

Determination of Dental Age by Gustafsons Method using OPG in Bihar population

Dr. Sweta¹, Dr. M Srinivasa Raju², Dr. Mani Kant³

¹(Assistant Professor, Dept. of Dentistry, SMC Bolpur, West Bengal)

²(Professor and HOD, Dept. of OMR, Dr. B.R.Ambedkar institute of Dental Sciences, Patna)

³(S.M.O, Dept. of Paediatrics, SDH, Narkatiaganj)

Abstract

Background: Morphological methods for age estimation from teeth have been developed and applied to samples without taking the postmortem interval into consideration. Dental color, translucency, length, attrition, cementum apposition and secondary dentin showed higher values from human skeletal remains than in fresh extracted teeth. Gustafson suggested the use of six retrogressive changes and ranked them according to degree of the change. Due to error in this morphometric method several modifications were done in subsequent studies but nothing stood the test of time.

Objective: The objective of this study is to determine dental age using OPG in Bihar population by Gustafson's method.

Materials and Methods: Patients attending OPD of Dr. B.R.Ambedkar institute of dental sciences, Patna were studied using panoramic radiograph (OPG) on 5 dental parameters namely Attrition, periodontal disease, cementum apposition, secondary dentine deposition and root resorption. Degree of attrition and extent of periodontal disease were recorded and scoring was done depending on our scale with first molar given highest priority.

Results and conclusion: Results are comparable with the reports using other methods. The results of age estimation were obtained using earlier methods after multiple regression of all studied changes were applied (absolute mean error of estimation 4.97 years 95% CI \pm 1.00). The estimation of age performed on the basis of histological examination and evaluation of morphological changes in hard tooth tissues was believed to be one of the most reliable methods, yet it has become the subject of heavy criticism especially when used with past populations. The prediction formula was thus:

Predicted Age = Constant + (5.289 * G-Score) - (1.024 * Number of teeth) + 2.406

43.9% of the variance in age was explained by the independent variables in the given formula.

Evidently, the issue of the estimation of age of adult individual's from teeth will remain a subject of further research.

Key Words: OPG, Gustafson's Method, Dental Age

Date of Submission: 03-07-2022

Date of Acceptance: 17-07-2022

I. Introduction

Age is one of the essential factors in establishing the identity of the person. Estimation of the human age is a procedure adopted by anthropologists, archaeologists and forensic scientists. Different factors have been used for age estimation but none has withstood the test of time for adults above 25 years. (Pillai and Bhaskar 1974).

Morphological methods for age estimation from teeth have been developed and applied to samples without taking the postmortem interval into consideration. Dental color, translucency, length, attrition, cementum apposition and secondary dentin showed higher values from human skeletal remains than in fresh extracted teeth (Mandojana et al).

Gustafson in 1950 suggested the use of six retrogressive changes and ranked them on arbitrary scale, allotting 0-3 points according to degree of the change. Due to error in this morphometric method several modifications were done in subsequent studies. Johanson (1971) in his research used same six criteria but different ranking scale and then estimated the age of an individual. Solheim (1980) used in situ teeth and eight variables which included two of color estimate, two for periodontosis, two for attrition, crown length and sex. None of the changes taken singly proved more accurate than when these were studied together help in age estimation.

The aims of this study are to note the various physiological changes occurring in teeth with age. To find whether factors like socioeconomic status, sex, diet or any habit like chewing tobacco or pan affects the morphological changes occurring in teeth.

