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Research article

Relationship between Tooth Colour, Skin Colour and Age: An Observational Study in Patients at the Ibadan Dental School

Dosumu Oluwole O and Dosumu Elizabeth B

¹*Department of Restorative Dentistry, College of Medicine, University of Ibadan, Ibadan, Nigeria*

²*Department of Periodontology and Community Dentistry, College of Medicine, University of Ibadan*

ABSTRACT: There is presently limited scientific knowledge in the literature about the relationship between tooth and skin colour and ability to provide fully edentulous patients with their natural tooth color on their complete dentures has always been a problem for clinicians. This observational study was carried out to investigate the possibility of using facial skin colour, gender or age as a guide for selection of teeth for prosthetic replacement of missing teeth in fully edentulous patients. A total number of 127 patients aged 18-60 years participated in this study. The Vita-Lumin and Cosmopolitan shade guides were used to select the color of the incisal third of both maxillary central incisors while facial skin colour selection was done using the L'Oreal True Illusion make up guide. No significant association was found between tooth shade and skin colour nor between tooth shade and gender ($P > .05$). It was however observed that facial skin colour related to gender and tooth shade related to age significantly ($P < .05$). About 19% of the total participants in this study had lighter (L1) tooth shade than those in the existing stock shade guides. Within the limitations of this study, it may be concluded that facial skin colour does not significantly correlate with tooth color and may not be a reliable guide for artificial tooth color selection. Manufacturers should include lighter shades on the shade guides and acrylic teeth. The selection of artificial teeth should be a matter of individual judgment.

Key words:

INTRODUCTION

Prosthodontists have always been faced with the challenge of harmonising tooth shade with facial appearance in fully edentulous patients. They suggest that the colour of the teeth must harmonise with the

surrounding environment such as skin, hair, eye colour and age all with the aim of enhancing facial appearance. It is also suggested that the hue of artificial teeth should harmonize with the patient's complexion (Boucher *et al*, 1975; Winkler, 1979); Bates *et al*, 1991). These authors also advocated the use of the colour of the facial skin as one basic guide in selecting colour for artificial teeth in Caucasians. The knowledge of human tooth colour and its distribution are very important to the understanding of matching in aesthetic dentistry (O'Brien *et al* 1997). He also reported statistically significant colour difference between the gingival to the incisal regions of teeth and that these differences are clinically significant. The illusion of greater contrast between skin colour and tooth shade explains the perception among prosthodontists and restorative dentists that individuals with darker skin colours have lighter shades of teeth (Richardson, 2001).

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*Address for correspondence: Tel.: +2348055203924

E-mail address: dr.dosumu@perfectdentservices.com

Size, shape, colour and arrangement of the teeth are very important as portrayed by biographers, novelists, poets, playwrights, essayists and journalists. They have included descriptions of teeth in portraying the facial appearance of their characters as aesthetically pleasing or less so. Richardson (2001) in his extracts from literary archives on the role of teeth on facial feature reported Anthony Trollope's description of beautiful teeth as those that are white as pearls while Harold Action's opinion of ugly teeth as arrays of black lacquered teeth which disfigures an otherwise beautiful face. Tooth colour has considerable influence on aesthetics and it is important for satisfactory social rehabilitation of denture wearers (Jahangairi *et al* 2002; Millar *et al*, 1993)

As a result of these, many edentulous adult patients request for white teeth in their denture prosthetic irrespective of the colour of the missing teeth and facial harmony (NCADP, 1977). This patient demand should be considered and discussed with them and if not convinced, their opinion should be respected in accordance with the aesthetic wishes and ideas of the patient (Devigus and Lombardi, 2004).

The selection of artificial teeth colour can be very tasking and denture aesthesis has been defined as "the cosmetic effect produced by a dental prosthesis which affects the desirable beauty, attractiveness, character and dignity of the individual (Otuyemi *et al* (1998).

Dento-facial relationship also contributes to the dental aesthetics of an individual and Africans' perception of dental aesthetics is generally based on stereotypes as they usually regard midline diastema as a sign of beauty (Kerosuo *et al*, 1988; Abu-Affan and Wisth, 1990, Otuyemi and Abidoeye, 1993; Diagne *et al*, 1993).

