

## ORIGINAL RESEARCH

# Assessment Of Accuracy Of Gustafson's Age Estimation Criteria In A Population Of Known Age: A Forensic Study

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### ABSTRACT:

**Background:** Forensic medicine comprises of a vast spectrum of areas concerned with identification process. Gustafson (1950) suggested the use of six criteria's that are seen with physiologic age changes. **Aim:** To assessment the accuracy of Gustafson's age estimation criteria in a population of known age. **Materials and Methods:** A total of 50 patients were selected for the study between the age group of 25-80 years who were undergoing extraction. Ground sections of the teeth were prepared. Modified Gustafson's criteria were used for the age estimation. **Results:** Age estimation by Gustafson's formula shows a great variation from the real age when compared to Maples formula and newly derived age estimation formula. **Conclusion:** Applicability of Gustafson's formula in age estimation in our study group is not relevant.

**Keywords:** Age determination, forensic, Gustafson's criteria

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## INTRODUCTION

Forensic Medicine comprises of a vast spectrum of which age estimation is a sub component and forms an integral part of every identification process. Dental component forms a unique and indispensable component of human body since it comprises of human skeleton. Dental evidence in forensic medicine can be invaluable in personal identification especially when data relating to the deceased is unavailable. The method of estimation should be as accurate as possible, since it will cut down the search within the police missing person's files and enables a time saving approach.<sup>1</sup>

Dental age estimation utilizing the dental parameters is one of the very few available measures of physiological development that are very uniformly applicable from infancy to late adolescence. After reaching the maturity stage, teeth continue to undergo changes making age estimation possible among adults.<sup>2</sup> Gustafson method consisted of six factors for estimation of

age. Measurement of root transparency is one of the most reliable of Gustafson's criteria.<sup>3</sup> This criteria of Gustafson is least affected by environmental factors and the pathological process.<sup>3,4,5</sup>

Gustafson's method of age estimation is of valuable importance in forensic sciences and involves numerous criteria and techniques. The accuracy of this formula is still a question of ongoing research; numerous studies in the past were conducted to prove its authenticity. Due to prevalence of large amount of diversity in people of different areas, Gustafson's formula may not be applicable to all individuals in equal magnitude.<sup>6</sup>

## MATERIALS AND METHODS

A total of 50 patients were selected for the study between the age group of 25-80 years who were undergoing extraction in the private clinics. Patient's age and extent of periodontal disease was noted at the time of extraction. Inclusion criteria: patients undergoing extraction because of periodontal disease, orthodontic and prosthetic reasons were included in the study. The ethical

clearance and consent of the patients were taken prior to the study. Patients with medical history, congenital anomalies of teeth, pathologies affected teeth, carious, restored teeth were excluded from the study. The dental parameters studied in each case were; attrition, periodontal disease, cementum apposition, secondary dentine deposition, root translucency and root resorption. Instruments and armamentarium used for the study comprised of electric lathe, carborundum stone (rough and smooth), alcohol, xylene, formalin, microscope and slides. Teeth were sectioned and ground sections were prepared by hand grinding initially with lathe and then with rough carborundum stone until a section of 1 mm were obtained and at this thickness, the root transparency was noted. Grinding was further continued using fine stone until the section of 0.25 mm thickness is left. At the end, dried section was mounted on slide using DPX mounting solution and viewed under microscope for secondary dentine, cementum apposition, and root resorption. Four point score system as per Gustafson's formula.<sup>7</sup>



