Reliability of dental root translucency in age estimation among adults aged between 25 to 60 Years – An autopsy study

SantoshSheelavant, Dr.Manjula Patil[1]

Department of Forensic Medicine, [1]Department of Anatomy,

S. N Medical College, Bagalkot, Karnataka, India.

Abstract

Introduction: Age is one of the essential factors in establishing the identity. Teeth being the strongest parts in human body and very resistant to external influences they are available for examination in all eventualities. At no time of life, an individual's tooth unit is static. They are many physiological changes which are appreciable with increasing age.Among them dental root translucency in age estimation is found to be of more help by researchers. This study was carried out to determine the reliability of the dental root translucency in estimating the age of an individual.

Material and methods: Maxillary first premolar tooth was extracted from the bodies subjected for medico legal autopsy at the Department of Forensic Medicine, S N Medical College, Bagalkot, after taking consent from the person in lawful possession of the body. A totalof 40 cases were studied in the age group of 25- 60 years. Authentic document of date of birth collected from legal heirs. Dental root translucency noted and scored according to Gustafson's method**.**

Rsults: The dental root translucency is a significant factor that can be used to estimate age ($P<0.001$, $R2 =76.5\%$). Regression formulawas derived from the graph obtained by plotting Dental root factor against actual age. Age estimation from dental root translucency gave the deviation, i.e. ±5.17 years which is least. Thus root translucency can estimate the age with near accuracy.

Conclusion: Dental root translucency is the best parameter to estimate the age based upon physiological changes in teeth with least deviation when age estimation done using single parameter.

Key words: Age estimation, Gustafson's method, Dental root translucency

Address for Correspondence

Dr.ManjulaPatil,Assistant ProfessorDepartment Of Anatomy
S. N Medical College, Bagalkot-587102
Email: drmanjulapatil@gmail.com

Introduction

Identification is the establishment of the individuality of a person and age is one ofthe essential factors in establishing the identity.

Over the years researchers haveestimated the age by various methods by collectively relying on the physical changes,secondary sexual characters, radiological examination of ossification centers and also for eruption of temporary and permanent teeth notonly in dead but also in living individuals whose chronological age is under dispute andthey have been successful in ascertaining the age quite accurately up to age 25 years. Howeverfor estimation of age beyond 25 years it has proved difficult [1].

Teeth in many ways form a unique part of human body as they are most durable andresilient part of the skeleton [2]and are veryresistant to external influences like putrefaction, fire, explosions, and chemicals etc.,which make them available for examination in all eventualities [3]. Teeth apart from its role as a partial identification feature by virtue of its peculiarities andcomparable data of dental procedures, is also an ideal source for the estimation of thechronological age. At no time during life of an individual tooth unit is static. It is constantly undergoingchanges of one sort or another e.g. eruption, tilting or even lateral movement through jaw.Other changes whichare appreciable with increasing age are attrition, periodontal disease, deposition ofsecondary dentine, root translucency, cementum apposition, root resorption, colorchanges and increase in root roughness. By taking into consideration these secondarychanges in teeth with advancing age, various studies were done to estimate the age of anindividual.

Gustafson (1950) was first to note the morphological changes in the structure of teeth.

These changes are:

Attrition - the gradual wear of the enamel on the occlusal surface, **Periodontosis**– retraction of gum margins and loosening of teeth, **Secondary dentine deposition** - age related build up of dentine on the walls of the pulpal chamber, **Cementum apposition** - continuous repositioning of the tooth in the alveolar bone, **Root translucency** - the tendency of root dentine in thick section to appear to betransparent in the transmitted light from the apex upwards, **Root resorption**- the gradual resorption of the root apex (appreciable microscopically)(Figure 1).[4]

Figure 1: Six physiological changes in teeth (Oberved by Gusthafson ,1950)

Among the 6 parameters of physiological changes in teeth, dental root translucency found to be of more help in many previously conducted studies.

In developing countries like India large numbers of people are illiterate and have noknowledge of their date of birth, which is required by law enforcing agencies as proof ofage in civil, criminal issues, for awarding compensation.

Hence this study is taken up to estimate the age from dental root translucency (Gustafson method) and to compare it with the actual age of deceased person asascertained by birth date records and note the difference between estimated age andactual age, so as to develop a reliable data for estimation of age in individuals whosebirth records are unavailable.

Material and Methods

Maxillary first premolar teeth were extracted from the bodies subjected for

medico legal autopsy at the Department of Forensic Medicine, S N Medical College,Bagalkot, after taking consent from the person in lawful possession of the body. A totalof 40 cases were studied in the age group of 25- 60 years, which were grouped as under -**Group I : 25 - 30 years, Group II : 31 - 35 years, Group III : 36 - 40 years,Group IV : 41 - 45 years,Group V : 46 - 50 years,Group VI : 51 - 55 years,Group VII : 56 - 60 years.**

Method of collection of data:
Certified document of date of birth viz, birth certificate/ marks card/driving license as a proof of actual age was collected from relatives.

