AGE ESTIMATION IN FORENSIC ODONTOLOGY

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ABSTRACT
Age is one of the imperative factors, which play an significant role in every aspect of life. Person recognition is an important feature of forensic medicine and dentistry. Age, gender, race and many other factors are used for identification of a person. Chronological age, as recorded by registration of birth date, is referred throughout an individual’s life. Major dental clues once neglected are increasingly used to solve the crime. Age is estimated on the basis of chronological age, bone age, dental age, mental age, and others methods. Dental age is considered to be essential as tooth development shows less variability than other developmental features and also low variability in relation to chronological age. Hence, dental age is considered to be indispensable in establishing the age of an individual. Different morphological stages of mineralization correlate with the different developmental stages. This paper reviews various aspects of age estimation like clinical, histological, and radiographical methods and its scope and limitation.

KEYWORDS: Age estimation, Demirjian method, Dental age.

INTRODUCTION
One of the interesting applications of Forensic Odontology is age estimation by means of teeth. Teeth may be better preserved than other parts of the body and thus gives a better indication of age. It also has application in living individuals whose chronologic age is under dispute. Dental age is one of the few measures of physiologic development that is uniformly applicable from infancy to late adolescence.

Many anthropologists have studied the age systems, where age is often a major organizing principle. Age systems include formal age classes of individuals of similar numerical age, age grades or developmental stages based on social and biological development, and relative ages of individuals.[1]

In many cases, chronological age and biological age may not be the same, due to the developmental variations. Hence, different parameters such as dental age, bone age, mental age, and other factors such as menarche, voice change, height, and weight are considered as proxy indicator for biological age and body development.[2]

Dental development is more reliable as an indicator of biological maturity in children. Dental maturity is more relevant as it is less affected by nutritional and endocrine status.[2]

Dental maturity is considered better than the emergence of teeth into the oral cavity as it is scarcely influenced by local factors such as lack of space and systemic factors. It is also widely used to estimate the chronological age of children of unknown birth records.[3]

Historically, age assessment using teeth was first published by EDWIN SAUNDERS[4] in 1837 who claimed that teeth provided the most reliable guidance to age compared to age estimation from height which was a standard method used during that time.

Dental Age Estimation Methods[8]
• Clinical: Visual observation of the stages of eruption of the teeth and evidence of changes due to function such as attrition can give an approximate estimation of age.
• Radiographical: Radiographs can provide the gross stage of dental development of the dentition.
• Histological: 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 post-mortem situations. It is also significant in estimation of age of early development of dentition.

- **Physical and Chemical Analysis:** The physical and chemical analysis of dental hard tissues to determine alterations in ion levels with age have been proposed.

**Factors Used for Age Determination.**[6]

1. The appearance of tooth germs.
2. Earliest detectable traces 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.
10. Formation of cementum.
13. Root surface resorption.
14. Discolouration and staining of teeth.
15. Changes in the chemical composition of teeth.

**Dental Age Estimation Methods**[6]

- Age estimation in prenatal, neonatal and early postnatal:
  - Neonatal line
- Age estimation in children and adolescents:

**Methods based on Tooth emergence and calcification are**

- Schour and Massler’s method,
- Demirjian’s method,
- Nolla’s method.

- Age estimation in adults:
  - Gustafson Method,
  - Dentin translucency,
  - Increment lines of cementum,
  - Radiographic method.

**Neonatal Line**[6]

- Is considered as an indicator of birth.
- May take 3 weeks after birth to form.
- Estimating age in this age group may have legal implications in cases that involve feticide and infanticide.

**Schour and Massler’s Method**[7]

This method involves comparison of a radiograph of the entire maxilla and mandible to diagrams depicting the stage of the development of the dentition that can be expected at each year in the life of a child.
Nolla’s Method

Nolla (1960)

Nolla developed a scale based on ten stages in tooth development and they are numbered from 0 to 10. The sum of the scores of all the teeth is used to define the dental age.
Demirjian’s Method

- The development of seven mandibular teeth on the left side was divided into eight stages each. These were named ‘A’ to ‘H’.
- Each tooth is assigned a ‘maturity score’ that corresponds to its development stage. The maturity score assigned for each tooth is added and a total maturity score is obtained. This total maturity score is then plotted on a chronologic ‘age conversion table’.
8 Stages of Mineralization.

Given by Demirjian are

A - Mineralized cusp tips, not yet coalesced
B - Mineralized cusps united
C - The crown is approximately half formed
D - Crown formation is complete to the dento-enamel junction
E - Root formation has begun
F - Root length at least as great as crown length
G - Parallel root walls with open apices
H - Apices are completely closed

**Gustafson Method**

It is based on the observation of six different dental criteria, all of which undergo age-related changes throughout life.

i) Attrition (A)
ii) Secondary dentine apposition (S)
iii) Periodontosis (P)
iv) Cementum build up (C)
v) Root resorption (R)
vi) Root transparency (T)

For each of these regressive changes or variables, different scores ranging from 0-3 were assigned. The results of these scores were then added together to give a score (X) that was then converted via a regression line to a chronological age.
Dentin Translucency\textsuperscript{[11]}
Bang and Ramm were the first to use dentin translucency alone for estimating the age and reported significant increase in root translucency with age.
\[ \text{Age} = B_0 + B_1 X + B_2 X^2 \text{ for zone of translucency } \leq 9 \text{ mm} \]
\[ \text{Age} = B_0 + B_1 X \text{ for zone } > 9 \text{ mm} \]
$B_0$ – regression constant
$B_1$ and $B_2$ – regression coefficient
$X$ – translucency length.

Age Estimation from Incremental Lines of Cementum\textsuperscript{[12]}
- Kegerer and groups used acellular cementum incremental lines to determine age.
- Estimated Age = No. of incremental lines + eruption of tooth.

Radiographic Methods of Kvaal and Associates
- They measured the pulp size measurement of six teeth (maxillary central and lateral incisor, second premolar; mandibular lateral incisor, canine and first premolar) observed on periapical radiograph.

Measurements Include Several Length and Width Ratios Such As
- Root length/tooth length (T)
- Pulp length/tooth length (R)
- Pulp length/root length (P)
- Pulp width/root width at level a (A)
- Pulp width/root width at level b (B)
- Pulp width/root width at level c (C)
- Mean values of all ratios (M)
- Mean value of width ratios from levels b and c (W)
- Mean value of length ratios P and R (L)
- Difference between W and L (W-L)

CONCLUSION
Age estimation presents a complex problem and requires considerable experience in recognizing significant changes and allowing for their variability with in 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,

Thus supporting the role of dentistry towards forensics.

REFERENCES