ORIGINAL RESEARCH

Effect of Vitality on Translucent Dentine – A Study

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ABSTRACT

Background: Sclerosis of dentinal tubules may be a response to pathological or physiological insult in the crown & root. The mechanism by which apical translucency is produced is still uncertain. The increase in size of the apical zone of sclerotic dentin in human teeth has been used often in forensic science as a method of age estimation. However, only few studies have been done to compare percentage of translucency between vital and non-vital teeth. Conflicting concepts exist regarding the amount of translucent dentin in the vital & non vital teeth and correlation of this variation with age of the subject.

Aims: To investigate the amount and distribution of apical translucent dentin in group-matched vital and non-vital teeth.

Materials and Methods: Study was conducted on 70 extracted teeth, which were subjected for vitality test before extraction, and divided into two groups (vital & non-vital teeth) with a minimum of 35 teeth in each group. Ground sections of 150µ thickness were observed under Stereomicroscope and photographed. The distribution of area and length was measured on the images captured, using PROPLUS IMAGE ANALYSIS SOFTWARE version 4.1.0.0 software.

Results and Conclusions: The present study revealed significant differences ($p<0.05$) in apical translucency of dentin, when both vital and non-vital teeth types were compared. There was more apical translucency present in non-vital when compared with vital teeth at any given age.

Keywords: Apical translucency; vital teeth; non-vital teeth.

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Introduction

Aging manifests as cumulative changes in various tissues, including dental hard tissue. One such aging related changes is the formation of physiologic translucent dentin (sclerotic dentin). Quantifying this form of dentin can be used in age estimation. Sclerosis of dentin tubules may be a response to pathological or physiological insult. Knowledge of the development and distribution of

sclerotic dentin which produces translucency in root dentin is still incomplete.

The theories proposed to explain the cause and mechanism of sclerotic dentin formation are not universally accepted but, it is generally agreed that sclerotic areas of root dentin increases in size with age. In case of caries, attrition, abrasion, and cavity preparation, sufficient stimuli are generated to cause collagen fibers and apatite crystals to begin appearing in the dentinal tubules. Apatite crystals are initially only sporadic in a dentinal tubule but gradually the tubules becomes filled with a fine meshwork of crystals[1]. While transparent dentin may be related to aging when associated with the dentinal tubules close to root apex. The alteration is believed to be caused by a reduction of the diameter of the dentinal tubules caused by intratubular calcification. Thereby the difference in refractive indices between intra tubular and extra tubular materials will be equalized resulting in increasing translucency of the dentin so affected.

Occlusion of tubules may occur in several other ways[2] :

i. Continued deposition of peritubular dentin
ii. Deposition of mineral within the tubule without any dentin formation.
iii. A diffuse mineralization that occurs with a viable odontoblast process still present.
iv. Mineralization of the process itself & tubular contents, including intratubular collagen fibrils.

Various methods have been used for assessing apical translucency and its relation to age. Among the traditional methods for estimating age in adults, the morpho – histological parameters suggested by Gustafson continue to find widespread use. Of the six variables that Gustafson suggested, dentinal translucency is perhaps the easiest to assess and also relatively accurate in age prediction[3]. While Johanson found that translucency was best correlated to age when used alone[4]. But, Conflicting concepts exist regarding the amount of translucent dentin in the vital & non vital teeth and correlation of this variation with age of the subject. Thus, our study aimed at evaluating the amount of translucent dentin present in non-vital teeth in comparison with vital teeth in different age groups thus adding more accurate age determination.

Materials & Methods

The study was conducted at the Department of Oral & Maxillofacial Pathology, College of Dental Sciences, Davangere, Karnataka, India. The sample consisted of permanent posterior teeth (except third molars) with age ranging from 15-65 years. Patient's due for extraction of teeth were identified and were subjected for vitality test before extraction. Demographic data for the teeth collected were recorded. The study sample was divided into two groups, age and type matched vital & non-vital with 35 teeth in each group, were collected from different individuals. All the teeth were fully erupted and were in occlusion.

