Estimation of age from physiological changes of teeth
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INTRODUCTION

The identity of the person is mainly established by age and sex. Determination of the human age is a procedure that is mainly adopted by forensic scientists.[⁵] Forensic dentistry has become an integral part of forensic science over the past 100 years.[⁶]

Age estimation is a subdivision of forensic dentistry. Age determination is crucial in medicolegal cases.[⁷] Age estimation is very important in the identification process of unknown bodies and also provides information about crime and accident scene. Teeth are one of the most durable and resilient parts of skeleton; hence, it is used for determination of age.[⁴] Various methods of age estimation are in practice, the first technique being Gustafson’s (1950) method.[⁵]

Tooth with its developmental stages certain changes are seen in the teeth. Gustafson in 1950 suggested the use of six physiological retrogressive changes in the teeth. Objective: The aim of this study was to determine the age of a person using the physiological changes occurring in the teeth. Materials and Methods: The six physiological changes in teeth are attrition, periodontal disease, root translucency, secondary dentin deposition, cementum apposition, and root resorption. These changes were studied in 20 persons. Teeth were selected, and the section was made. Degree of attrition and extent of periodontal disease were recorded before the extraction of the tooth. Tooth was extracted, preserved in formalin and then ground section was prepared by hand grinding. The root translucency was noted. Grinding was further done. Finally, cleaned and dried sectioned tooth was mounted on a slide and viewed under a microscope for secondary dentin deposition, cementum apposition, and root resorption. Data collected were statistically analyzed and results obtained. Results: The study sample consisted of 20 teeth (20 persons). 11 were female and 9 were male with maximum number of patients in 20–30 years age group. All six age-related changes were evaluated and the scores are given. Total score was plotted against actual age, and a regression line was drawn, and a regression formula was obtained - Y = 4.62X + 10.57 (X - total score, Y - estimated age). In age estimation, a mean error of 3.045 ± 0.55 years was observed. Conclusion: Among the various factors considered for determination of age, teeth are very useful as they are the most durable structures in the human body which are better preserved even in the acidic soil. Thus, six physiological factors of teeth (attrition, periodontal disease, secondary dentin deposition, root translucency, cementum apposition, and root resorption) can be utilized to identify the age of a person.

KEY WORDS: Age, Attrition, Periodontitis, Physiological changes, Root resorption, Teeth

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tooth which is still developing; and consequently, dental age estimation methods have to rely on the development of this tooth until the age of 20 years. After this period, age determination is mainly done by visual examination, radiographic methods, and structural changes in teeth and by means of biochemical methods.

Classification of dental age estimation:

1. Association of the state of development of dentition
   - Methods of identification of person below 20 years
   - Methods of identification of person above 20 years

2. Association of technique of identification
   - Visual
   - Radiographic
   - Physical and chemical
   - Histological

The aim of this study was to determine the age of a person with Gustafson’s method using the physiological changes occurring in the teeth.

**MATERIALS AND METHODS**

A total of 20 patients who attended the Outpatient Department in Saveetha Dental College, Chennai, were selected. The consent of the patients was taken before the study.

**Inclusion Criteria**

- Teeth extracted due to periodontal disease and for orthodontic and prosthetic reasons were included in the study.

**Exclusion Criteria**

The following criteria were excluded from the study:

- Patients with medical and drug history, trauma from occlusion, abnormal oral habits, congenital anomalies of teeth, pathology affected teeth, carious, and restored teeth.
- Teeth from patients younger than 20 years.

The armamentarium used in the study was electric lathe, carborundum disk, Arkansas stone (rough and smooth), alcohol, xylene, formalin, container, microscope, and slides.

Before extraction, age of the patient and extend of periodontal disease was noted. Extracted tooth was cleaned and put into container containing formalin and labeled. The tooth was cut longitudinally with the help of an electric lathe and carborundum disk. Ground section was prepared by hand grinding which was done with rough surface of Arkansas stone until a section of 1 mm was obtained, and grinding was further done using fine surface until the tooth section of 0.25 mm thickness was obtained at this thickness the following dental parameters were studied in each case; attrition, periodontal disease, cementum apposition, secondary dentine deposition, root translucency, and root resorption. Finally, cleaned with alcohol and the dried section was then immersed in xylene and mounted on a slide and viewed under a microscope for secondary dentine, cementum apposition, and root resorption. The order of preference was incisors-canine-premolars. The scores obtained were tabulated.

