



DENTAL AGE ESTIMATION BY USING DEMIRJIAN METHOD IN ADULTS- A REVIEW

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ABSTRACT

Age is one of the essential factors, which plays an important role in every aspect of life. Age, gender as well as race are used for identification of a person. Age is an important factor in clinical practice, research and court law and is estimated on the basis of chronological age, dental age, mental age and others. Dental age is considered to be vital as tooth development shows less variability in relation to chronological age. Hence dental age is considered to be vital in establishing the age of an individuals and age estimation by teeth in adults play important role in various methods of age estimation in

adults in different stage of tooth developmental stages, different morphological stages of mineralization and we discuss here various aspects of age estimation like, morphological, biochemical and radiographic methods and its scope and limitation. These methods have inherent advantages and disadvantages. Although there are many methods of age estimation, Demirjian method has been used universally with appropriate modifications. The forensic literature has provided several methods for estimating age in adults, both dead and living. One of the interesting implications of forensic odontology is age estimation by means of teeth.

KEYWORDS: Age estimation, adults.

INTRODUCTION

Forensic age estimation has application in living individuals in whom the chronological age is disputed. The first human attempt that used teeth as an indicator of age originated from England. Edwin Saunders, a dentist, was 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.

Purpose of age estimation

- For criminal proceedings
- Civil and asylum proceedings
- Old age pension proceedings
- Determining the age of skeleton

Literature describes several techniques that address age estimation in adults. The various methods are divided into three categories.

Morphological methods

Biochemical methods

Radiological methods

Morphological methods

Gustafson (1950), Dalitz (1962), Bang and Raman (1970), Johanson (1971), Maples (1978), Solheim (1993) are few morphological methods.

Gustafson's method (1950)

Gustafson (1950) and Thomas (1944) described the age changes occurring in the dental tissues and noted six changes related to age. They are.

- a) Attrition of the incisal or occlusal surfaces due to mastication (A)
- b) Periodontitis (P)
- c) Secondary dentin (S)
- d) Cementum apposition (C)
- e) Root resorption (R)
- f) Transparency of the root

Disadvantages: - cannot be used in living organism. Most acceptable method for age estimation in adults compared to other morphological methods.

Biochemical methods

Biochemical methods based on the racemization of amino acids is a reversible first order reaction and is relatively rapid in living tissues in which metabolism are low. Aspartic acid has been reported to have the highest racemization rate of all amino acids and to be stored during aging. In particular L-aspartic acids are converted to D-aspartic acids and thus the levels of D-aspartic acid in human enamel, dentine and cementum increases with age.

Radiographic method

Radiology plays an important role in the human age determination. Radiologic images are utilized in the process of age estimation. This method is simple, non-invasive and reproducible method that can be employed both on living and unknown dead.

Various radiographic images that can be used in identification are.

- Intra oral periapical radiographs
- Lateral oblique radiographs
- Cephalometric radiographs
- Panoramic radiograph
- Digital imaging and
- Advanced imaging technology

The radiological age determination is based on assessment of various features as follows

- Jaw bone prenatally
- Appearance of tooth germs
- Earliest detectable trace of mineralization or beginning of mineralization
- Early mineralization in various deciduous teeth during Intra uterine life
- Degree of crown completion
- Eruption of the crown into the oral cavity
- Degree of root completion of erupted and unerupted teeth
- Degree of resorption of deciduous teeth
- Measurement of open apices in teeth
- Volume of pulp chamber and root canals or formation of physiological secondary dentine.
- Tooth to pulp ratio

Clinically the development of permanent dentition completes with the eruption of the third molar at the age of 17-21 years, after which the radiographic age estimation becomes difficult. The two methods commonly followed are the assessment of the volume of teeth and the development of the third molar.

- 1) Volume assessment of teeth
 - Pulp to tooth ratio method by kvaal
 - Coronal pulp cavity index
- 2) Development of third molar

- Harris and Nortje method
- Van heerden system
- kohler's method

Volume assessment of teeth

The age estimation in adults can be achieved by radiological determination of the reduction in size of the pulp cavity resulting from secondary dentine deposition, which is proportional to the age of the individual.

Pulp to tooth ratio method by kvaal

In this method, pulp tooth ratio is calculated for six mandibular and maxillary teeth, such as maxillary central and lateral incisors, maxillary second premolars, mandibular lateral incisor, mandibular canine and the first premolar. The age is derived by using pulp to tooth ratios in the formula for age determination given by kvaal et al.

$$\text{Age} = 129.8 - [(316.4 \times m) / (6.8 \times (W - L))]$$

The coronal pulp cavity index

This method calculates the correlation between the reduction of the coronal pulp cavity and the chronological age. Only mandibular premolars and molars were considered, as the mandibular teeth are more visible than the maxillary ones. Panoramic radiography is used to measure the length (mm) of the tooth crown (coronal length) and the length (mm) of the coronal pulp cavity (coronal pulp cavity height or length CPCH). The tooth-coronal index (TCI) is computed for each tooth and regressed on the real age of the sample using the formula.

$$\text{TCI} = \text{CPCH} \times 100 / \text{CL}$$

Development of third molar

The radiographic age estimation becomes problematic after 17 years of age as eruption of permanent dentition completes by that age with the eruption of the third molar. Later, the development of the third molar may be taken as a guide to determine the age of the individual.