Figure 1: Armamentarium used



Figure 2: Sections of teeth at various region

**Periodontal Disease (P)** P0—no periodontitis P1—beginning of periodontitis P2—periodontal disease more than 1/3rd of the root P3—periodontal disease more than 2/3rd of the root  
**Secondary Dentin (S)** S0—no secondary dentin formation S1- secondary dentine has begun to form in the upper part of pulp cavity S2-pulp cavity half filled with secondary dentine S3-pulp cavity is nearly or wholly filled with secondary dentine  
**Attrition (A)** A0—no attrition A1—attrition limited to enamel level A2—attrition limited to dentine level A3—attrition reaching pulp  
**Root Transparency (T)** T0-no translucency T1-beginning of translucency T2-translucency extending more than 1/3rd of root apex T3-translucency extending more than 2/3rd of root apex  
**Root Resorption (R)** R0-no root resorption R1-root resorption only at a small isolated spot R2-resorption limited to cementum R3-greater area of root affected  
**Cementum Apposition(C)** C0-normal layer of cementum C1-thickness of cementum more than normal C2-greater layer of cementum C3-heavy layer of cementum

## RESULTS

The study sample of 50 teeth was divided into four groups according to age (Table 1). All six age related changes were evaluated and given scores. Total score was plotted against actual age and a regression line was obtained from which a regression formula was obtained-  $Y = 4.59X + 11.57$  (X- total score, Y- Estimated age). With the obtained total score, age estimation was done with Gustafson's formula  $Y = 4.56X + 11.43$  (X- total score, Y- Estimated age), Maples formula  $Y = 4.26X + 13.45$  and a regression formula was obtained-  $Y = 4.59X + 11.57$  (X- total score, Y- Estimated age) (Table 2). In age estimation a mean error of  $4.32 \pm 2.80$  yrs with Gustafson's formula,  $3.84 \pm 2.65$  yrs with maples formula and  $3.98 \pm 2.65$  yr with newly derived formula was obtained. By using Anova test the estimated ages were found to be significant.

Table 1: Distribution of sample according to actual age of the subject (percentage)

Actual age	Number	Percentage
25-30	5	10
31-40	5	10
41-50	15	30
51-60	14	28
> 60	11	22
<b>TOTAL</b>	<b>50</b>	<b>100</b>

**Comparison of estimated age using different formula;**

**Gustafson formula**  $Y = 4.56X + 11.43$  (X- total score, Y- Estimated age)

**Maples formula**  $Y = 4.26X + 13.45$  (X- total score, Y- Estimated age)

**New formula**  $Y = 4.59X + 11.57$  (X- total score, Y- Estimated age)

**Table 2:** Comparison of estimated age based on different formula

Formula	Mean	SD	N	P
Gustafson formula	53.13	7.92	50	.864
Maples formula	52.95	7.86	50	Non-Significant
New formula	53.76	8.95	50	

**DISCUSSION**

Age estimation and sex determination of the victim or remains are the important factors in the identification of an individual in forensic medicine. Among all available remains, teeth are among the most reliable tools in the process of age identification. Teeth forms one of the most durable parts of our body, which can withstand more assaults and injuries than any other part of the body. This is feature and qualities of the teeth are particularly useful in the identification of bodies in mass disasters and natural calamities.<sup>8</sup>

Naturally occurring changes with time or with environmental effect were given score and used to estimate age using linear regression formula and age was estimated with a mean error of  $\pm 3.98$  in contrary to Gustafson's 3.63. In the present study with Maples formula mean error of age is  $\pm 3.84$  while with Gustafson's formula it is  $\pm 4.32$  yrs The mean error of present study is less than, Bajpai's (2011) 4.86 but greater than results found in some previous studies.<sup>9,10</sup> Therefore, estimation of dental age can be divided broadly into two phases in life. First phase involves the time when teeth are developing in jaws up to 20 years. Later on, when all teeth are fully formed and regressive age-related changes might be used as a forensic method. All the studies regarding age estimation shows lots of epidemiological fluctuations. These errors can be multifactorial including differences arising in epidemiological data, demographic detail, various oral habits and hygiene, sample size selection and lack of specificity of evaluation. Approximate and exact age estimation requires following of strict principles and standardizations.

**CONCLUSION**

From the present study, we can conclude that age estimation by Gustafson's formula shows a great variation from the real age when compared to

Maples formula and newly derived age estimation formula. Hence applicability of Gustafson's formula in age estimation in our study group is not relevant. Further studies with larger sample group and more precise specifications is required for more efficient and detailed results.

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