International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 7(A); July 2018; Page No. 13931-13933
DOI: http://dx.doi.org/10.24327/ijcar.2018.13933.2506

Research Article

ESTIMATION OF THE AGE IN CHILDREN BY CEMENTAL ANNULATIONS IN CERVICAL AND MIDDLE THIRD OF THE ROOT OF PRIMARY AND PERMANENT TEETH USING LONGITUDINAL SECTIONS

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A R T I C L E I N F O

Article History:

Received 10th April, 2018
Received in revised form 18th May, 2018 Accepted 26th June, 2018
Published online 28th July, 2018

Key words:

Cementum, Cemental annulations, Age estimation, Eruption Age

A B S T R A C T

Introduction: Cementum is a hard tissue that deposits in the root around dentin in layers throughout life. Under light microscope it shows light and dark rings known as incremental lines of cementum. In paleontology and forensic medicine, the number of incremental lines can be used to derive the age of an individual at the time of death.
Aim: To estimate the age of children by cemental annulations in cervical and middle third of the root of primary and permanent teeth. **Materials and Method:** Fifty extracted teeth of children around the age of 6-16 years were selected and divided into 2 equal groups. Teeth with an intact root surface without the loss of adjoining cementum were selected. Longitudinal ground sections in mesio-distal plane were mounted on glass slides using DPX mountantand viewed under a light microscope. Cemental annulations were counted manually. **Result:** Cemental annulations of middle third region of primary teeth as well as permanent teeth were much reliable than cervical region to estimate the age of child. **Conclusion:** Cemental annulations can be used as a reliable guide to determine the age of the child.

INTRODUCTION

Teeth can be a useful indicator of some past variation in diet or of metabolic diseases and can also be of use for calculation of age at the time of death. Although the status of a person's teeth changes throughout the life, the combination of decayed, missing and filled teeth is measurable, reproducible and comparable at any fixed point in time (Mallar *et al*.2015; Aggarwal *et al*.2008). The hard tissues of the human dentition are able to resist decay and degradation long after other tissues are lost (Avadhani *et al*.2009). This resistance has made teeth useful indicators for assessing variation in diet, expression of metabolic diseases, and calculation of age at the time of death.(Stein1990). Therefore like comparison of unique patterns of fingerprint, a scientific, objective analysis of antemortem and postmortem dental variables is achievable. Estimation of age provides valuable information in cases where there is conflict of age, natural calamities and matters pertaining to illegal immigration. It is also useful for evaluating a child's growth status and assessing the age of subjects in anthropological, forensic and medico-legal situations. Literature indicates that cemental annulations can be used more reliably than the other morphological or histological traits of human skeleton for age estimation.

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Cementum is a calcified tissue that surrounds the dentine and forms the attachment site for the periodontal ligament fibers that link the tooth to the alveolar bone. It is deposited around the dentin, in layers, throughout life, thereby increasing in thickness with age (Stott *et al*.1982).

Numerous studies have been performed, where tooth cemental annulations have been used as criteria for estimation of age in permanent teeth but the same is not proven for primary teeth. Hence, the present study is an attempt to highlight cementum annulations and its correlation with chronological age in primary and permanent teeth of children.

MATERIALS AND METHOD

Fifty extracted teeth of children around age of 6-16 years were selected for the study who reported to department of pedodontics and preventive dentistry of Sharad Pawar Dental College, Wardha and were divided into two equal groups of 25 each. Group 1 comprised of twenty-five extracted primary teeth and Group 2 comprised of 25 extracted permanent teeth. The inclusion criteria were the chronological age of the patient to whom the teeth belong and having intact root surface. Teeth lost due to periodontal disease and teeth extracted for orthodontic purpose were also included. Teeth with root caries, attrition were excluded.

Using a laboratory lathe, longitudinal ground sections in mesio-distal plane were made, under continuous cooling of

water. After this, sections were trimmed manually, on the coarse side of an Arkansas stone, following the finer side. The ground sections were cleaned carefully with xylene and mounted on glass slides using DPX mountant and cover slips. Slides were kept for drying and then viewed under a bright light microscope. Cemental annulations were counted manually by marking a point against each line. For each alternating light and dark band of cementum annulations, a score 1 was given.