Inclusion Criteria:

For **vital teeth**, teeth extracted during orthodontic treatment or due to the periodontal disease were included. As Solheim found that the increase in translucent zone with advancing age was not affected by periodontal destruction[5].

For non-vital teeth, Premolars and Molars extracted for treatment of periapical lesions were included.

Immediately after extraction the tooth was rinsed in normal saline solution and preserved in 10% neutral formalin till the ground section were prepared. Each tooth was embedded in acrylic and sections of 150µ thickness, was cut longitudinally using a hard tissue microtome (LEICA SP 1600, GERMANY).

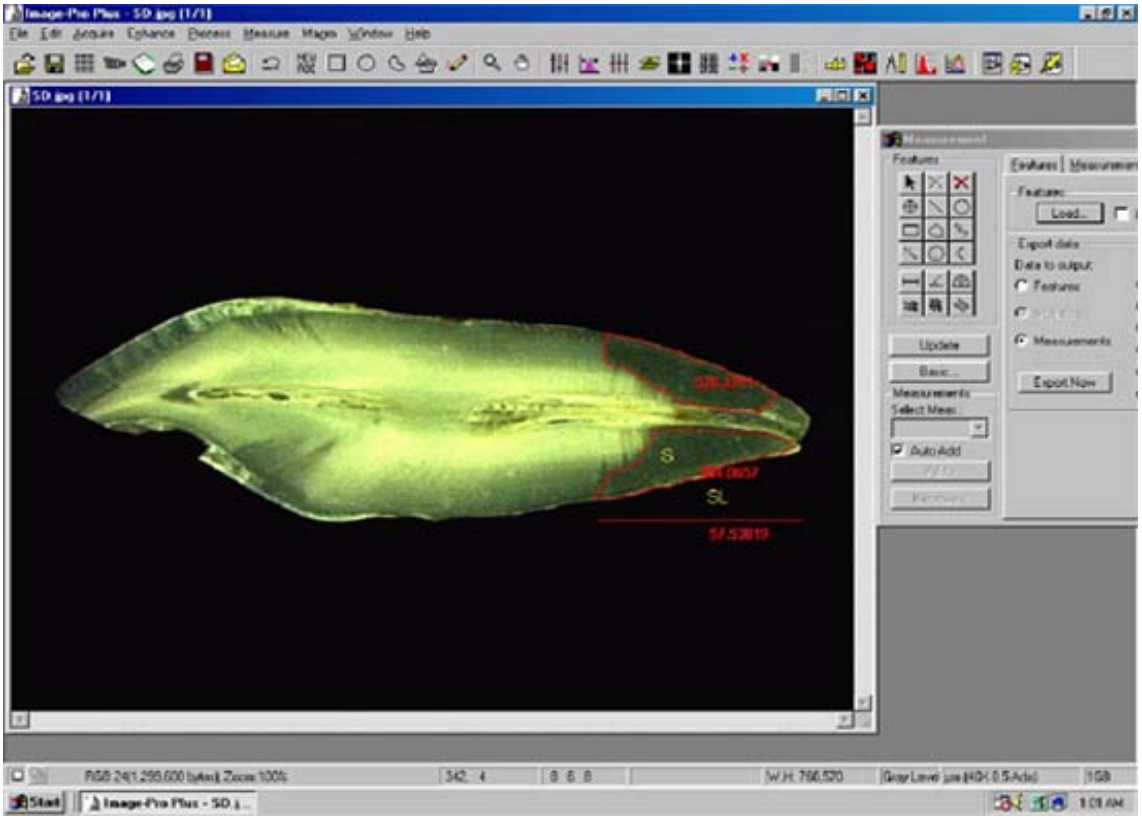

Fig. 1: Stereomicroscope image (5X) of tooth with measurement of Sclerotic Dentin Area (S) and Length of Sclerotic Dentin (SL)