Inclusion criteria:
1. Randomly selected cases between 25 to 60 years age group with thedocument certifying the actual age.
2. Maxillary first premolar tooth were taken for the study. (right or left)

Exclusion criteria:
1. Tooth with caries and fillings observed during the process of extraction orduring ground sectioning.

Method:
In our study first premolars were only considered as they gave strongest coefficient[3, 5].
Thenthe tooth was extracted with extraction forceps and preserved in formalin for a period of15 – 17 days 26 then the ground section was prepared.

Preparation of the ground section:
Tooth were sectioned into two halves using high speed metal grinder (2600 rps) ,and thengrinding was done manually with rough carborundum stone till a thickness of 1 mm, atthis thickness, the root translucency was noted(Figure 2). According to degree of structural change, each changewas ranked arbitrarily and scored as 0, 1, 2 and 3. 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.(Figure 3)[4].
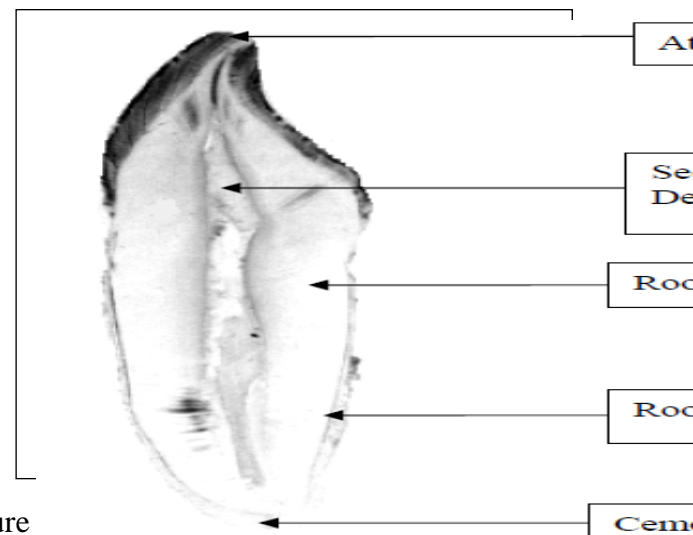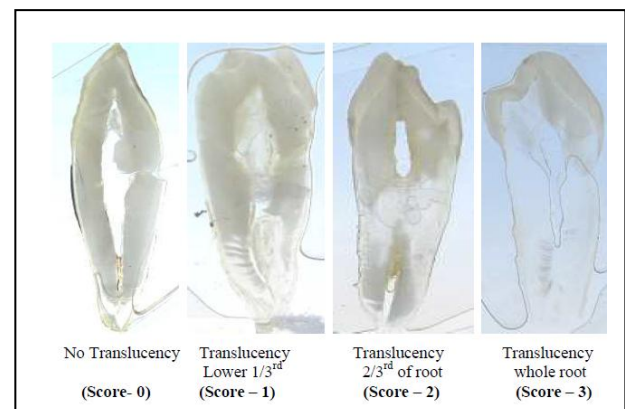

Figure teeth

Figure 2: Grading of dental root translucency   Figure 3: Dental root translucency

Results:

Table 1: Distribution of cases according to age

Group	Age Group
I	25 – 30
II	31 – 35
III	36 – 40
IV	41 – 45
V	46 – 50
VI	51 – 55
VII	56 – 60
	TOTAL

Table 1 shows that, a total of 40 cases were studied with age ranging between 25 – 60 years and divided into7 groups at 5 years interval

Table 2 : Calculated age using age regression equation derived by scoring root translucency (RT) Formula: (y= 14.67x+20.25)

Sl. No	Actual age	RT score	Estimated age	Difference	No. of Cases
1	35	1	34.90	0.10	
2	32	1	34.90	-2.90	
3	27	1	34.90	-7.90	
4	37	1	34.90	2.10	
5	60	3	64.30	-4.30	
6	44	1	34.90	9.10	
7	56	2	49.60	6.40	
8	38	1	34.90	3.10	
9	35	1	34.90	0.10	
10	55	2	49.60	5.40	
11	26	1	34.90	-8.90	
12	32	1	34.90	-2.90	
13	33	1	34.90	-1.90	6
14	29	1	34.90	-5.90	
15	59	3	64.30	-5.30	11
16	40	1	34.90	5.10	
17	49	2	49.60	-0.60	
18	31	1	34.90	-3.90	7
19	45	1	34.90	10.10	
20	51	2	49.60	1.40	
21	32	1	34.90	-2.90	4
22	36	1	34.90	1.10	
23	25	1	34.90	-9.90	2
24	38	1	34.90	3.10	
25	55	2	49.60	5.40	
26	40	1	34.90	5.10	6
27	55	2	49.60	5.40	
28	38	1	34.90	3.10	4
29	33	1	34.90	-1.90	
30	52	2	49.60	2.40	
31	29	1	34.90	-5.90	40
32	34	1	34.90	-0.90	
33	31	1	34.90	-3.90	
34	8	1	34.90	-6.90	
35	60	3	64.30	-4.30	
36	42	1	34.90	7.10	
37	48	2	49.60	-1.60	
38	32	1	34.90	-2.90	
39	42	1	34.90	7.10	
40	53	2	49.60	3.40	