Harris and Nortje method

They have given first stage of third molar root development with corresponding mean ages and mean length.

Van heerden system

The development of the mesial root of the third molar was assessed to determine the age using panoramic radiograph.

Demirjian's method

In 1973, Demirjian introduced a method (DemI973) which estimated chronological age based on developments of seven teeth from the left side of the mandible. This method was similar to that of Tanner, Whitehouse, and Healy, who estimated chronological age based on the maturity of hands and wrists. It is a widely used in dental age estimation of children and adolescents and assess tooth development/calcification. The method makes use of mandibular permanent teeth on the left side from the central incisor to the third molar. If any tooth is missing on the left side, the corresponding right side tooth may be utilized. Compare the radiograph to the "tooth development chart" and assign each tooth any one of ten development stages (0, 1, 2, 3, 4, 5, 6, 7, 8, or 9)

Stage 0: Dental calcification has not yet begun.

Stage 1: The bony crypts have formed, but no sign of the tooth germ.

Stage 2: In both uniradicular and multiradicular teeth, a beginning of calcification are seen at the superior level of the crypts, in the form of inverted cone or cones.

Stage 3: Fusion of the calcified points from one or several cusps, which unite to give a regularly outlined occlusal outline.

Stage 4: a) Enamel formation is complete at the occlusal surface. Its extension and convergence towards the cervical region is seen.

b) The beginning of dentinal deposit is seen

c) The outline of the pulp chamber has a curved shape at the occlusal border.

Stage 5: a) The crown formation is complete down to the cement-enamel junction.

b) The superior border of the pulp chamber in uniradicular teeth has definite curved form, being concave towards the cervical region. The projection of the pulp horns, if present gives an outline like an umbrella top. In molars the pulp chamber has a trapezoidal form.

c) Beginning of root formation seen in the form of spicules.

Stage 6: Uniradicular teeth

a) The walls of the pulp chamber now form straight lines, whose continuity is broken by the presence of the pulp horn, which is larger than in the previous stage. The root length reaches atleast $1/3^{\text{rd}}$ of the crown height Multiradicular teeth

Stage 7: Uni radicular teeth

- a) The walls of the pulp chamber now form a more or less isosceles triangle.
- b) The apex ends in a funnel shape.
- c) The root length is equal to or greater than crown height.

Stage 8: a) The walls of the root canal are now parallel (distal root in molars).

b) The apical ends of the root canals are still partially open (distal root in molars).

Stage 9: a) The apical end of the root canal is completely closed (distal root in molars).

b) The periodontal membrane has a uniform width around the root and apex.

Corresponding to the selected Development Stage, and based on the sex of the subject, each tooth is given a numerical score. Eight numerical scores are obtained (one score for each tooth). These scores are added to obtain a total maturity score. This total score is usually between 0–100. The total maturity score (S) is then substituted in one of the sex-specific formula to derive the age.

DISCUSSION

One of the most important sub-disciplines of forensic sciences is age estimation and is of paramount importance in medico-legal issues. The broadening frontiers of dentistry have taken the dentist as an expert witness in legal room proceedings and in the field of forensic sciences. However, forensic odontology for long had been a less explored area of dentistry. Age estimation is an important requisite in some judicial proceedings. Age assessment is required in following circumstances like, asylum seekers of unknown age, young people accused of criminal activities, and convicted criminals whose age is claimed to be less than 18 years prior to sentencing. Age estimation is also useful for human identification and in determining legal age for criminal responsibility. Both are related to local legal requirements and one can be apply that to ageing in both human remains and living people. However, age estimation is a challenging task. Dental surgeon plays a major role in age estimation. The main objective is to obtain the best standardized method for legal, medical age estimation, which is reproductive, simple and reliable, that we can apply in living and dead.

Limitations

1. Demirjian method use orthopantomograms which are difficult to obtain in young children, due to both technical reasons, as well as legal and ethical considerations.
2. Since simultaneous evaluation of seven left mandibular teeth are required, cannot apply it in children with lacking teeth inborn or acquired.

3. This method may not express, agenesis of teeth, distinctive retardation of dental development (excluding third molars), and systemic diseases and various developmental stages of the tooth.
4. The appreciation of developmental stage may become difficult as the choice of the tooth developmental stage is quite subjective.
5. This method does not give maturity scores for stages 1-4 in case of 1st molar, central and lateral incisor; thus excluding the individuals below the age of 4-4.5 years.

CONCLUSION

Determination of dental age is done by reference to the ever-growing human deciduous and permanent dentitions. However, several authors have shown that results are less accurate if one compares another population to Demirjian's standards. Hence, for age estimation based on age, ethnicity/race we need to develop specific standards. Further studies are required to check validity, reliability, and applicability of this method in different populations across the world. The importance of age estimation includes an assessment of minor/major status in individuals without legal documents, Demirjian method, the widely used method with appropriate modifications shall be a reliable method. One needs to remember that the age estimation based on dental changes cannot be expressed in precise terms of chronological age, but as the most likely age with an age range.

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