The commonest cause of tooth loss is periodontal disease (MacGregor, 1972; Okoisor and Ana, 1976; Okoisor, 1977; Ana and Kumar, 1988; Aderinokun and Dosumu, 1997; Dosumu *et al*, 2003) and hence pre-exfoliation record of the colour of these missing teeth is not usually available as a guide in colour selection of artificial teeth to replace those lost. The present study was designed to explore the relationship between tooth Colour, skin colour and age in patients attending dental clinic.

MATERIAL AND METHOD

Patient selection was carried out in the Oral Diagnosis Clinic of the University College Hospital (UCH) Dental Center, Ibadan, where first general consultation is done. The clinic is run on a daily basis from Monday to Friday under the supervision of clinical consultants.

All the patients that came for consultation in this clinic over a period of three months who were willing to participate in the study were recruited after informed consents were obtained from them. Patients were free to decline involvement in the study and this did not affect the level of care they received because of their decline of involvement in the study. In addition, ethical clearance was obtained from the University College Hospital/College of Medicine Ethical Committee.

Data was collected by only one of the investigators to ensure standardization and a total of 127 patients age ranged 18-60 participated in the study. Initial information obtained included patient's age, gender, occupation, past dental history and past medical history.

The facial skin colour categorization was done as carried out by Jahangairi *et al* (2002) in which skin tones were divided into 4 categories (fair, fair/ medium, medium and dark) with the use of L'Oreal True Illusion compact make up shades as a guide. Subjects that fell into fair and dark categories were included in the study for clarity while the exclusion criteria were albinism, chemical skin toning and mixed racial background.

Tooth shade selection was done in an open natural daylight against a neutral background at a close point with the patient seated on an upright sitting chair. The selection was done under this condition based on Lee's (1962) report that objects appear darker when viewed at a distance and enclosed environment. Tooth colour exclusion criteria were pathologic enamel discoloration and artificial tooth replacement such as acrylic and porcelain crowns.

After initial inclusion in the study, dental prophylaxis was done on every willing participant to remove extrinsic stains. Matching of the incisal third of maxillary central incisors (left & right) colour with the stock shade guides (Vita-Lumi and Cosmopolitan) was done a day after dental prophylaxis to avoid any interference with the original tooth shade. These shade guides are a series of tooth shaped tabs mounted on metal or plastic strips that is designed for comparison of hue, value and chroma characteristics with those of natural teeth or existing restorations. Munsell system of colour identification uses hue, value and chroma to describe teeth colours. Hue is the dimension of colour that distinguishes one family of colour from another (red, blue, yellow etc.) value refers to the dimension of colour that denotes relative blackness or whiteness/brightness. Chroma is the dimension that describes the saturation, intensity or strength of a hue.

Cosmopolitan and Vita -Lumin shade guides were used having rearranged the teeth in the ascending order of darkness. The Vita-Lumin and Cosmopolitan tooth shade guides were selected because of their routine use

in Nigeria and for the purpose of comparison and reliability as reported by Hammad I.A(2003), Cal E, Guneri P, Kose T, Cal et al(2006)and Bayinder F, Kuos, Johnston WMet al(2007) .

The shade guide teeth were moistened and placed close to the subject's incisal one third of upper central incisors in natural daylight with the patient seated on an upright sitting chair because shade selection is affected by illumination and surrounding tissue, in sequence until the matching shade was identified.

In recording the datae, Cosmopolitan shades A, B were classified as light (L2) shades and O, C, E, F, J, H, K, R, P, L, G, T as dark (D) shades while Vita-Lumin shades B1, A1, A2, B2, C1 were classified as light (L2) shades and D2, A3, D4, B3, B4, C2, D3, A3.5, C3, A4, C4 as dark (D) shades. Teeth with lighter shades than those on the stock shade tray were designated L1

Compiled data was analysed using the three way interactions categorical models tested through model 1(gender, skin colour and teeth shade) and model 2 (age, skin colour and teeth shade),and chi-squared tests of independence done to determine any association between the variables and the significance of the association.