II. Material And Methods

Source of data

The patients came to the department of oral medicine and radiology, Dr. B R Ambedkar Institute of Dental Sciences and Hospital, Patna

The following 5 dental parameter were studied in each case using panoramic radiograph (OPG):

1. Attrition
2. Peridontal disease
3. Cementum apposition
4. Secondary dentine deposition
5. Root resorption.

Inclusion Criteria:

- Healthy teeth
- Individuals above 15 yrs of age
- Exact age known

Exclusion Criteria:

- h/o trauma
- unknown chronological age
- caries on teeth significantly affecting the stages of gustafsons method
- restoration on teeth
- root fracture
- patient younger than 15 years
- patient did not signed consent form

METHOD:

The details regarding age, diet, habits and socioeconomic status of the deceased as noted from the relatives accompanying, was noted on the Performa. For the Socioeconomic status p Modified Kuppuswamy's socioeconomic status scale was used. [Source: Office of the Economic Advisor, Department of Industrial Development, Ministry of Industry, Government of India]

After collecting the details, teeth to be studied were selected and this selection was made based on the study of Solheim (1980) with priority given to first premolars then second premolars and canines and lastly incisors. In our study we took first premolars as they gave strongest coefficient (Kvaal and Solheim 1994). Degree of attrition and extent of peridontal disease was recorded before the extraction of the tooth and scoring is done depending upon the scale given below. Then the Tooth was extracted with extraction forceps and preserved in formalin till the ground section was prepared.

VARIOUS STAGE OF ATRITION AND ITS SCORING

The factors seen in the tooth before and after sectioning were recorded in the Performa using 4 points allotment system (Krishan Vij) as follows:

(1) Attrition (A):

A0- No Attrition

A1- Attrition limited to enamel level

A2- Attrition limited to dentine level

A3- Attrition up to pulp cavity.

(2) Peridontal disease (P):

P0- No obvious peridontal disease

P1- Beginning of peridontal ds. but no bone loss

P2- Peridontal disease more than 1/3rd of the root

P3- Peridontal disease more than 2/3rd of the root.

(3) 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.

(4) 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.
- (5) 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 and calculating the total score, a graph was plotted with actual age on one side and the score calculated on the other. This graph can be used to derive regression formula for the determination of age of the unknown cadaver.

The total score was also used in various previous known formula and age calculated and the difference is calculated from the actual age. Following formulas were used:

1. Formula A: Newly Derived
2. Formula B: $y = 5.34 x - 4.08$
3. Formula C: $y = 4.56 x + 11.43$
4. Formula D: $y = 4.26 x + 13.45$
5. Formula E: $y = 6.26 x - 6.0$
6. Formula F: $y = 8.5 A - 26.073$
7. Formula G: $y = 6.37 T + 4.63 P + 2.7 S + 2.4 C + 3.08 A + 1.34 R + 8.57$

(where y – calculated age, x – total score, A – Attrition score, T – Root Translucency score, P – Peridental Disease score, S – Secondary Dentine deposition score, C – Cementum Apposition Score and R – Root Resorption score)

The difference in the calculated age and actual age was found. From the above obtained difference maximum and minimum deviation of the calculated age from the actual age were also derived. Any correlation between socioeconomic statuses of the person with the total score recorded from the physiological factors of his teeth was also observed.

III. Results

Demography of the study subjects- Descriptive Statistics

There were 675 study subjects 15 each from 15 years to 59 years. The mean age was 37 with a standard deviation of 12.9. There were 351 (52%) males and 324 (48%) females. 269 of the study subjects were vegetarian by diet (39.9%) and 406 (60.1%) had a mixed diet. From the rural area, there were 313 (46.4%) participants and 362 (53.6%) were from urban areas. There were 135 participants from each of the five socio-economic groups according to Modified Kuppuswamy Classification.

Table 1: Age distribution of the study participants

Age group	Number (Percentage)
15-19	75 (11.11%)
20-24	75 (11.11%)
25-29	75 (11.11%)
30-34	75 (11.11%)
35-39	75 (11.11%)
40-44	75 (11.11%)
45-49	75 (11.11%)
50-54	75 (11.11%)
55-59	75 (11.11%)
Total	675

Table 2: Distribution of the study participants according to Socio-economic status

SE group	Number (Percentage)
Lower Class	135 (20%)
Lower Middle Class	135 (20%)
Middle Class	135 (20%)
Upper Middle Class	135 (20%)

Upper Class	135 (20%)
Total	675

There was no significant correlation of gender, socio-economic status or area of residence with total G-Score. Thus, it can be hypothesised that these factors do not affect the physiological changes in the teeth. There was a mild negative correlation between mixed diet and G-score (Spearman Rho: -0.125, p-Value 0.001). There was also a mild correlation between oral hygiene and G-score (Spearman Rho: 0.123, p-Value 0.001).

