases which had marked influence of calcium metabolism results in hypomineralized incremental lines. They further concluded that the year of production of these hypomineralized lines could be dated precisely. Different quality of incremental lines can, therefore, serves as valuable tool in identification cases.[10]

Backofen UW, Gampe J, Vaupel JW (2003) conducted study on large known-age sample, age estimates by tooth cementum annulations were estimated involving 363 teeth. Tooth-root cross sections were made using a refined preparation technique. Improved digital graphic procedures and enhancement strategies were used to produce digital images with a specially adapted software package. This resulted in high concordance between the tooth cementum annulation age estimates and chronological age. Assessment of the method's accuracy, as expressed by 95% confidence intervals, showed that error bounds for age estimates do not exceed 2.5 years. Sex differences, intraindividual correlations, and the effects of periodontal disease were studied. None of these indicators had a quantitative effect on the number of tooth cementum annulation bands when the proposed methodological standard was followed. They conclude that the tooth cementum annulation technique is a reliable method for estimating a subject's age from cementum annulations.[11]

Aggarwal P, Saxena S, Bansal P (2006) examined the correlation between age and the number of incremental lines in human dental cementum using thirty nonrestorable teeth. Longitudinal ground section of each tooth was prepared and examined under light microscope and polarized microscope. In each section, the area at the junction of apical and middle third of root and the area where the lines were easiest to count, disregarding whether the cementum was cellular or acellular, were selected for counting. These areas were photographed and images were transmitted from the microscope to a computer monitor, and counting was done with the help of image analysis software. They found that strong positive correlation between the estimated age and actual age. They concluded that no significant influence of sex, age, periodontal disease, or tooth type on the estimation quality of the tooth cementum annulations method. This suggests that the accuracy and repeatability of the method is not dependent on tooth type or location, and this method can be applied to general populations regardless of systemic or periodontal health. Application of Tooth Cementum Annulations age estimation improves individual age estimation and it may serve as a valuable aid for forensic identification. Also they found that the lower correlation in older persons. It may be due to a decreased apposition of cementum in individuals over 60 years.[12]

Pinchi V, Forestieri A L,Calvitti M (2007) conducted study to determine correlation between thickness of the cementum and chronological age. They included 127 extracted tooth specimen from people age 16-90 years. The thickness was measured on both side lingual and vestibular side. They determined the thickness at two level at apex and at the junction of middle on third and apical one third. They found correlation between age and increase in thickness of cementum. Further they suggested that the comparison with the measurement taken at approximately at the junction of middle one third and apical one third.[13]

Pundir S, Saxena S, Aggrawal P (2009) examined the correlation between age and the number of incremental lines in human dental cementum using three different forms of microscopy light, polarized, phase-contrast and longitudinal ground sections of 40 teeth age ranging

from 20−70 years. There was no significant influence of sex, age, periodontal disease, or tooth type on age estimation by the tooth cementum annulations method. There was a strong positive correlation between the estimated age and calculated age when phase-contrast microscopy was used; the correlation was less for light and polarized microscopy. Therefore they concluded that among the methods of counting incremental lines by various types of microscopy phase-contrast microscopy improves the accuracy of age estimation and may serve as a valuable aid in forensic identification.[14]

***Avadhani A, Tupkari JV, Khambaty A(*2009)** determined if any relation exists between incremental lines of cementum and age of the individual. In the study they included twenty-five teeth from patients of known age. They were observed that cementum annulations, when appreciated, can be used as a reliable guide to determine the age of the patient. The age thus determined varied by about 2−3 years from the actual age of the patient. The reliability of the method was found to be 94.73%. There was good interobserver agreement in counting annulations.[15]

Dias P, Beaini T, Melani R (2009) conducted a study on periodontally diseased and periodontally healthy tooth to count tooth cementum annulations. They concluded that estimating age by counting tooth cementum annulations added to the tooth mean eruption age can be reliable method for the periodontally healthy tooth. Periodontally compromised tooth shows underestimation by the proposed method. They also noticed marked less thickness of cementum. Further they point out that the accuracy of method decreases with increase in age. The image quality and inter and intra observer variation did not provide major source of error.[16]

Joshi PS, Chougule MS, Agrawal GP, (2010) conducted study including 30 teeth from patient ranging in age from 20-70 years. Longitudinal ground section were prepared & observed under polarizing & phase contrast microscope. The cementum lines were counted on magnified images on computer. They found that there was a strong correlation between the estimated and calculative age when phase contrast microscopy was used. Also they noticed increased accuracy in calculating age by phase contrast microscopy than polarizing microscopy.[17]

Kumar K, Shetty DC (2011) evaluated efficacy of age estimation using tooth cementum annulations as a criteria. They used 24 tooth specimens, teeth were first cleaned with pumice slurry and polishing brush in slow rotating hand piece. Tooth specimens were washed overnight with running tap water & placed in 70% alcohol. Each tooth was cut into sections using diamond tipped discs; in the middle third of the root. Middle third of the root was selected because of presence of acellular cementum deposition is there, that facilitates counting of cementum annulations. Cut sections were rinsed with distilled water. Sections were dehydrated in ascending grades of alcohol (50%, 70%, 90%, 95% & 100%) for 5 min each, placed in xylene & mounted. Cementum annulations were observed in Brightfield and Polarized microscope in quinoline & distilled water media under 10X and 40X magnifications. Specimens showed a high correlation between the TCA and actual age. They concluded that no statistically significant influence of sex, age, tooth type on estimation of age using tooth cementum annulations were observed. If described preparation and analysis standard is followed. Further they suggested that demonstrations of incremental lines are best viewed under the polarized light microscope with qunoline as imbibing media.[18]