RESULTS

Three-way interactions among gender and age with the outcome (model 1 i.e. gender, skin colour and teeth shade; model 2 i.e. age, skin colour and teeth shade) could not give separate categorical models. Hence chi-squared tests of independence was used to evaluate bivariant relationships among variables with Fischer's exact tests used when necessary. Skin complexion was associated with gender (p=0.0000210, P<0.05) (Table 1).

Table 1:
Facial Skin Colour related to Gender

Facial Skin Colour	Facial Skin Colour	Male	Female	Total
	Light	11(8.7%0	49(38.6%)	60(47.2%)
Dark	38(29.9%)	29(22.8%)	67(52.8%)	
Total	49(38.6%)	78(61.4%)	129(100%)	

P<0.05 P = 0.0000210; Highly significant

There was no significant relationship between cosmopolitan tooth colour shade and gender (>0.05) and both shade guides combined although a significant

relationship was observed with the Vita-Lumin shade guide (P<0.05) (Table 2). Majority of the participants (63.8% cosmopolitan and 53.5% Vita-Lumin) had the light (L2) tooth colour shade.

Table 2:
Tooth colour related to gender

Tooth colour shade	Cosmopolitan	Male	Female	X2 = 4.02 df = 2 P>0.05 Not significant
		Lighter (L1)	5(3.94%)	
Tooth colour shade	Cosmopolitan	Lighter (L2)	47(37%)	X2 = 6.07 df = 2 P<0.05 Significant
		Dark (D)	12(9.5%)	
Tooth colour shade	VITA-LUMIN	Lighter (L1)	16(12.6%)	X2 = 6.07 df = 2 P<0.05 Significant
		Light (L2)	39(30.7%)	
		Dark (D)	23(18.1%)	

Combined: $\chi^2 = 10.72$; df = 5; P>0.05; Not significant

The lighter (L1) tooth color shade was seen appreciably more in females (15% cosmopolitan and 126% Vita-Lumin) as compared to males (3.9% cosmopolitan and 1.6% Vita-Lumin). Table 3 shows the association between tooth colour shade and skin complexion. No significant relationship was observed in either of the tooth shade guides (P>0.05) individually and combined.

Among those with dark tooth colour 10.2% (cosmopolitan) and 18.9% (Vita-Lumin) had dark skin complexion while 7.1% (cosmopolitan) and 13.4% (Vita-Lumin) had light skin complexion.

Table 3
Tooth colour by Facial Skin Colour

TOOTH COLOR		Colour		X2 = 1.96 df = 2 P>0.05 Not significant
		Light	Dark	
TOOTH COLOR	Cosmopolitan	Lighter (L1)	15(11.8%0	X2 = 1.94 df = 2 P>0.05 Not significant
		Light (L2)	39(30.7%0	
		Dark (D)	13(10.2%)	
TOOTH COLOR	VITA-LUMIN	Lighter (L1)	11(8.7%)	X2 = 1.94 df = 2 P>0.05 Not significant
		Light (L2)	32(25.2%)	

Dark (D)	17(13.4%)	24(18.9%)
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Combined: $\chi^2 = 3.92$; $df = 5$; $P > 0.05$; Not significant

Table 4:
Tooth colour related to age

TOOTH COLOR		Age		X2 = 7.41 df = 2 P<0.05
		18-39yrs	40-59yrs	
Cosmopolitan	Lighter (L1)	14(11.0%)	10(7.9%)	P<0.05
	Light (L2)	68(53.5%)	13(10.2%)	
	Dark (D)	18(14.2%)	4*3.2%)	
VITA-LUMIN	Lighter (L1)	9(7.1%)	9(7.1%)	X2 = 9.27 df = 2 P < 0.05
	Light (L2)	57(44.9%)	11(8.7%)	
	Dark (D)	32(25.2%)	9(7.1%)	

Combined: $\chi^2 = 16.81$; $df = 5$; $P < 0.05$; Significant

There was a significant association between tooth colour shade and age ($P < 0.05$) (Table 4). Higher percentages of the younger age group was recorded for all the shade colours as compared to the older age group.