Photomicrograph showed incremental lines of the cementum at 40x magnification using a light microscope. Age was estimated using the following formula:
Estimated Age = Total number of cementum annulations + Age of eruption of that tooth
Then, the numbers obtained were compared with the known age of subjects.

Statistical Analysis

Descriptive and analytical statistics were done. The mean and standard deviation was tabulated. The normality of data was analyzed by the Shapiro-Wilk test. As the data did not follow normal distribution, the Mann-Whitney U test was used to check differences between groups. SPSS (Statistical Package for Social Sciences) Version 20.1 (IBM Corporation, Chicago, USA) was performed.

OBSERVATION AND RESULTS

Table 1 Comparison of mean error of age in cervical and middle third of the root in deciduous and permanent teeth

Variable	Deciduous		Permanent	
	Cervical Third	MiddleThird	Cervical Third	MiddleThird
N	25	25	25	25
Mean	7.61	5.28	0.92	0.16
Std. Deviation	2.00	1.98	0.95	0.47
Median	7.90	5.50	1.00	0.00
Minimum	1.50	0.50	0.00	0.00
Maximum	10.50	8.50	3.00	2.00
Z-Value	-3.630		-3.472	
P-Value	<0.001s		0.001s	

S →significant.
*P-value derived from Mann-Whitney U test; significant at $p < 0.05$

Table 1 showed that the mean error of age in cervical and middle third of the root in deciduous and permanent teeth was compared. In deciduous teeth it was found that mean error of age assessed with middle third of the root (7.61±2.00) was lower than the cervical third (5.28±1.98) and the difference was statistically significant ($p<0.001$). Similar results were seen in permanent teeth. It was found that the mean error of age assessed with middle third of the root (0.16 ±0.47) was significantly lower than the cervical third (0.92 ±0.95) and the difference was statistically significant ($p=0.001$).

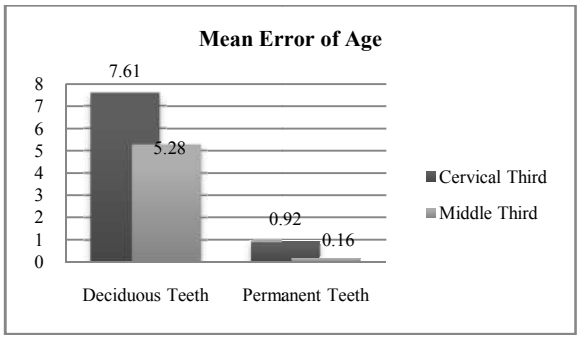

Figure 1 Comparison of mean error of age in cervical and middle third of the root in deciduous and permanent teeth

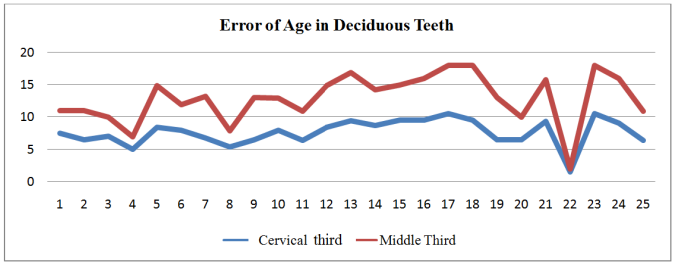

Figure 2 Line graph comparing error of age in cervical and middle third of the root in deciduous teeth

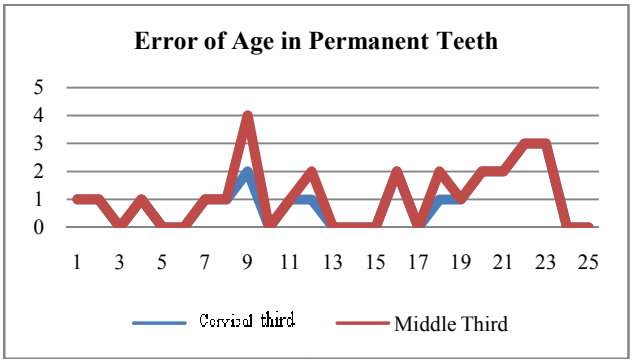

Figure 3 Line graph comparing error of age in cervical and middle third of the root in permanent teeth

DISCUSSION

Age determination plays an important role in crime, civil matter, identification of bodies, forensic medicine and illegal immigration.