Table 2 shows that, the parameter Root Translucency is a significant factor that can be used to estimate age($P<0.001$, R^2 =76.5%). Higher R^2 value indicates that this parameter can give better estimate of the actual age. These findings are similar to Bang and Ram, where a mean error of estimationof ± 4.7 years in 58% cases and ± 10 years in 79% of subjects. [6]

Table 3: Maximum and minimum deviation in the estimated age using dental root translucency

Parameter	Minimum deviation	
Dental root translucency	0.10	

Table 3 shows, Minimum deviation of 0.10 and maximum deviation of 10.10 which indicates that the dental root translucency is significant factor in age estimation.

Table 4: Comparison of actual age with calculated age by dental root translucency

Parameter	Actual age (Mean ±SD)	Estimated age (Mean ±SD)	Mean difference	T value	P value
Root translucency	40.42 ±10.53	40.41 ±9.229	0.012	0.006	0.996

Table 4 shows, that there is mean difference between actual age and the calculated age is only 0.012 (P value 0.996)

Discussion

Gustafson (1950) was first to note the morphological changes in the structure of teeth.

These changes are:

Attrition - the gradual wear of the enamel on the occlusal surface, **Periodontosis**– retraction of gum margins and loosening of teeth, **Secondary dentine deposition** - age related build up of dentine on the walls of the pulpal chamber, **Cementum apposition** - continuous repositioning of the tooth in the alveolar bone, **Root translucency** - the tendency of root dentine in thick section to appear to betransparent in the transmitted light from the apex upwards, **Root resorption**- the gradual resorption of the root apex (appreciable microscopically)[4].

Gustafson awarded a scores of 0-3 based upon visual severity of changes and estimated

age and calculated age using the regression formula derived from his observation: $Y = 3.52 X + 8.88$ (X = Total Score and Y = Estimated Age) and established that the difference between calculated age and actual age would not exceed ±3.63 years in 33% of cases, ± 7.3 years in 4.5%cases, ±9.1 years in 1% of cases and ±10.9 years in 0.3% cases[7].

The use of dentine translucency alone for estimating age and significant increase in roottranslucency with age was reported. Root dentine starts to become translucent duringthird decade of life beginning at the apex and advancing coronally. For age estimation,translucency length (mm) or area (in mm2) may be measured either manually or bycomputer image analysis. Length of translucency has greater co-relation with age, forwhich two equations were given: Age = $B0+B1X+B2X2$ for zones of translucency <9mmand Age= $B0+B1X$ for zones >9mm, where B is regression constant, B1 and B2 areregression efficient and X is translucency length. They found a mean error ofestimation of ± 4.7 years in 58% cases and ± 10 years in 79% of subjects[2,8].

A total of 210 teeth ranging between 25 to 60 years including 185 males and 25 femaleswere studied. By using 0.5 – 1 mm section of tooth, determined root translucency was found 0.344 (p < 0.001)[6].

A technique to study single rooted tooth is based on measurement of two dental features:periodontosis height times 100/root height (P) and Transparency of the root height times

100/ root height (T). Their sample consisted of 135 males, 73 females, 198 whites and 10blacks. The sample ranged from 22 years to 90 years. By using formula (A =0.18 x P +0.42 x T + 25.53, where A =Age in years, P = Periodontosis X 100/root height and T=Translucency

height X 100/root height), were able to calculate the age at death with an error between the actual age and calculated age, of ± 10 years on their working sampleand ±8 years on a forensic control sample[9,10].

In our study the parameter Root Translucency is a significant factor that can be used to estimate age (P<0.001, R^2 =76.5%). Higher R^2 value indicates that this parameter can give betterestimate of the actual age. These findings are similar to Bang and Ram, where a mean error of estimation of ± 4.7 years in 58% cases and± 10 years in 79% of subjects[6].

Conclusions:

Dental root translucency was observed in 40 cases. Regression formulawas derived from the graph obtained by plotting Dental root factor against actual age.Age estimation from dental root translucency gave the deviation, i.e. ±5.17 years which is least. Thus root translucency can estimate the age with near accuracy.

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