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*Research article*

# **Gingival Tissue Color Related With Facial Skin and Acrylic Resin Denture Base Color in a Nigerian Population**

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**ABSTRACT:** It is impossible to underestimate the importance of dentures to the wearer, they remain one of the most challenging aspects of modern day dentistry. The patient interprets the success of a denture from two distinct points: function and aesthetics. The objective of this study is to determine the predominant gingival tissue colour in this environment; to assess the association of gingival tissue colour with gender and facial skin colour. Four hundred and thirty subjects that attended the Dental Centre, University College Hospital, Ibadan, who consented to participate in the study were recruited for the study. The Dummett Oral Pigmentation Index (DOPI) was used to evaluate gingival tissue colours of the four upper central and lateral incisors and the colour of the available acrylic denture base material. Categorical modelling with chi square analysis using SPSS statistical package was done ( $P=0.05$ ). Association between gingival tissue colour and facial skin colour was found to be highly significant ( $P<0.05$ ). Attached gingival predominant colour was the darker DOPI 3 colour. Colour of processed acrylic denture base material was closely related to the DOPI colour zero while no significant association was found between gingival colour and gender. This study supports the impression that a strong relationship exists between facial skin colour and gingival tissue pigmentation. Research into the degree of epithelial vascularisation, keratinisation and melanin pigmentation of the various zones in the mouth in this environment is required which may explain the reason for the dark colour observed in the attached gingival.

**Key Word:** Gingival tissue colour, denture, skin, acrylic resin, Nigerians.

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## **INTRODUCTION**

The gingiva is the fibrous mucosa surrounding the teeth covering the coronal portion of the alveolar process (Zimmerman, 1982). The gingival is the most frequently pigmented of the intra-oral tissues as well as the most readily seen. Dummett (1966) queried the frequently used description of normal gingival as ‘coral

pink’ and suggested a more accurate statement of the pattern of normal pigmentation in the following definition. ‘The colour of healthy gingival varies from pale pink to blueish purple. Between these limits of normalcy are a large number of colours which primarily depend on the intensity of the melanogenesis, degree of epithelial cornification, depth of epithelialization and the arrangement of gingival vascularity.’ Colour variation may be uniform, unilateral, bilateral, mottled, macular or blotched.

There are two basic color zones in the oral cavities of most white people, which comprises the attached and marginal gingivae on one hand and the adjacent alveolar mucosa on the other hand. Studying gingival color using the Munsell color system in dentistry, Ibusuki (1975) reported that gingival color varied with the position of the papillary, marginal and attached

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gingivae. The color of the healthy gingiva is assumed to vary from pale pink, coral pink, light brown and dark brown, the exact line being a matter of individual variation. This color variation may depend on the amount of physiological melanin pigmentation in the epithelium, the degree of keratinisation of the epithelium, the vascularity and the fibrous nature of the underlying connective tissue pigmentation which is minimal in white people and can be found as brown or blue black areas in Africans or Asians (Manson and Eley 2000). Keratinisation of the oral epithelium decreases with age and varies in the following order; palate, gingival, tongue and cheek with the highest keratinisation in the palate and the least in the cheek/alveolar mucosa. Dummett (1946) reported gingival pigmentation to be 60% in blacks in his study of the distribution of oral pigmentation. The attached gingiva is reported to be generally light coral pink in colour with an orange peel like texture, while the alveolar mucosa is a darker red-blue color which is smooth and shiny in nature (Zimmerman, 1982). It may be noted that a definite correlation exists between the colour tone within the oral cavity and the external pigmentation of the individuals in White, Negroes, Asiatic and Indian populations.

One of the functions of a denture is to restore esthetics in which the ability to restore the gingival color is very important. This is because most of the time, denture wearers show much of the labial gum, which the anterior denture flange substitutes in speech and laughter, which makes it look very artificial. Hence many attempts have been made to give a natural appearance to the denture base, which includes application of various stains (Wright 1974).

Aesthetics is a matter of personal perception influenced by the society in which we live. Neumann et al (1989) stated that it may be foolish to assume that the clinical observations of a dentist corresponds with the self-image of the patient. Hence in planning the esthetics of the replacements, the patient has to be involved and esthetics information needs to be communicated to the patient and discussed fully (Neumann et al, 1989). In general, esthetics harmony leads to functional unity and efficiency. Esthetics can be a strong influencing factor on the decision to seek prosthodontic treatment in patients (Conny et al 1985).

Denture resins currently available are polymethyl methacrylate resins (PMMP) methacrylate resins of higher molecular weight (MRHMWT), epimine resins and visible light activated resins (VLAR). The powder of some of these resin contain pigments to provide a wide range of shades while some have poor color stability and inferior initial esthetics. Pure poly (methyl methacrylate) is a colorless, transparent solid. To

facilitate its use in dental applications, the polymer may be limited to provide almost any shade and degree of translucency.

