Original Article

Reliability of Enamel Shade as a Method of Chronological Age Estimation: A Study in North Gujarat Population

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Abstract

Background of the Study: Dental hard tissues are highly resistant to degradation and putrefaction. Enamel shade, which usually ranges from light yellow to gray white, is of great significance because of its translucency. The shade of enamel is found to be associated with the chronological age. This may also be influenced by various environmental factors, diet, habits, deficiency states, fluoride level, etc., It also depends on the color of dentine.
Aim: The aim was to evaluate the relation between enamel shade and chronological age.
Materials and Methods: A total of fifty patients were included and divided into various age groups. The enamel color was evaluated using a VITA classical shade guide.
Results: The data were analyzed using SPSS version 12, and highly significant results were obtained. The accuracy of age determination was found to be 73.7%.
Conclusion: Enamel shade can be considered as an adjunct in age range estimation of an individual.

Key Words: *Age estimation, enamel, shade guide*

Introduction

Forensic science works in concert to address criminal justice issues, terrorism, missing person, child abuse, mass disaster scenarios, refugees with disputed birth records, etc.[1-3] Age estimation is an important subspecialty of forensic medicine. Dental hard tissues are resistant to degradation and putrefaction. This makes teeth as useful indicators for the evaluation of age.[2] Tooth color measurement has attracted attention in the field of dentistry in recent years. Several authors have reported that teeth tend to darken with age. Moreover, estimation of the age of a deceased individual can be of great importance in identification.[4]

The enamel, dentin, and cementum of teeth have been used to estimate the chronological age of unidentified individuals.[5] Due to less variability, the morphological characteristics of teeth form the basis of the most commonly used methods of dental age estimation. Teeth can be useful indicator of some past variation in diet or of metabolic diseases and can also be of use for calculation of age at time of death.[1,6] The color of the teeth has been reported to be affected by chronological age because studies have reported to measure the dentine color for age estimation.[2] Dentin thickens[7] and the volume of pulp chamber reduces with age due to continuous dentin deposition.[2] Enamel color may also depend on environmental factors, diet, occupational habits, vitamin deficiencies, and fluoride levels in drinking water.[7]

Time-consuming techniques for age estimation can be replaced if a valid and time-effective alternative is available. The present study was aimed to evaluate the relation between enamel shade and chronological age.

Materials and Methods

A total of fifty individuals were randomly selected from various camps organized at various parts of North Gujarat region by Narsinhbhai Patel Dental College and Hospital, Visnagar. After taking a written consent, the participants were divided into five groups based on age as follows: Group 1: 21–30 years, Group 2: 31–40 years, Group 3: 41–50 years, Group 4: 51–60 years, and Group 5: 61–70 years.

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Exclusion criteria

Endodontically treated teeth; teeth with internal stains; traumatized tooth; teeth with dental caries, fluorosis, and systemic problem; and teeth of those with tobacco chewing, smoking, other occupational habits, and birth trauma were excluded. Bright colors were excluded from the field of view.

The enamel color was evaluated using a VITA classical shade guide [Figure 1]. The arrangement of the shades in the VITA classical family of shades is as follows: A1–A4, B1–B4, C1–C4, and D2–D4. The shade guide is arranged on the basis of hue difference from A to D.

Oral prophylaxis was performed prior to the shade identification procedure. Then, the volunteer was seated on the dental chair (near adequate natural light), and oral findings were recorded. The maxillary central and lateral incisors were used for shade matching, and the teeth were viewed at eye level. The shade guide was held parallel to the selected tooth at an arm's distance, and the middle third of the labial surface of the tooth was matched with the shade guide [Figure 2]. First, the value (lightness) of the color was assessed followed by hue and chroma. Each tooth was observed for 4–5 s. The surroundings were kept free from bright colors. To ensure accuracy, these findings were further evaluated by two observers. By observing the enamel shade found in an individual in a particular age group, a linear regression equation was derived for the calculation of age.

Data were exported to an excel spread sheet, and statistical analysis was performed using SPSS software version 12 (SPSS Version 12, IBM Inc, Chicago, USA). Linear regression analysis was used to find correlation between age and enamel shade.

Results

The observations were tabulated. B2 was the most common shade in young and middle-aged individuals, A3 was the most common shade in old individuals, and C3 was the most common shade in the elderly with $P = 0.000$, which was highly significant. The results of the present study showed that the tooth becomes darker and opaque with increasing age.

Discussion

Color alteration of teeth, due to wear and degeneration of hard tissue, is a unique indicator of aging over time. The main goal of forensic dentistry is to provide information about the possible cause, time, and place of death. Forensic dentist's opinion is very important for judicial audience in any crime or mass disaster scenarios.[3]

The main objective of this study was to understand the reliability of enamel shade to evaluate the age of an individual. Estimation of age of the individual by using tooth color by comparison with a dental shade guide has been used by few forensic odontologists because changes in color with aging have been described. Visual shade matching is a method, in which a color standard from a commercially available dental shade guide is compared to and matched with the target tooth. We preferred visual shade matching over spectrophotometer and digital techniques because of its easy availability and cost-effectiveness.

