REVIEW ARTICLE

# Forensic Age Estimation - An Overview

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## ABSTRACT

Age is one of the essential factors to establish the identity of a human being. One of the interesting applications of forensic odontology is age estimation by means of teeth. Age assessment proves to be a critical factor in the victim identification process. Teeth display a number of observable age-related variables, and they tend to remain intact under the circumstances, which might alter or obliterate the rest of the skeleton. Different methods are used to estimate age. The purpose of this review article is to familiarize about different techniques used to by means of teeth.


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## INTRODUCTION

Dental maturity has played an important role in estimating the chronological age of individuals due to the low variability of dental indicators and age estimation is important in forensic medicine and odontology for identification of deceased victims and also for crimes and accidents.[1,2] Various methods have been constructed and tested to estimate the age of young individuals.[2] Among them are the physical examinations using anthropometric measurements,[3,4] skeletal maturation,[5] dental age estimation,[6] a combination of dental development and anthropometric measurements[7] and a combination of skeletal and tooth eruption.[8] Age estimation is an important step in constructing a biological profile from human skeletal remains. The goal of the forensic anthropologist is to assist medico-legal officials with identification by presenting a probable age range of the deceased. In adults, this is typically done by examining various skeletal traits, which have been shown to degenerate with age in a predictable manner.[9] Teeth are among the most reliable tools in the process of identification of age, especially in the first and second decades. The stages of development can be considered as one of the most dependable indicators in assessing the age of the victim.[10] Developmental stages of dentition and craniofacial skeleton are well established. Any disturbances during this period produce changes in these tissues and serve as a lifelong permanent record. Even after the complete development of dentition and craniofacial skeleton certain physical, chemical, and biological changes take place which aid in the age estimation.[10]

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## HISTORY OF AGE ESTIMATION

The first attempt was made in England to use teeth as an indicator for age estimation. In the early 19th century, due to economic depression, juvenile work and criminality were serious social problems. A dentist named Edwin Saunders was the first to publish information regarding dental implications in age assessment by presenting a pamphlet entitled "teeth a test of age" to the English parliament in 1837.[2] Need For Age Estimation: As already mentioned every person whether dead or alive has the right to be identified for several reasons: (Ia) Living person requires age estimation fora birth certificate is not available or records are doubtful, (b) to determine the age of a young or adult for criminal liability, and (c) the in case of illegal marriages. II (a) Dead person requires age estimation fora during disaster victim identification and b) aborted fetal age estimation.

## AGE ESTIMATION METHODS IN DENTISTRY[11]

Various methods are utilized for determination of age from dentition. Age assessment methods may be classified as:

(A) According to the state of development of the dentition:
   1. Methods applied to the forming dentition
   2. Methods for the adult fully formed dentition.

(B) According to the technique of investigation:

1. Clinical or visual method
   Visual observation of the stage of the eruption of the teeth and evidence of changes due to function such as attrition can give an approximate estimate of age.
2. Radiographic method
   Radiography can provide the gross stage of dental development of the dentition.

3. Histological method
   Histological methods require the preparation of the tissues for detailed microscopic examination, which can determine more accurately the stage of development of the dentition. This technique is more appropriate for postmortem situations. It is also significant in the estimation of the age of early development of dentition.
4. Physical and chemical analysis
   The physical and chemical analysis of dental hard tissues to determine alterations in ion levels with age has been proposed. While these techniques, as yet, are not of great value to the forensic odontologist, future developments might provide an adjunctive means of collecting evidence of value in the dental context.

## FACTORS USED FOR THE AGE DETERMINATION USING DENTITION[3]

1. The appearance of tooth germs.
2. Earliest detectable trace of mineralization.
3. Degree of completion of the unerupted tooth.
4. Rate of formation of enamel and formation of the neonatal line.
5. Clinical eruption.
6. Degree of completion of roots of erupted teeth.
7. Degree of resorption of deciduous teeth.
8. Attrition of the crown.
9. Formation of physiologic secondary dentin.
10. Formation of cementum.
11. Transparency of root dentin.
12. Gingival recession.
13. Root surface resorption.
14. Discoloration and staining of teeth.
15. Changes in the chemical composition of teeth age estimation using the dentition can be grouped into three phases.