One of the three primary factors involved in reproducing complete nature-like realism is that denture bases should be color tinted to blend with the individuals intra and extra oral pigmentation. Spolsky and co-workers (Spolsky *et al* 1983) in their study showed the degree to which people avoid conversations because of the appearance of their teeth or gingiva. Many individuals may find it very embarrassing to speak or smile and display the stereotyped pink denture base, which discloses the 'false' or artificial denture look (Spolsky *et al* 1983). The final dimension of color must be incorporated into the denture base matrix material to reproduce the patient's natural tissue tones in order to achieve the ultimate realistic goal in constructing artificial denture (Zimmerman, 1982). There is therefore a need for denture bases to match pigmented gingiva of the black population, which is not possible to measure the colors accurately at present (Powers 1953). Various methods of coloring the labial flanges of the dentures are done to simulate the color of the gingiva of the black population. Since the introduction of acrylic resin for use in complete dentures, attempts have been made to match the color of the denture flange of natural gingival (Zimmerman, 1982). Pyor (1941), Nelson (1942), Rich (1944), Pound (1951), Powers (1953), Dummett (1955), Gerhard and Sawyer (1966) and Quinlivan (1975) developed various techniques to match the color of the denture flange with the oral tissues between 1941 and 1975. Although the basic acrylic powders have been tinted to produce nature like appearance in the denture base, it may not completely satisfy the artist technician who desires to achieve the ultimate color needed to faithfully reproduce adequate depth and translucency.

The objectives of this study therefore are to determine the predominant gingiva color in this environment; to assess the variability of gingiva color with positions in the mouth; to assess the association of gingival color with gender and skin complexions in this environment and to assess the suitability of the color of the available acrylic material with the observed gingival colors in this environment.

## **MATERIALS AND METHODS**

This correlational investigation study was carried out at the Dental Centre, University College Hospital, Ibadan over a period of six months. A total of 430 subjects out of all this dental clinic attendees age ranged 15-75 years, who consented to participate in the study within the six months study

period were recruited for the study. Informed consent was obtained from all the subjects after fully explaining the nature of the procedures, the objectives and possible discomforts and risks of the study to them. The fact that their decline in participation in the study will not affect the quality of treatment that will be given to them negatively was established.

Ethical approval was also obtained from the ethical review committee of the University of Ibadan/University college Hospital, Ibadan.

The inclusion criteria are uniformly pigmented and non-mottled labial gingivae between the fourth maxillary central and lateral incisors. The skin color must be distinctly dark or light, which is similar to the criteria adapted by Aina et al(1978). Although some scientific and claimed objective reproducibility<sup>15</sup> of skin and gingival color evaluations have been reported, the method used for gingival color evaluation in this study is the Dummett Oral pigmentation Index (DOPI)(Dummett and Gupta, 1966) . This index represents the assignment of a composite numerical value to the total melanin pigmentation manifested on clinical examination of various oral tissues. The criteria is as follows:

- 0 = Pink tissue (no clinical pigmentation)
- 1 = Mild, light brown tissue (mild clinical pigmentation)
- 2 = Medium brown or mixed pink or brown tissue (moderate clinical pigmentation)
- 3 = Deep brown or blue/black tissue (heavy clinical pigmentation)

The higher the number, the darker the oral pigmentation.

One investigator was calibrated for the examination of the colours after been tested for normal colour vision and colour aptitude using the line test, comparison of observers and of light sources with the use of a colour rule.

The investigator was also seen to be adapted to daylight because higher intensity of light available from the day light sources may produce more colour change.

The observer views the specimen illuminated hence meeting the three conditions as highlighted by the International Commission on illumination (CIE)( Powers et al 1977), although Wright(1974) however stated that even after objective scientific evaluation, the eye is still the final judge of color.

The exclusion criteria are patients with pathoses of the gingiva drawn from the calculus, plaque and gingival indices, gingiva texture and density and sulcus depth; drug or chemical pigmentation and mottling. Others are chemical skin toning, albinism and mixed racial skin coloration.

Color tabs that matched the DOPI criteria were matched with selected gingiva area of the mouth, free gingiva, attached gingiva and alveolar/cheek mucosa after the lips are retracted and the color tabs held adjacent to the area under day light. The selection of color tab is done by the most nearly corresponded with the lightness or darkness of the gingiva. The color shade of the processed acrylic dentures resin available in this environment is selected when matched with DOPI colors.

The association between gingiva colour and skin complexion, and gender was tested statistically using the SPSS statistical package. The predominant gingiva color for the three zones of the oral mucosa (free, attached and alveolar/cheek) was also determined and its relative matchability with the available processed acrylic color in this environment determined..

## RESULTS AND DISCUSSION

Results of this study are presented in Tables 1 – 7. Processed acrylic denture resin available in this environment was observed to be closely related to DOPI color zero that is pink coloration.