DISCUSSION

The commonest cause of tooth loss in Nigerian adults is periodontal disease (Diagne *et al*, 1993; Aderinokun and Dosumu, 1997) which does not allow for pre-exfoliation record of tooth colour and hence the need for the probable use of facial skin colour, age or gender for tooth shade selection. There is limited scientific information on the relationship between tooth shade and skin colour. This lack of knowledge may hinder the ability of the prosthodontists to select artificial teeth that complement the facial complexion of the patient.

The similar observation in this study on the relationship of skin color with both tooth shade guides (Vita-Lumin and the cosmopolitan) implies that either of the shade guides is suitable for selection of artificial

tooth colour. The fair and dark tones of the facial skin colour as reported by Jahangairi *et al* (2002) was used in this study because it is universally accepted and it has a representation of the range of skin tones in our population.

Hasegawa *et al* (2000) reported on the consistency of the Vita-Lumin shade guides with the lightness values of natural teeth at any particular site was another reason for its use in this study. The Vita-Lumin shade guide consists of 16 shades organised by chroma level within 4 hue groups of A,B,C and D which are also numbered to discriminate lightness and darkness values. The cosmopolitan shade guide was used for comparison to test the possibility of been used as much as Vita-Lumin. The numerical values given to each tab of the Vita-Lumin shade did not correlate with the value numbers given to the tabs which made it confusing as reported by Schwabacher and Goodkind (1990). The tabs were therefore re-arranged in the order of the darkness of the shades. No interaction among gender, facial skin colour and tooth shade was found in this study, which is the same as reported by Jahangairi *et al* (2002).

Females were observed to have lighter teeth shades while males had darker teeth shades which is similar to the findings of Hallarman (1971) in adult Caucasians and Hassel *et al* (2008) in a white elderly cohort study, while Esan *et al* (2006) reportedly found older adults and men to have darker teeth. This association is found to be significant with the Vita-Lumin tooth color shade while it is not significant with the cosmopolitan. This could be because of the wide range of colour in Vita-Lumin shade which allowed more matching of the colour.

The lack of association between skin colour and teeth colour recorded in this study for both shade guides suggests that choice of artificial tooth shade may not be confidently made in the patient's facial skin colour. This supports the finding of Dummett *et al*, (1980) but in contrary to that of Hallarman (1971), Jahangairi *et al* (2002) and N'Guessan *et al* (2001) which may be due to the differences in the population examined.

The significant association between tooth colour shade and age may be due to the fact that teeth tended to get darker with increasing age as reported by Hallarman (1971). Jahangairi *et al* (2002) also reported a significant association between age and tooth shade with older persons more likely to have teeth with lower value (darker). However, higher percentages of the younger age group (18-39yrs) for all the tooth color shades (L1, L2 and D) in both shade guides was observed in this study probably because we had more participants in this age group.

An appreciable percentage (18.9% Cosmopolitan, 14.2% Vita-Lumin) of the participants were observed to have lighter (L1) teeth colour in this study. The number of patients that had tooth colour shade that were lighter (L1) than those of either of the shade guides when related with gender was observed to be more with the cosmopolitan (3.9% male, 15% female) than the Vita-Lumin shade guide (1.6% male, 12.6% female). This may be due to the fact that the Vita-Lumin shade guide has more lighter shades than the cosmopolitan shade guide which the teeth matched. This observation that a group of people have this lighter (L1) tooth colour supports the statement of problem in Hasegawa *et al* (2000) study that the range of shade in shade guides is not consistent with natural teeth. This therefore shows a need for the incorporation of a range of lighter colour shades in the existing stock shade guides.

Within the limitations of this study, it may be appropriate to conclude that facial skin colour does not significantly correlate with tooth colour and may not be a reliable guide for artificial tooth colour selection in this environment. Selection of artificial teeth with suitable shade for any edentulous patient may therefore be a matter of individual judgment.

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