## AGE ESTIMATION IN PRENATAL, NEONATAL, AND EARLY POSTNATAL CHILD[3]

Age estimation in this group of individuals can be very accurate. Histological methods are used to assess the stage of tooth development during the premineralization period. Mineralization of deciduous dentition commences from 2 or 4 months *in utero*. Some of the histological methods can detect early mineralization 12 weeks before being detectable in the radiographs. The neonatal line[3] is considered as an indicator of birth. Neonatal lines are present in both enamel and dentin of deciduous teeth and permanent first molars which indicate the development during the transitional period between intrauterine and extrauterine environments. Hence, it can be used to assess the amount of pre- and post-natal enamel formation. In the dentin incremental lines[3] of Von Ebner and contour lines of Owen are present. These lines are used to estimate the age of the neonates or fetus at death. Incremental lines of Retzius are caused by variation in the rhythmic mineralization of enamel prisms. These rhythmic patterns may be altered by various external factors such as metabolic age estimation using the dentition can be grouped into three phases. Age estimation in prenatal, neonatal, and early postnatal child.[3] Age estimation in this group of individuals can be very accurate. Histological methods are used to assess the stage of tooth development during the premineralization period. Mineralization of deciduous dentition commences from 2 or 4 months *in utero*. Some of the histological methods can detect early mineralization 12 weeks before being detectable in the radiographs. The neonatal line[3] is considered as an indicator of birth. Neonatal lines are present in both enamel and dentin of deciduous teeth and permanent first molars which indicate the development during the transitional period between intrauterine and extrauterine environments. Hence, it can be used to assess the amount of pre- and post-natal enamel formation. In the dentin incremental lines of Von Ebner and contour lines of Owen are present. These lines are used to estimate the age of the neonates or fetus at death. Incremental lines of Retzius are caused by variation in the rhythmic mineralization of enamel prisms. These rhythmic patterns may be altered by various external factors such as metabolic disturbances so that the lines may appear closer or the rest periods may be prolonged. Certain drug such as tetracycline and elements such as lead, strontium, and fluoride will produce characteristic incremental lines. These incremental lines will help to determine the age at death. These lines can be studied by taking a ground section of the teeth.

## AGE ESTIMATION IN CHILDREN AND ADOLESCENTS

Tooth eruption and tooth calcification are the two events that can be used to measure dental age in children and adolescents. Radiographical evidence of formation of crown and root completion has been utilized for this age group. Schour and Massler's chart[4] was the first attempt to study dental age estimation. This chart permits direct comparisons with radiographs. Willems G *et al*. developed an age estimation method[5] that made use of a scoring system. In this method, seven mandibular teeth on the left side were divided into eight stages, and maturity score was evaluated. Age estimation can be measured using mandibular third molars[6] in which formed part of root were digitized, but the precision of

the age estimation was slightly inferior compared with the standard method.

## AGE ESTIMATION IN ADULTS

Most of the methods used in adults use various regressive changes of hard and soft tissues of the teeth. Gustafson[7] (1950) studied the changes occurring in individual teeth and succeeded in estimating the age with some accuracy. He used six dental changes connected with aging, namely attrition, apical migration of periodontal ligament, deposition of secondary dentin, cemental opposition, root resorption, and transparency of the root dentin. Age was estimated using the formula. Age=11.43+4.56 x where x is the total score. It was found that an increase in the total score corresponds to an increase in age. The average error with this method was 3.6 years. Lucy D and Pollard AM[8] modified Gustafson's method by multiple regression analysis and proposed a more accurate formula for age estimation with a standard error of 5.16 years. Deposition of secondary dentin[9] can be assessed using periapical radiograph to estimate age. Pulp diameter to crown diameter ratio and pulp/root length, pulp/root width was measured. The extent of racemization[10] of aspartic acid in coronal dentin of normal permanent teeth can be used to estimate the age of an individual at the time of death. As age advances L aspartic acid will change into D aspartic acid. An interesting method using intensity of fluorescence[11] in dentin and cementum, which shows strong correlation between age, deepening of color of the tooth, and increase in the intensity of fluorescence. The color changes in the cementum and dentin are caused by infusion of decomposition products from erythrocytes. The incremental lines[12] of cementum will help to determine the age of adults. A major disadvantage of this method is the necessity to extract or section the tooth. It is not practical among living individuals. Root dentin starts to become translucent due to the increased intratubular calcification. Dentin translucency[13] will increase with age. Disadvantages of this method include underestimation of age in older age groups due to slowing down of dentin sclerosis and the irregular junction at translucent and nontranslucent zones will make difficulties in measuring the length. Age estimation from the adult tooth is more accurate with modified Gustafson's method when multiple factors are used.

## CONCLUSION

Age estimation presents a complex problem and requires considerable experience in recognizing significant changes and allowing for their variability within any particular population. Teeth are particularly useful in age evaluation because they display a number of observable age-related variables and they tend to remain intact under circumstances which might alter or obliterate the rest of the skeleton.

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