**Table 1**  
The association between free gingival color and gender

Gender	DOPI Index of Free Gingival				
	0	1	2	3	
Male	120	71	18	1	$X^2= 1.37$
Female	135	64	19	2	$P > 0.05$

**Table 2**  
The association between attached gingival color and gender.

Gender	DOPI Index of Free Gingival				
	0	1	2	3	
Male	76	95	29	10	$X^2 = 2.9$
Female	85	85	37	13	$P > 0.05$

Our findings in this study is in line with those of Ibusuki (1975) and Zimmerman *et al* (1982) having DOPI value zero (0) to be most prevalent in the free gingival and alveolar/cheek mucosa while one (1) is in the attached gingival of Ibusuki<sup>2</sup> and Zimmerman *et al*(1982). It is also found generally in this study that 30 out of the 430 subjects (about 6.98%) had the DOPI value 3 out of which 22 (5.12%) were found in the

attached gingival. The major observed attached gingival color 166 (38.61%) subjects in this study is more of light coral pink (DOPI zero) in the alveolar mucosa and not a darker red-blue color as in white people and brown pigmentations inter mixed throughout the attached gingival and alveolar mucosa in oriental races as reported by Zimmerman et al(1982).

**Table 3**

The association between alveolar/cheek mucosa color and gender.

Gender	DOPI Index of Alveolar/ Check/ Mucosa				
	0	1	2	3	
Male	76	103	72	35	X <sup>2</sup> = 3.62 P > 0. 05
Female	113	66	38	3	

**Table 4**

The Association Between Free Gingiva Color And Skin Complexion

Gender	DOPI Index of Free Gingival Skin Complexion				
	0	1	2	3	
Male	130	144	14	8	X <sup>2</sup> = 59.02 P < 0. 05
Female	102	14	14	4	

More subjects, 22 (5.12%) had the darker DOPI 3 color although less than DOPI zero subjects 166(38.61%) in the attached gingival with very few of this color shade in the free gingival and alveolar/cheek mucosa in which only 4(0.93%) of the subjects each had this DOPI 3 color in this study. This implies that the attached gingival showed more darker color shades than the

other two zones. Although generally epithelial cells of the attached gingival are supposed to be keratinised and multi-layered preventing a translucent screen that reveals the arterial and venous circulation of the deeper investing tissues, it still shows more of the darker color than the other zones in this study. This may be due to more pigment deposits in this area, which may be confirmed by further research investigations in this environment.

**Table 5**

The association between attached gingiva color and skin complexion

Gender	DOPI Index of Attached Gingival Skin Complexion				
	0	1	2	3	
Male	89	59	74	74	X <sup>2</sup> = 33.45 P < 0. 05
Female	56	8	56	14	

**Table 6**

The association between alveolar/cheek mucosa color and skin complexion.

Gender	DOPI Index of Alveolar/ Check/ Mucosa Skin Complexion				
	0	1	2	3	
Male	118	30	114	44	X <sup>2</sup> = 14.47 P < 0. 05
Female	55	29	41	9	

Zimmerman et al(1982) found that dark skinned individuals such as the Negroes, Asiatic and Indian populations had this dark pigmentation in the attached and marginal gingival They also stated that it may be noted that a definite correlation exists between the color tone within the oral cavity and the external pigmentation of the individual.

**Table 7**

Prevalence of gingival color in three zones of the mouth.

DOPI color Index	Free Gingival		Attached Gingival		Alveolar/Check Mucosa	
	Number of Subjects	Percentage of population	Number of Subjects	Percentage of population	Number of Subjects	Percentage of population
0	263	61.16	166	38.61	216	50.23
1	131	30.47	178	41.40	138	32.09
2	32	7.44	64	14.88	72	16.74
3	4	0.93	22	5.12	4	0.93

Highly significant positive correlation was found between facial skin complexion and DOPI estimates for the three oral tissue zones (free gingival, attached gingival and alveolar/cheek mucosa) investigated in this study. The amount of variance and significance levels for two areas were appreciable (59.02% & P=0.001 for the free gingival; 33.45% & P=0.001 for the attached gingival) which may suggest that facial skin complexion may be used to predict gingival pigmentation or determine colors of the denture labial flange. However, the amount of variance (14.47%) and significance level (P=0.002) for alveolar/cheek mucosa precludes the clinical use of facial skin complexion to predict its color. Wright(1974) reported that non-pigmented gingival are found more often in fair skinned individuals, while pigmented gingival are usually seen in dark persons. These reports support our finding in this study, which may be related to the degree of melanin pigmentations in the tissues. Gender was observed not to be significantly related to the colors of any of the three zones of the gingivae studied.

It is observed in this study that the color of the processed acrylic resin available in this environment is pink, which corresponds to the DOPI color zero. Additives to tint the acrylic resin powder to correspond with the other colors (DOPI 1, 2 & 3) that were also observed in the various zones of the mucosa in this study is therefore a great need in this environment to match these other DOPI colors of the oral mucosa.

The following conclusions may be drawn from this study:

- Although the methods used in this study to assess skin colors is not quantitative and that used for gingival may be subjective, they may still be useful guides for the development of more natural appearing denture resins for this environment.
- The impression that a strong relationship exists between facial skin complexion and gingival pigmentation is supported.
- There is a need for the development of chemical additives by manufacturers and dental clinics to tint acrylic powder resins to match the observed gingival colors in this environment.
- There is a need for research into the degree of epithelial vascularization, keratinisation and melanin pigmentation of the gingival and alveolar/cheek mucosa of the peoples in this environment which may then explain the reason for the dark color observed in the attached gingival.

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