Radovic M B, (2012) conducted anthropological study using tooth cementum annulations method, teeth of twenty one individuals of the Djerdap anthropological series were analysed. They concluded that the obtained data from the tooth was important for overcoming methodological issue as well as precise age of estimation of old individuals and with the assessment of age in cases where the skeletal material has been very poorly preserved.[19]

Timothy P, Gocha, Schutkowki H (2012) applied method of tooth cementum annulations in heat treated samples at 600, 800, 1000°C . They found that cementum annulations survive thermal alterations. The visibility of cemental annulations are dependent on temperature. They further concluded that the method is not applicable to tooth exposed to more than 600°C.[20]

Gauthier J, Schutkowski H.(2013) compared tooth cementum annulation with macroscopic age estimation. For that they used undecalcified, polished and unstained transverse thin sections viewed using standard light microscopy, with phase contrast microscopy tooth cementum annulations counting was done. Age estimates were applied independently on archeological specimens, to analyze their measure of correspondence and to assess whether data produced by a single histological technique are comparable to information pooled from multiple morphological age markers. Statistical analysis shows significant association between tooth cementum annulations and morphological age estimates. They further suggested that such studies with larger samples of known age material would help to improve understanding of tooth cementum annulations age estimation performance relative to macroscopic age assessment as well as continued refinement and standardization of cementum sectioning which wass suggested to impact annulation visibility.[21]

REFERENCES

1. S. Balagopal, Forensic odontology in India, Journal of Forensic Dental Sciences / January-June 2009 / Vol 1 / Issue 1.

2. Saxena S, Age estimation of Indian adults from Orthopantomographs. Braz Oral Res. 2011 May-Jun; 25(3): 225-9.
3. Talreja PK, Acharya AB, Naikmasur VG. An assessment of the versatility of Kvaal's method of adult dental age estimation in Indians. archives of oral biology, 2012; 57: 277 – 284.
4. Stavrianos D, Mastaga I, Starianou, karaiskou. Dental age estimation of adults: A review of methods and principals. Research Journal of Medical Sciences 2008; 2(5): 258-268.
5. Gustafson G, Age Determinations On Teeth. J Amer Dent Ass 1950; 41: 45-54.
6. Zander HA, Hürzeler B. Continuous cementum apposition. J Dent Res 1958; 37: 1035-44.
7. Stott GG, Sis RF, Levy BM, Cemntum annulations as an age criteria in forensic dentistry, J dent res June 1982; 61(6): 814-817.
8. Renz H, Schaefer V, Duschner H, Radlaanki RJ incremental lines of root cementum of human teeth: an approach to their ultrastructural nature by microscopy. Adv Dent Res., November 1997; 11(4): 472-477.
9. Solheim T: Dental cementum apposition as an indicator of age. Scand J Dent Res 1990; 98: 510-9.
10. Kagerer P, Grupe G. Age at deathdiagnosis and determination of life history parameters by incremental lines in human dental cementum as an identification aid. Forensic Sci Int 2001; 118: 75-82.
11. Backofen UW, Gampe J, Vaupel JW. Tooth cementum annulation for age estimation: Results from a large known-age validation study. American Journal of Physical Anthropology 10.1002/ajpa.10303
12. Gustafson G, Age Determinations On Teeth. J Amer Dent Ass 1950; 41: 45-54.
13. Pinchi V, Forestieri A L,Calvitti M. thickness of the dental cementum a parameter for age estimation. J forensic odontostomatol 2007; 25: 1-6.
14. Pundir S, Saxena S, Aggrawal P. Estimation of age based on tooth cementum annulations using three different microscopic methods, Journal of Forensic Dental Sciences / July-December 2009 / Vol 1 / Issue 2.
15. Avadhani A, Tupkari JV, Khambaty A, Cementum annulations and age determination, Journal of Forensic Dental Sciences / July-December 2009 / Vol 1 / Issue 2. 73-76.
16. Dias P, Beaini T, Melani R, age estimation from dental cementum incremental lines and periodontal diseases, J forensic Odontostomatology 2010; 28:1: 13-21.
17. Joshi PS, Chougule MS, Agrawal GP. Comparison of polarizing & phase contrast microscopy for estimation of age based on cemental annulations. Indian Journal of Forensic Odontology Volume 3 Number 3,July-Sept, 2010.
18. Kumar K, Shetty DC, Efficacy of Age Estimation in Forensic Dentistry Using Cemental Annulations as a Criteria, JIDA, Vol. 5, No. 1, January 2011, 114-116.
19. Radovic M B,againg in the Danube gorges population (9500-5500 BC) – tooth cementum annulation method. DOI. 10.2298/ STA1262009R (2012).
20. Timonthy P, Gocha, Schutkowski H tooth cementum annulations for estimation of age at death in thermally altered remains. J Forensic Sci 2013 vol58 no S1.
21. Gauthier J, Schutkowski H, Assessing the application of tooth cementum annulation relative to macroscopic aging techniques in an archeological sample. 2013 Feb; 64(1): 42-57. doi: 10.1016/j.jchb.2012.11.001.