

# Age estimation in adult human sound and periodontally affected teeth using tooth cementum annulations

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## Abstract

**Background:** There are many tools for identification of human remains, via radio graphical imaging, histological processing & microscopical examination of dental remains.

**Purpose:** to estimate the age of both female and male adults using tooth cementum annulations (TCA) method, evaluate the accuracy of TCA of both sound and periodontally affected teeth, and compare the estimated age (Est.age) with the chronological age (Chr.age) of an individual by the aid of; light microscope (LM), polarized microscope (PM) and phase contrast microscope (PHM).

**Material and methods:** 60 teeth divided into four equal experimental groups; group I contained sound teeth extracted from female patients, group II contained sound teeth extracted from male patients, group III contained periodontally affected teeth extracted from female patients and group IV contained periodontally affected teeth extracted from male patients. Longitudinal ground section for all groups were prepared & observed under LM, PM and PHM. Afterward, images were taken for each section then the average of TCA for each section was counted. The age was estimated using the formula {Estimated age = Numbers of incremental lines + Eruption age of tooth}.

**Results:** There was no significant difference between Est.age and Chr.age of both male and female sound teeth (group I and group II) while in periodontally affected teeth of both male and female (group III and group IV) there was significant difference. Also, there was a strong correlation between the Est. & Chr. age when PHM was used followed by LM then PM. Finally, there was no sex difference.

**Conclusion:** TCA is reliable for sound but not for periodontally affected teeth using either LM, PM or PHM. Moreover, PHM is a more accurate microscope for TCA in contrast to LM & PM. Interestingly, a novel regression formula was developed to enable estimating age in periodontally affected teeth by TCA method.

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*Keywords:* Age estimation; Tooth cementum annulations; Periodontitis; Light microscope; Polarized microscope; Phase contrast microscope

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## 1. Introduction

Forensic odontology (Forensic dentistry) is a specialized branch of forensic medicine which, in the interests of justice, deals with examination of dental

evidence from which a proper evaluation and presentation of dental findings can be made [1]. Age determination plays an important role in forensic medicine, not only in identification of bodies but also in connection with crimes. When the subjects have undergone changes so extensive that external characteristics yield no information, the teeth are often the only means of identification. Also, Human tooth can be preserved for a long time after death without gross changes so; it serves as an important tool in forensic science [2]. Various methods are utilized for determination of age from dentition. These may be described in four categories namely, clinical, radiographic, histological, physical and chemical analysis [3]. Apart from above mentioned techniques, a histological method based on counting the incremental lines of tooth cementum has shown promise for age estimation method in adult as the biological factors of cementum formation is well established so far. Tooth cementum is the calcified ectomesenchymal tissue that surrounds the dentine and forms the attachment site for the periodontal ligaments that support the tooth to the surrounding alveolar bone [4]. Microscopically, cementum appears as a series of alternating light and dark lines or bands that have the appearance of tree annual rings called TCA [5,6]. In acellular cementum, many fine incremental lines of about 0.5 micron width were observed that ran perpendicularly or obliquely to Sharpey's fibers. Also, these lines are not straight lines but had wave-like structure. Additionally, the fine incremental lines showing a close relationship to the degree of calcification, they also seemed to show a strong relationship to the quality of the organic component of acellular cementum [7].

In respect of cementum position, it has not been used to the extent of enamel and dentin to estimate the age of unidentified individuals. However, many studies recommended that counting of TCA in thin histological sections and adding them to the mean eruption age of the tooth may offer a more accurate method for age estimation in human beings and can be used as a more reliable age marker than any other morphological or histological traits in the human skeleton based on the biological factors of TCA [8]. For many years, it was reported that age determination using TCA could be an accurate means of age determination in animals that live on a relatively constant diet throughout life [9,10].

On the other hand, numerous studies were done to estimate ages by TCA method in human sound teeth using different types of microscopes and considered this method to be extremely valuable in forensic medicine, forensic dentistry, and anthropology [11,12].

Surprisingly, It has been shown that, few studies were done on age estimation using TCA method in periodontally affected teeth and these studies exhibited many contrasts. Therefore, it is of prime importance to study the efficiency of using TCA in age estimation of adult male and female using both sound and periodontally affected teeth with the aid of three microscopes; LM, PM & PHM and to compare the Est. ages with the Chronological ages of the individuals.

## 2. Materials and methods

### 2.1. The sample

Sixty extracted single rooted teeth were used in this study including both sound and early periodontally affected teeth. They were obtained from the Oral Surgery and Maxillofacial Department, Faculty of Dentistry, Tanta University. Teeth were extracted as a part of essential clinical care from patients ranging from 20 to 70 years old of both sexes with well known Chr. age and well known date and reason of extraction. Both written and oral consents were obtained from the patients. The protocol was approved from ethical committee at Faculty of Dentistry, Tanta University. Afterward, the selected teeth were divided into four equal experimental groups each one consists of fifteen teeth. **Group I:** sound single rooted teeth extracted from female patients, **Group II:** sound single rooted teeth extracted from male patients, **Group III:** periodontally affected single rooted teeth extracted from female patients and **Group IV:** periodontally affected single rooted teeth extracted from male patients.

### 2.2. The method

#### 2.2.1. Histological study

The extracted teeth were preserved in 10% buffered formalin then they were washed under running water. Thin longitudinal ground histological sections were done as reported by Aggarwal et al. [13]. After excluding unbeneficial sections, the ground sections in each group were examined by light, polarized and phase contrast microscopes. Afterward, images were taken for the middle third of the root of each section using the three microscopes at magnification  $\times 400$  for areas of the cementum showing uniform thickness, clear definition of layers from the cementodentinal junction (CDJ) to the outer border of the root then images magnified by computer. The average of TCA for each section was counted by image analysis system as follow: Counting the dark lines manually at the

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