The present study shows that A1 and B2 were found to be the most common (30%) in the age group of 21–30 years [Table 1], while Vaidya *et al*. found A2 to be the most common (52%) in the age group of 15–25 years. Sigh *et al*. in their study found that in the age group of 15–36 years, the shades A2 and B2 (reddish hue) were found to be most common.

The present study shows B2 to be the most common shade in the age group of 31–40 years (40%) and 41–50 years (50%). A3 and C3 (50%) were common in the age group of 51–60 and 61–70 years, respectively. Vaidya *et al*. found A2 to be the most common (73%) in the age group of 26–36 years and A3 (90%), B3 (96%), and C3 (100%) in the age groups of 37–47, 48–58, and 59–69 years, respectively.

Table 1: Correlation of the various shades

Group	Age (years)	Shades observed	Common shade	Frequency (%)
Group 1	20-30	A1, A2, B1, B2, C1, and D2	B2	30
Group 2	30-40	A1, A2, A3, and B2	B2	40
Group 3	40-50	A2, A3, A4, B2, and B3	B2	50
Group 4	50-60	A3, B3, and C2	A3	50
Group 5	60-70	A3, A3.5, C3, C4, and D3	C3	50
χ^2			92.83	P<0.000**

Figure 1: Shade matching

Figure 2: Vita Shade Guide

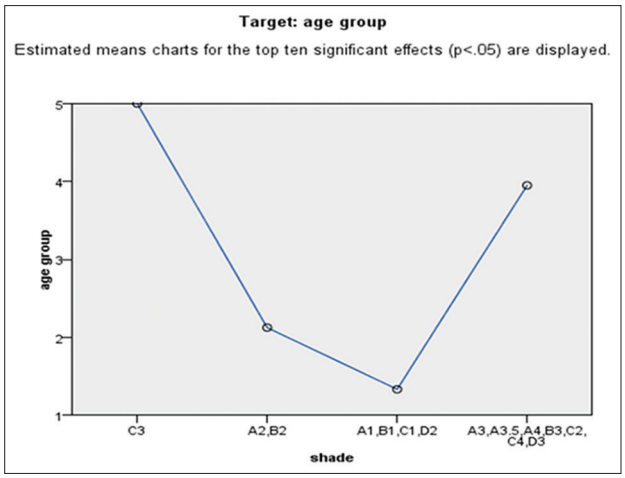

Figure 3: Graph showing the estimated means

Sigh *et al*. noted that in the age group of 37–58 years, shades ranged from A3 to B3 (brownish to yellowish hue); in patients above 59 years of age, the enamel shade with grayish hue was found to be most common. According to Metgud *et al*., for 15–36 years' age group, the common shade was B1 (yellowish hue), for 37–58 years, the frequent shade was B2 (yellowish hue), and for patients above 59 years, C2 (grayish hue) was the common shade.

The Munsell Color system is recommended for shade matching, which is based on the three dimensions of color: the hue, value, and chroma. The results obtained in this study are in agreement with previously published results. Color grades of dark or very dark yellow and brown were significantly associated with an average age of more than 55 years.

The present study with various age groups against most common shade noted in that group, which was statistically highly significant with $P < 0.000$ [Figure 3].

Sigh *et al*. and Vaidya *et al*. found that there was no statistically significant difference observed in the color of enamel in males and females ($P < 0.05$) in any of the age groups.[2,3] Visual shade selection varies, depending on the clinician's color perception and experience, ambient light condition, background of the tooth, and the shade guide used. Hence, this could be one of the limitations of the present study.

Conclusion

In this preliminary study, the color of the enamel served as a significant method for age estimation as a cost-effective and time-saving procedure. Studies on large scale are required to improvise similar methods for age estimation, as the shade of the tooth is dependent on the thickness of dentin, enamel, and size of the pulp chamber.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest

References

1. Metgud R, Naik P, Naik S. Enamel shade: A bright future in age estimation. J Forensic Res 2015;6:1-4.
2. Sigh V, Shethi P, Saluja R, Singh D. Role of enamel color in age estimation using a dental shade guide: A study in the Tricity region of Chandigarh, Mohali and Panchkula. J Punjab Acad Forensic Med Toxicol 2010;10:76-78.
3. Vaidya S, Ahuja N, Bajaj P, Kapoor C, Sabarwal R, Rajpal K. Objective measurement of shade color in age estimation. J Forensic Dent Sci 2015;7:171-4.
4. Martin S, Valenzuelaa A, Bellinia R, Salasb C, Rubino M, Garcia IA. Manual of Forensic Odontology. Forensic Sci Int 2003;132:57-62.
5. Someda H, Saka H, Matsunaga S, Ide Y, Nakahara K, Hirata S, *et al*. Age estimation based on three-dimensional measurement of mandibular central incisors in Japanese. Forensic Sci Int 2009;185:110-4.
6. Brkic H, Milicevic M, Petrovecki M. Age estimation methods using anthropological parameters on human teeth-(A0736). Forensic Sci Int 2006;162:13-6.
7. Nancy A. Ten Cate's Oral Histology, Development, Structure, and Function, Enamel. 8th Ed. Elsevier: Mosby Publications; 2013.