Table 3: Correlation of various factors on G-score

Factor	Spearman Correlation Coefficient (ρ)	p-Value
Age	0.578	<0.0001*
Gender	-0.007	0.855
Socio-economic Status	-0.047	0.226
Diet	-0.125	0.001*
Area of residence	-0.048	0.211
Oral Hygiene	0.123	0.001*

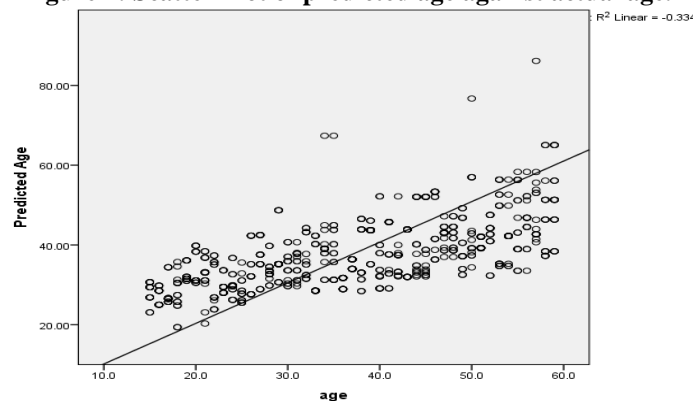
MLR analysis was conducted to determine the factors that correlated significantly with age in order to determine a formula for the estimation of age from various factors. It was found that female gender, number of teeth present and g-score had significant correlation and were thus used to predict age. These variables statistically significantly predicted Age, $F(3,671) = 174.774$, $p < 0.0001$, $R^2 = 0.439$. All variables added statistically significantly to the prediction, $p < 0.0001$.

The prediction formula was thus:

$$\text{Predicted Age} = \text{Constant} + (5.289 * \text{G-Score}) - (1.024 * \text{Number of teeth}) + 2.406$$

43.9% of the variance in age was explained by the independent variables in the given formula.

Figure 1: Scatter Plot of predicted age against actual age.



IV. Discussion and Conclusion

In forensic dentistry, determination of dental age-using stages of tooth development to gauge an individual's degree of maturity is one of a few biologic methods for monitoring physiologic development, and the dentition arguably is the only system available from prior to birth to early childhood. Dental development can also be used to estimate chronological age, such as, age at death of an unidentified person or the age of a suspect without legal documentation at birth. Analysis's of data revealed that previous method. (Absolute maximum error of estimation is 9.94 years at the 95% confidence interval) enables to give more accurate estimations of age than present method.

Results are comparable with the reports using other methods. The results of age estimation were obtained using earlier methods after multiple regression of all studied changes were applied (absolute mean error of estimation 4.97 years 95%, CI ± 1.00). The estimation of age performed on the basis of histological examination and evaluation of morphological changes in hard tooth tissues was believed to be one of the most reliable methods, yet it has become the subject of heavy criticism especially when used with past populations.

The best results of age estimation using earlier reports were obtained after multiple regression of all variables was applied. Analysis of the data revealed that Kilian's method (absolute maximum error of age estimation is 7.72 years at the 95% confidential interval) enables us to give more accurate estimations of age than Kashyap and Koteswara Rao's methods (absolute maximum error of estimation is 9.94 years at the 95% confidential interval), while in the study give best results (absolute maximum error of estimation is 4.95 years at

the 95% confidential interval). In conclusion these methods do not estimate direct relationship with age in years but they allow to individuals into a set of broad range age categories as the previous methods.