Four point allotment system as per Gustafson’s method:

**Attrition (A)**
- A0 - No attrition
- A1 - Attrition limited to enamel level
- A2 - Attrition limited to dentine level
- A3 - Attrition up to pulp cavity

**Periodontal Disease (P)**
- P0 - No obvious periodontal disease
- P1 - Beginning of periodontal disease but no bone loss
- P2 - Periodontal disease more than 1/3rd of the root
- P3 - Periodontal disease more than 2/3rd of the root

**Secondary Dentine (S)**
- S0 - No secondary dentine formation
- S1 - Secondary dentine up to upper part of pulp cavity
- S2 - Secondary dentin up to 2/3rd of the pulp cavity
- S3 - Diffuse calcification of entire pulp cavity

**Root Translucency (T)**
- T0 - No translucency
- T1 - Beginning of translucency
- T2 - Translucency more than 1/3rd of the apical root
- T3 - Translucency more than 2/3rd of the apical root

**Cementum Apposition (C)**
- C0 - Normal cementum
- C1 - Thickness of cementum more than normal
- C2 - Abnormal thickness of cementum near the apex of the root
- C3 - Generalized abnormal thickness of cementum throughout the apex of the root

**Root Resorption (R)**
- R0 - No resorption
- R1 - Spotted resorption
- R2 - Resorption limited to cementum
- R3 - Extensive resorption of both cementum and dentin

After collecting the data, scores were given. These scores were substituted in the formula \(10.57 + 4.62 \times \text{score}\) and estimated age was calculated, and difference between the estimated and actual age was also calculated.
RESULTS

The study sample consisted of 20 teeth from 20 persons. 11 were female and 9 were male with maximum number of patients in 20–30 years age group. There were 7 people between the age group of 20 and 30 years, 2 people between the age group of 31 and 40 years, 5 people between the age group of 41 and 50 years, 4 people between the age group of 51–60 years, 1 person in the age group of 61–70 years, and 1 person in the age group of 71–80 years. All six age-related changes were evaluated and given scores. Total score was plotted against actual age, and a regression line was drawn, and a regression formula was obtained - \( Y = 4.62X + 10.57 \) (\( X \) - total score, \( Y \) - Estimated age). Age was determined for each of the patients, and the difference in actual age and calculated age was derived [Table 1]. In age estimation, a mean age difference (between actual age and calculated age) of 3.045 ± 0.55 years was obtained.

DISCUSSION

A total of 20 cases were taken in our study, and 6 physiological changes (attrition, periodontal disease, cementum apposition, secondary dentine deposition, root translucency, and root resorption) were recorded. In our study, the mean age difference (between calculated age and actual age) was 3.045 years with a standard deviation of ±0.55 years. Thus using this method, we estimated the age of a person with minimal deviation from the actual age.

Various pathological conditions and quality of oral hygiene influence adversely the different dental features which may affect the scoring of secondary changes in teeth. In Gustafson’s method, no consideration was given to changes in teeth due to pathological conditions. In Gustafson’s experiment a mean age difference of ±3.63 years was observed, which is similar to our study results. In our study, the mean difference was less as compared to those reported by previous workers such as Dalitz;\(^{[13]}\) Miles;\(^{[14]}\) Bang and Ramm;\(^{[15]}\) Johanson;\(^{[16]}\) and Pillai et al.\(^{[17]}\)

Bajpai et al.\(^{[18]}\) found the mean age difference of ±4.86 years which was high compared to our study results. Similarly, Shrigirivar et al.\(^{[19]}\) obtained a higher mean age difference of ±4.43 years in their study. In the research done by John et al.,\(^{[20]}\) the mean age difference calculated was ± 4.32 years (Gustafson’s formula).

In contradictory to our study findings, Singh et al.\(^{[21]}\) in their study demonstrated a lower mean age difference between calculated age and the actual age of ±2.16 years. The mean age difference between actual and calculated age in 70 cases studied by Singh et al.\(^{[22]}\) was ±2.64 years.

Researchers showed a great fluctuation in their study results. The error could be multifactorial including the difference in demography, oral habits and hygiene, limited sample size, and nonspecificity of evaluation. Reliable estimation with the reproducible result is possible when standardization is strictly followed. A scientific method to accurately measure different criteria without operator bias should followed to accurately determine the age of a person using the physiological changes that occur in the teeth.\(^{[23]}\) Thus, if all the parameters are precisely recorded, the correct age of an individual can be estimated using Gustafson’s method.

CONCLUSION

Among the various factors considered for determination of age, teeth are very useful as they

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Sex</th>
<th>Actual age (years)</th>
<th>Score</th>
<th>Calculated age (years)</th>
<th>Difference in age (years)</th>
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are the most durable structures in the human body which are better preserved even in the acidic soil. Thus, six physiological factors of teeth (attrition, periodontal disease, secondary dentin deposition, root translucency, cementum apposition, and root resorption) can be utilized to identify the age of a person.

REFERENCES


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