The prepared ground sections were observed under Trinocular research microscope with Stereomicroscope (SZX 12, OLYMPUS, JAPAN) and were photographed using 3 CHIP CCD CAMERA attached to the research computer. The distribution and the area of sclerotic dentin was measured on the images captured, using PROPLUS IMAGE ANALYSIS SOFTWARE version 4.1.0.0 after proper calibration (Fig.1). All the measurements were in millimeter. Observation was limited to the area and length of sclerotic dentin and these was expressed as percentages of total root length and area. Root area did not include the area of cementum, pulp or root filling. Root length was designated as the distance from the apical dentin, perpendicular to a line taken across the cemento - enamel junction and the data from image analysis software was exported to Microsoft excel master chart for further interpretations and data were subjected to statistical analyses with the SPSS version 16.0 statistical software package (SPSS Inc., Chicago, USA). Mann – Whitney test and One way Kruskal – wallis test (or H test) ANOVA was used for simultaneous multiple group comparisons. "p" value of 0.05 or less was considered to be statistically significant.

Results

When the average mean values and standard deviation of length percentage of translucent dentin in vital and non-vital teeth of different ages was compared, non-vital teeth showed significant differences in the amount of translucent dentin present relative to the age of the patients only between the age group of 15 – 34 years, while the age group above 35 years and above showed increases in the length percentage of translucent dentin as age advanced (Table 1 and 3).

The amount of area of translucent dentin also showed an increase with the age in both vital and non-vital teeth. Non-vital teeth presented a

statistically significant increase in the area of translucent dentin as compared to the vital teeth of same age group ($p < 0.05$). In the age group of 35 years and above the length percentage translucent dentin showed a significant increase as age advanced in both age groups (Table2 and 4).

Table 1: Inference in Length Percentage of Translucent Dentin in Vital and Non-Vital Teeth

Age Group (Years)	No. of Cases	Length Percentage (%)				p-value	Inference
		Vital		Non-Vital			
		Mean	Std Deviation	Mean	Std Deviation		
15-24	7	15.71	18.26	39.44	25.14	0.055	S
25-34	7	23.26	9.48	49.16	13.94	0.009	S
35-44	7	46.99	20.72	55.08	11.29	0.482	NS
45-54	7	46.61	9.26	56.82	21.71	0.338	NS
>55	7	51.27	13.61	64.12	12.11	0.12	NS

S – Significant, NS – Not Significant

Table 2: Inference in Area Percentage of Translucent Dentin in Vital and Non-Vital Teeth

Age Group (Years)	No. of Cases	Length Percentage (%)				p-value	Inference
		Vital		Non-Vital			
		Mean	Std Deviation	Mean	Std Deviation		
15-24	7	5.83	6.19	16.44	6.7	0.03	S
25-34	7	12.47	3.69	29.36	6.19	0.002	S
35-44	7	28.8	5.73	37.94	6.4	0.03	S
45-54	7	33.41	9.74	48.06	6.1	0.004	S
>55	7	44.38	7.19	55.48	10.56	0.073	NS

S – Significant, NS – Not Significant

Table 3: Inter Group Inference of Length Percentage of Translucent Dentin in Vital and Non-Vital Teeth

Age Group (Years)	No. of Cases	Length Percentage (%)			
		Vital		Non-Vital	
		Mean	Std Deviation	Mean	Std Deviation
15-24	7	15.71	18.26	39.44	25.14
25-34	7	23.26	9.48	49.16	13.94
35-44	7	46.99	20.72	55.08	11.29
45-54	7	46.61	9.26	56.82	21.71
>55	7	51.27	13.61	64.12	12.11
K-W ANOVA		$x^2=17.19$		$x^2=5.57$	
		$p< 0.01$		$p= 0.23$	

Table 4: Inter Group Inference of Area Percentage of Translucent Dentin in Vital and Non-Vital Teeth					
Age Group (Years)	No. of Cases	Length Percentage (%)			
		Vital		Non-Vital	
		Mean	Std Deviation	Mean	Std Deviation
15-24	7	5.83	6.19	16.44	6.7
25-34	7	12.47	3.69	29.36	6.19
35-44	7	28.8	5.73	37.94	6.4
45-54	7	33.41	9.74	48.06	6.1
>55	7	44.38	7.19	55.48	10.56
K-W ANOVA		x^2=28.06		x^2=28.72	
		p< 0.01		p< 0.01	