In the present study there were 675 study subjects 15 each from 15 years to 59 years. The mean age was 37 with a standard deviation of 12.9. There were 351 (52%) males and 324 (48%) females. 269 of the study subjects were vegetarian by diet (39.9%) and 406 (60.1%) had a mixed diet. From the rural area, there were 313 (46.4%) participants and 362 (53.6%) were from urban areas. There were 135 participants from each of the five socio-economic groups according to Modified Kuppaswamy Classification. There was no significant correlation of gender, socio-economic status or area of residence with total G-Score. Thus, it can be hypothesised that these factors do not affect the physiological changes in the teeth. There was a mild negative correlation between mixed diet and G-score (Spearman Rho: -0.125, p-Value 0.001). There was also a mild correlation between oral hygiene and G-score (Spearman Rho: 0.123, p-Value 0.001). The factors that correlated significantly with age in order to determine a formula for the estimation of age from various factors. It was found that female gender, number of teeth present and g-score had significant correlation and were thus used to predict age. These variables statistically significantly predicted Age, $F(3,671) = 174.774$, $p < 0.0001$, $R^2 = 0.439$. All variables added statistically significantly to the prediction, $p < 0.0001$.

The prediction formula was thus:

Predicted Age = Constant + (5.289 * G-Score) - (1.024 * Number of teeth) + 2.406

43.9% of the variance in age was explained by the independent variables in the given formula.

Evidently, the issue of the estimation of age of adult individual's from teeth will remain a subject of further research.

References

- [1]. Hoppa RD, Vaupal JW. Paleodemography Age Distributions from Skeletal Samples, Cambridge Studies in Biological and Evolutionary Anthropology: Cambridge: Cambridge University Press, 2002 (31).
- [2]. Buikstra JE, Ubelaker DH. Standards for Data Collection from Human Skeletal Remains. Research Series Fayetteville: Arkansas Archeological Survey, 1994 (44).
- [3]. Jackes M. Building the basis for Paleodemographic Analysis: Adult Age Determination. In : Katzenberg MA, Saunders SR, Editors. Biological Anthropology of the Human Skeleton. New York: John Wiley and Sons, Inc. 2001, pp. 417-466.
- [4]. Kemkes - Grotenthaler A. Aging through the ages: Historical perspectives on age indicator methods: In Hoopa RD, Vahpel JW. Editors: Paleodemography. Age distributions from skeletal samples. Cambridge Studies in Biological and Evolutionary Anthropology. Cambridge: Cambridge University Press (31), 2002, pp. 48-72.
- [5]. Gustafson G. Age determination on teeth. Journal of the American Dental Association 1950 (41), pp. 45-54.
- [6]. Kashyap V.K., Koteswara Rao N.R. A modified Gustafson method of age estimation from teeth. Forensic Science International 1990 (47), 237-247.
- [7]. Vlcek E., Mrklas L. Modification of the Gustafson method of determination of age according to teeth on pre-historical and historical osteological material. Scripta Media (Brno) 1975 (48), 203-208.
- [8]. Johanson G. Age determination from human teeth: A critical evaluation with special consideration of changes after fourteen years of age. Odontologic Revy 1977, 22 (Suppl. 21), 1-126.
- [9]. Kilian J, Sidlo R, Merglova V.K. problem atice urcovani stari jedince podlechrupu. Soudni lekarstvi 1981 (26), 33-42, 49-54, 55-59.
- [10]. Bruzek J., Novotny V. Jak stari umirali stari premyslovci aneb jak presona Je presnost urceni veku Jedince podle Kosty. Vesmir 1999 (78), 453-455.
- [11]. Kilian J. K technice vybrusu zubu. Cesk oslovenska stomatologic, 1975 (75), 24-28.

Dr. Sweta, et. al. "Determination of Dental Age by Gustafsons Method using OPG in Bihar population." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(07), 2022, pp. 07-11.