

Age Estimation from Teeth in Adult - A Review

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Abstract: *Tooth is the hardest substance in human body. Time from beginning of tooth formation to completely formed tooth, it undergoes many changes. Different stages of tooth development are at certain time period followed by the next stage. So age could be estimated from teeth as it goes through many phases of age changes.*

Keywords: age estimation, forensic

1. Introduction

Age estimation in forensic science is an important factor used around the world in global migration, civil and criminal cases and wars. It is used in both dead and alive person. Various methods of age estimation have been proposed for decades. Commonly used methods for dental age estimation are based on determination of developmental stage. One of the reasons is simplicity of these approaches. The following method like Gustafson's method, Attrition method, Dental radiograph, Modified Gustafson's method by Johnson, Pulp tooth area ratio of Mandibular canine and age estimation using cone beam CT. Racemisation of aspartic acid in human dentin is a biochemical method.

2. Discussion

Aging is the accumulation of changes over time. Aging in human is multidimensional process. Like any tissues in human body, dental tissue also undergoes changes from time to time of development as the age advances. Age estimation from tooth is a reliable method because of phases of age change through which a dentition grow can be predicted using various methods and techniques.

Gosta Gustafson studied attrition the following senile changes associated with the teeth in older persons after 25 years that help in estimation of age. His method is based on ground sections and six age associated parameter he studied were⁽¹⁾:

- 1) Attrition (A)
- 2) Periodontal ligament recession (P)
- 3) Root resorption (R)
- 4) Secondary dentin (S)
- 5) Root transparency (T)
- 6) Cemental apposition (C)

The formula suggested by Gustafson had each regressive alteration assigned with any of the 4 grades. i.e (0-3) .
Age= 11.43+ (4.56 x Y)

Later it was modified by G. Johnson. He introduced a new formula with seven grades, 0, 0.5, 1, 1.5, 2, 2.5 and 3.
Age=11.02+ (5.14 x A) + (2.3 x S) + (4.14 x P) + (3.71 x C) + (5.57 X R) + (8.98 x T)

The application of Gustafson's method on Indian population has error rate of +- 8years. It may be due to dental hygiene and habits in Indian population of betel nut chewing.⁽²⁾

Attrition is (physiological) wearing of the incisial/occlusal portion of teeth. Pathological wearing can be due to different diet and the way it is prepared and mental stress. Stress can also be one of the major causes of attrition. For the age estimation in adults, 1st and 2nd molars are mainly seen. A study done on cadavers and dry skulls by Chunbiao Li and Guijin Ji by the method of average stage of attrition. Ten stages with 0-9 were assigned⁽³⁾.

Stage 0-No attrition

Stage 1-Slight

Stage 2-Oblique Facet

Stage 3-Great part of cusp has worn out

Stage 4-Dentine appears as spot <1mm

Stage 5-Dentine appears as spot >1 mm

Stage 6-One exposed dentine spot coalesces with another

Stage 7- One exposed dentine spot coalesces with two other

Stage 8-Secondary dentine exposed

Stage 9-Dentine is exposed on entire occlusal surface and secondary dentine exposed.

As there is no significant effect of sex on molar attrition, many scientists accept that sex is not an important factor.⁽⁴⁾ Most scientist consider that the attrition of Mandibular molars is slightly greater than maxillary molars and side differences exist but without significant regularity so they considered the differences of attrition between maxilla and mandible but did not so between left and right sides. The exposure of the pulp cavity was not selected as predictor of molar crown attrition because previous studies done by Mo and Wei⁽⁵⁾ indicated that the incidence of pulp cavity exposure is low even beyond 70 years.

Two types of imaging techniques Dental radiograph and Cone beam CT can be used to estimate the age of an adult.

Dental radiographs can be used to check the reduced pulp cavity because as the age advances deposition of secondary dentine compresses the pulp. The measurements of this reduction can be used as an indicator of age. A study done by *Kvaal et al* (1995) on full mouth dental radiographs was to find a technique which could be used to evaluate or calculate the chronological age of an adult from measurement of size of pulp.

Periapical radiographs were taken of 100 dental patients who attended the clinics of Dental faculty in Oslo. The radiographs of six types of teeth from each jaw were measured: maxillary central and lateral incisors and second premolars, mandibular lateral incisors, canines and first premolars. There can be differences in magnification and angulations on radiograph so to compensate that following ratios were calculated: pulp/root length, pulp/tooth length,

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tooth/root length and pulp/root width at three different levels.⁽⁶⁾

When statistical analysis was done, it was found that Pearson's correlation coefficient between age and the different ratios for each type of tooth was significant. Principal component analyses were done then regression analysis was performed on all the ratios with age as dependent variable and the principal components as independent variables. The principal analysis showed that only the two first of them had significant influence on age and a good and easily calculated approximation to the first component was found to be mean of all ratios. The measurement on radiograph is a non invasive method but more studies should be done using this method.

