Correlation of Tooth Shade with Age and Gender: Promising Applications in Aesthetic and Forensic Dentistry

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Introduction

Forensic examination as a means of personal identification has been a part of human civilization and society ever since. It also carries medicolegal importance in terms of the determination of the individuality of a person which may be complete or partial[1,2]. One of the most important aspects has been the age and sex estimation of an individual which is a vital aspect of the identification process, even more, when done retrospectively for deceased individuals. An accurate method of age and sex estimation is important for forensic investigators dealing with unknown bodies, parts of bodies or skeletons[3,4].

A dental examination may contribute to a person's identification as it consists of hard tissues which are most resistant to environmental changes such as temperature, diet and nutrition. The colour of the teeth has been observed to be variable with many internal and external factors contributing to the colour of the teeth. The tooth colour and shade are an outcome of multiple factors such as enamel and dentin thickness, pulp tissue vascularity and fibrosis and age-related changes in dental hard and soft tissues, extrinsic factors such as smoking and chewing tobacco and developmental defects such as amelogenesis imperfecta and dentinogenesis imperfecta[4]. It has been observed that variation in tooth colour and shade is seen where medium to darker facial skin complexion were more likely to have teeth with a higher tooth shade value (lighter shades) whereas individuals with a fair or lighter skin complexion tend to have teeth with a lower tooth shade value (darker shades) regardless of their age or gender[5].

With the physiological process of secondary dentin deposition and reduced vascularity of pulp tissue with ageing, the teeth become darker with a lower tooth shade value (decrease in lightness and increase in yellowness) and less translucent, hence for restorative procedures, a lighter shade of teeth is recommended in younger individuals and darker shades for geriatric patients. Previous studies have shown that tooth shade has variation when compared within genders, where it has been observed that females have lighter shades than those who have comparatively darker tooth shades[5–7]. Dental hard tissues have also been useful indicators of a person's age in the past with the advantage of being less variability and morphological stability in tooth colour over a longer duration[8].

The present study was designed to evaluate the utility of tooth colour and shade in age and sex determination and its correlation with the chronological age and sex of an individual in the North Indian population.

Materials and Methods

The study samples included 70 subjects in different age groups after taking written informed consent from all subjects (consent was taken from guardians in case of minors). Subjects with natural intact permanent incisors and molar teeth were included where no dental treatment

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on the same had been done previously. Participants with restorations, oligodontia and developmental anomalies affecting the teeth were excluded from the study.

The shade of the middle third of the labial/buccal surface of the permanent maxillary left or right central incisor and mandibular first molars was recorded using the Vitapan 3DMaster shade guide (Vita Zahnfabrik H, Rauter Gmb Germany) for anterior and posterior teeth respectively. To avoid observation errors, all the shades were recorded by a single operator to avoid inter-observer variability. Subjects were asked to rinse their mouth with water before recording avoided dehydration and colour-related errors. To avoid visual errors, views at eye level were taken and readings were taken within 5-6 seconds. Not more than 3 subjects were observed in a day to avoid fatigue. Natural daylight was used, preferably between 10:00 am and 12:00 noon. To avoid, distance-related errors, readings were made at arm's length in all cases. The observations were recorded in an excel sheet and statistically analysed using SPSS software (v.19 IBM Inc. USA).

Results

The mean age of the study samples was 37.2±16.84 years (range 10-77 years). Statistically significant correlations were obtained with anterior tooth colour, posterior tooth colour with age and anterior tooth colour with posterior tooth colour. The maximum correlation was obtained when both anterior and posterior teeth were included for comparisons (0.576, p<0.p05) as compared to only when either anterior or posterior tooth colour was included (0.026, p> 0.05). No significant correlation was observed between age, anterior tooth colour and posterior tooth colour with the gender of study groups. However, C1(28.6%) shade was most common and A1, A2 and D3 (1.4%) were least common in anterior teeth whereas B2 (27.1%) shade was most common and C4 and A4 (1.4%) were least common in posterior teeth. B2 (29.3%) shade was most common in males and C1 (34.5%) in females in anterior teeth. B2 (29.3%) shade was most common in males and B1 (31.%) in females in anterior teeth. The regression equation for age estimation using anterior and posterior tooth colour was calculated as Age = 1.460-0.004x-0.001y (where x is the anterior tooth shade value and y is the posterior tooth shade value).

Discussion

This study demonstrated the influence of factors, especially in completely edentulous patients with no pre-extraction records which present a unique challenge to dentists. The dentist has to completely rely on clinical judgment, together with the esthetic preferences of the patient and the shade of the available artificial teeth. However, all the available factors are subjective and need to be tempered with an objective evidence-based technique for age-related changes in shade selection. Factors such as age and gender on tooth colour determination are very important and have been correlated and presented in our study as well.

Our results have shown a positive correlation between anterior and posterior teeth shade with respect to age changes which means to connect the change in the shade of teeth in dentition with progressing age no matter whether it is anterior or posterior. The results of the present study have various clinical applications. Age and gender determination through teeth shade can be made useful in forensic odontology as it already considers concepts for age estimation. It can serve as a useful and simple objective tool in age and gender determination in cases with post-mortem records. Therefore, the present study was designed to establish a relationship between the shade values of teeth and with age and gender of subjects of different age groups.

The results of our study show that tooth colour can be used as an objective tool for age determination which was statistically significant showing that variation in age can cause a change in tooth shade which is more yellow or dull in the case of higher age groups than that seen in age groups below 40. This is possibly due to secondary dentin deposition as well as thinning of enamel owing to wear and ageing processes. The difference in teeth shade, however, was not significantly altered with gender in our study groups. Similar observations were made in a study by Vaidya et al.[10] However, Esan et al., (2006)[11] and Rekha et al., (2016)[12] have shown that gender is significantly associated with tooth shades, in that men are more likely to present with darker tooth shades whereas women of the same age group were more likely to show lighter tooth shades[11,12].

Visual shade matching was used in the present study which is common, cost-effective and widely used in Indian subcontinent. Although more authentic devices like colour scanners, spectrophotometers, and photoelectric

Table 1. Correlation of age, gender, anterior and posterior tooth colour in study groups

	Age	Anterior Tooth colour	Posterior Tooth colour	Gender
Age	1	.505**	.432**	0.049
Anterior Tooth color	.505**	1	.338**	-0.025
Posterior Tooth color	.432**	.338**	1	-0.014
Gender	0.049	-0.025	-0.014	1

Table 2. Correlation of Anterior and Posterior tooth color with age in study groups

	Correlation Coefficient	p-value
Both Anterior and Posterior Tooth Color	0.576	0.00**
Anterior or Posterior Tooth Color	0.026	0.97

colourimeters can also be utilized which are more objective methods to detect colour and shade. Keeping in mind the limitations of the visual method of tooth colour observations, precautions and standardisation methods were used to avoid subjective and procedural errors[9].

Conclusion

The results of the present study suggest that tooth shade varies with age and should be taken into consideration while choosing materials for restorative and prosthetic purposes. Variation in the shade of both anterior and posterior teeth could also be a useful tool in age and gender determination with significant forensic applications. Further studies comparing various objective methods of shade determination with a wider sample size could be studied to enhance its applicability in forensic odontology.

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