Leiberman and Schroder identified cementum as an ideal material for age determination because of its unique location as compared to dentin and enamel. It primarily consists of uncalcified dense bundles of collagen fibrils. These bundles later become mineralized by hydroxyapatite crystals whose varying orientations may be responsible for the optical effect of alternating dark and light layers. The biological explanation given for the alternating lines is that the dark lines are the stop phases of mineralization during the continued growth of fibroblasts, leading to change in mineral crystal orientation. This pattern is visible under the microscope as a series of alternating light and dark lines or bands which are known as incremental lines of cementum (Dias *et al*. 2010).The alternating dark and light lines are less in count in the cervical region of the root when compared to the middle third of the root where they are distributed evenly, are even in growth and are not affected by seasonal rhythm (Mallar *et al* .2015; Dias *et al*. 2010; Charan Gowda BK *et al*.2014).

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. Stott *et al* in 1982, 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. Aggarwal *et al*. (2008) and Joshi *et al*. (2010) in their studies also used longitudinal ground sections similar to the present study. Klevezal and Kleinenberg in their study advocated use of longitudinal sections for viewing the whole root surface, whereas Stott *et al*. (1982) preferred cross-sections that allowed a series of observations.

Avadhani *et al*. (2009) studied 25 teeth, half of which were sectioned longitudinally and the other half group were cross-sectioned (Avadhani *et al*. (2009); Prabhpreet Kaur *et al* 2015). Mallar *et al* (2015) found that the middle third of tooth root was most suitable to count annulations, similar to the studies conducted by Millet and by Aggarval. However, Harris and Roksandic *et al.* in their studies preferred the apical region of the root to observe and count cementum layers as they found that the cervical and middle regions of the cementum were the most difficult to record and most likely affected by diagenic processes. In the present study it was found that the mid root examination minimizes factors known to obscure annulations such as cementocytes, has adequate thickness and is minimally affected by local or systemic diseases (Mallar *et al.*2015).

According to Avadhani *et al*., in 18 of 19 specimens, the estimated age varied from chronological age by about 2-3 years. The reliability of this method was found to be 94.73 %.(Priya *et al* 2014).

In studies by Jankauskas and Millet, visible cemental annulation suitable for counting was possible only in 82 -86 % and 71% cases, respectively in permanent teeth. In our study, incremental line count was possible in 90% of cases (Priya *et al*. 2014). There is sufficient data and literature regarding use of cemental annulations as criteria for age estimation in permanent teeth. However, the same information is not proven for primary teeth. Hence, the current study throws light on cementum annulations and its correlation with chronological age in primary and permanent teeth of children. In this study, the mean error of age in cervical and middle third of the root in deciduous and the mean error of age in cervical and middle third of the root in permanent teeth was compared (Figure 1). In deciduous teeth it was found that mean error of age assessed with middle third of the root (7.61±2.00) was lower than the cervical third (5.28±1.98)(Figure 2). Similar results were seen in permanent teeth. It was found that the mean error of age assessed with middle third of the root (0.16 ±0.47) was significantly lower than the cervical third (0.92 ±0.95) **(**Figure 3).The cementum present in the mid-root region of a tooth is usually acellular, undisturbed and even in growth, such annulations can be counted easily without any hindrance.(Bosshardt and Selvig(2000) This is indicative in the present study with data obtained from the middle third of the root providing quality results as compared to the cervical third.

CONCLUSION

It was concluded from the present study that:

- Cemental annulations of cervical third region of primary teeth were not reliable to estimate the age.
- Cemental annulations of middle third region of primary as well as permanent teeth were much reliable than cervical region to calculate the estimated age.
- Cemental annulations can be used as a reliable guide between 12-16 years.
- Not much reliable in deciduous teeth for age estimation.

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