Cameriere et al introduced a similar method measuring in two dimensions, only the tooth and pulp area. Initially the studied on maxillary canine but later added second molar and mandibular canine.⁽⁷⁾ A study done Babshet et al on radiographic images using Cameriere's formula was saved as a high resolution JPEG and using Adobe Photoshop CS2 lines were marked at two levels:

- 1) Maximum curvature of crown at mesial and distal side and
- 2) Cementoenamel junction. (CEJ)

Lines were drawn apically from CEJ till root apex. To mark the perimeter of tooth and pulp, 20 points were drawn marking the tooth outline and 10 points surrounding the pulp using AutoCAD software program. Linear regression analysis was done. The authors didn't get accurate result. For precise results, more studies using multiple teeth and regression analysis as well should be done.

The other imaging technique i.e. cone beam CT (Computed Tomography). The development in software presents a new application, cone beam CT image data for determining the chronological age. The positive point of using imaging method on subjects is that it can be used without requiring high dose of radiation. The complete procedure takes less than one hour per patient, including clinic scanning, image reconstructing, pre-processing and post-measurement. Comparatively it is faster than 5 hours per tooth processing time than previously reported study on uCt (micron CT) and cone beam CT provides abundant of 3D volume information of the living individual in a single scan of the targeted area. With appropriate intercept and slope determined based on sufficient datasets, this method can be applied to age determination

To enhance the preciseness, advancement in hardware and software is needed. Cone beam CT has better contrast resolution and also it brings fine detail in gray level range and also allows better visualization of tooth segmentation. A gray level range is the range of shades of gray in pixels, representing x-ray attenuation coefficient that allows for tissue density assessment in computed tomography (CT). More studies need to be done to make good use of this technique.⁽⁸⁾

Another important technique is racemization of aspartic acid. Racemization is chemical reaction in which one pure

mixture gets converted into a mixture with more enantiomers. L form amino acid changes into D form amino acid. Aminoacids are the building blocks of protein of body and L-amino acid where L stands for Levorotation and in D-amino acid, D stands for Dextrorotation and these indicate direction of rotation of spiral that is chemical structure of the molecule. D is synthetic form of Amino Acid whereas L is natural form. Inside protein, L-amino acid gets converted into D amino acid due to automatic chemical reaction and it is influenced by temperature, humidity and pH. Aspartic acid is a type of amino acid.⁽⁹⁾ The racemization of aspartic acid is seen in dentin as tooth, bone and cartilage are of low metabolic rates which are not affected by temperature or pH or humidity. The structures with low metabolic rates are better suited for estimation of chronological age.

Many studies have been done on aspartic acid racemization and found it to be very accurate. Helfman and Bada found it to be most rapid racemization whereas Ogino studied racemization on supernumerary and unerupted teeth. Ohtani and Yamamoto in addition to dentin studied racemisation on enamel.⁽¹⁰⁾

3. Summary and Conclusion

Tooth formation is the best choice for estimating the age as variations are less as compared to other development factors as 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. Many studies have concluded that tooth formation is a more reliable indicator of dental maturity. Age estimation presents a complex problem and requires considerable experience in recognizing significant changes and allowing for their variability within any population. With multiple methods available, if done accurately dental age estimation could help bringing about a breakthrough in forensics when the other options seem desolate.

References

- [1] Justice K.Kannan, "Modi, A Textbook of Medical Jurisprudence and Toxicology." chapter 10, page 212.
- [2] Forensic Odontology, Age Estimation Chapter 3 (page 6-10)
- [3] Chunbiao Li, Guijin Ji, Age estimation from permanent molar in north east China by the method of Average stage of Attrition 1995 (189-196)
- [4] J. Tomenchuk and J. T. Mayhall, A correlation of tooth wear and age among Modern Eskimos. Am. J. Phys. Anthropol., 51 (1979) 67-78).
- [5] J.J. Feng, Age determination from structure of teeth. Acta Anthropol. Sinica, 4 (1985) 377-384)
- [6] Age estimation of adults from dental radiographs. Forensic science International, 1995 (175-185)
- [7] Babshet et al, Age estimation in Indians from pulp/tooth area ratio of Mandibular canine, Forensic science, 2010.
- [8] Fan Y., Reinilde J. & Guy W., Dental age estimation through volume matching of teeth image by cone beam CT. Forensic Science International.2006 March (78-83)
- [9] Yekkela R, et al. Racemization of aspartic acid from human dentin in the estimation of chronological age. Forensic Science International, 2006

[10] Kumar K.K., Dental age estimation using amino acid racemisation. Indian Journal Dental Research, 2008, 19 (2), 172-174