Table 5: Length Percentage of Translucent Dentin in Premolar & Molar										
Groups	Vital Teeth				Non-Vital Teeth				p - value	Inference
	Mean	SD	Range		Mean	SD	Range			
			Min	Max			Min	Max		
Premolar	34.1	19.28	0	64.5	50.43	18.78	8.86	86.68	0.002	S
Molar	47.43	22.26	18.57	77.92	62.92	15.78	41.95	87.41	0.2	NS
S – Significant, NS – Not Significant										

Table 6: Area Percentage of Translucent Dentin in Premolar & Molar										
Groups	Vital Teeth				Non-Vital Teeth				p - value	Inference
	Mean	SD	Range		Mean	SD	Range			
			Min	Max			Min	Max		
Premolar	22.49	14.08	0	47.24	34.52	13.84	8.94	56.46	0.003	S
Molar	34.94	18.54	6.22	55.33	49.18	17.68	26.58	70.01	0.16	NS
S – Significant, NS – Not Significant										

Irrespective of the vitality status of the teeth, the mean area and length percentages of translucent dentin in molars were more than premolars. Statistically significant difference was seen between the premolars of both vital and non-vital group in respect to the area and length percentage translucency but was not the case in molars (Table 5 and 6).

Discussion

Age estimation constitutes an important factor in the identification of an individual in forensic odontology.

i. Being used in cases where a dead body or part of body has to be identified
ii. Individual does not reveal his identity,
iii. Legality of child marriage cases.
iv. Even when the subjects have undergone changes so extensive that external

characteristics yield no information, teeth are a means of identification.

The amount of length & area of translucent dentin was shown to increase with age in both vital and non-vital teeth. This finding is similar to the findings of Gustafon, Johansson, Miles, Bang and Ramm study where the amount of translucent dentin increased in both vital and non-vital teeth as the age increase[3,4,6,7].

Non-vital teeth presented a statistically significant area of apical translucent dentin when compared with vital teeth of same age group. Thomas et al[8] indicated that when percentage area of translucent dentin were examined there were significant differences in the amount of translucent dentin present in non vital teeth relative to the age of the patients ($p < 0.05$).

Present study has shown some apical translucency has been found in the youngest age group (16 years) Confirming the findings of Vasilidis et al (found just under 17 years of age), Bang and Ramm (marked translucency of root dentin was seen under 28 years) Thomas GJ et al but not supporting the view of Gustafson study, that apical transparency only starts to appear after the age of 30 years [3,7-9].

Our results suggested that non-vital teeth had greater amount of translucent dentin which conflicts with the findings of Bang and Ramm who observed that the percentage of translucent dentin in non-vital teeth is well below that of vital teeth of corresponding ages[7].

Our results supports the findings of Thomas GJ et al, who suggested that sclerosis is related to the length of the time for which a tooth has been non-vital rather than the chronological age of the tooth. The formation of translucent dentin in non-vital teeth appears to be influenced by factors other than age[8].

We believe that in non-vital teeth the odontoblast would have been lost & thus will not be able to control the rate of mineralization that would take place within the tubules, simultaneously due to inflammatory & repair changes with in non-vital pulp, the pH would be lower leading to availability of free Ca++ & PO_4 ions. This may be deposited on the previously formed intratubular dentin. Thus increasing the total amount of translucent dentin in non-vital teeth in comparison to vital teeth.

Conclusion

The present study revealed non-vital teeth showed a greater amount of translucency in comparison to vital teeth, in both area and length percentages. Study also showed a greater amount of apical translucent dentin in molars in comparison to premolars. As the majority of the molars were 1st Permanent molars with the earliest age of eruption. Thus establishing that the amount of translucent dentin formed depends on age of eruption rather than chronological age.

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