The Oral Pigmentation Chart: A Clinical Adjunct for Oral Pigmentation in Removable Prostheses

Caroline J. de Krom, DDS^a/Marinus A. J. van Waas, DDS, PhD^a/Paul Oosterveld, PhD^a/ Arjen S. F. Koopmans, DDS^a/Niel R. Garrett, PhD, DDS^b

> Purpose: Non-Caucasian patients exhibit different characteristics of oral pigmentation and may request that the acrylic resin parts of their dentures look natural, simulating the original mucosal color. Tooth loss, bone resorption, and lack of attached gingiva may, however, make it difficult to determine what the original pigmentation was like. The purpose of this investigation was to study the distribution in oral pigmentation around the natural dentition in non-Caucasians, in a preliminary effort to classify these variations into a chart of oral pigmentation, and to analyze its reproducibility. *Materials and Methods:* For the study, 106 dentate non-Caucasians were selected from two universities: ACTA (patient group) and UCLA (nonpatient group). A pigmentation scheme was devised on the basis of half of the participants, and the others were divided into categories by four observers independently. Cohen's kappa was then calculated. Results: On the basis of information obtained from the ACTA participants, six categories of mucosal pigmentation were defined. The kappa statistics for the four observers varied from .58 to .79 for intraobserver agreement and from .15 to .55 for interobserver agreement. Conclusion: The Oral Pigmentation Chart is a simple device that makes it possible to simulate oral pigmentation in the acrylic resin parts of removable dentures. The reproducibility appeared to be acceptable when clinician and dental technician were calibrated. Patients can be offered a choice of the kind of pigmentation geography they want in their removable prostheses. Int J Prosthodont 2005;18:66-70.

t must be recognized that a large number of people in the industrialized world are edentulous or will become edentulous in the future.¹ With the increasing number of elderly persons, the need for complete dentures is expected to remain high. As denture patients may be of non-Caucasian origin and most of the denture base materials match the nonpigmented mucosa of Caucasians, the color choice for acrylic resin may present esthetic problems.

A MEDLINE search was done with the key words "denture," "pigmentation," "gingiva," and/or "melanin"; it revealed a limited number of articles, many of them pre-1980. A more recent article² reports the following: Racial pigmentation of oral mucosa is the most common cause of oral pigmentation and a kind of melanoplakia. It is a constant dark pigmentation of the oral mucosa, commonly seen in dark-skinned individuals (melanoderms). The condition is physiologic, with attached gingiva as the most common site, and results from increased amounts of melanin, an endogenous pigment, produced by melanocytes present in the basal layer of the epithelium. The color is often a diffuse, symmetric, ribbon-like dark band with a well-demarcated border that separates it from the alveolar mucosa. The degree of pigmentation varies from light to dark brown and sometimes blue-black and also occurs in other sites (eg, buccal mucosa, hard palate, lips,

^aDepartment of Oral Function, Academic Centre for Dentistry Amsterdam (ACTA), The Netherlands.

^bUniversity of California Los Angeles (UCLA) School of Dentistry, Los Angeles, California.

Correspondence to: Dr M. A. J. van Waas, Department of Oral Function, ACTA, Louwesweg 1, Amsterdam 1066 EA, The Netherlands. Fax: + 31-20-5188414. e-mail: Mvwaas@acta.nl

tongue). Melanoplakia should be differentiated from similar-appearing but pathologic conditions that produce oral pigmentations, such as Addison's disease, Albright syndrome, Peutz-Jeghers syndrome, heavy metals, melanoma, and the use of antimalarial drugs.

Dummett³ describes variations in the pigmentation of the oral mucosa, which occur in all races. A nonpigmented (ie, pink) mucosa is not confined to any one race. The color of the healthy gingiva is extremely variable, ranging from pink to red, brown, blue, purple, gray, and black, from the most intense shading to the most pale, and occurs in almost every conceivable mixture of the above colors. The distribution may be uniform, unilateral, bilateral, mottled, macular, or blotched, or a combination of any of these.

In 1966, Dummett and Gupta⁴ proposed the Dummett-Gupta Oral Pigmentation Index (DOPI), which represents the assignment of a composite numeric value to the total melanin pigmentation seen during the clinical examination of the soft tissues in the oral cavity. In the case of the gingiva, the assignment is made for each arch separately and obtained by dividing the sum of the assigned estimates of pigmentation in the lingual and buccal unit spaces by the total number of unit spaces in the arch. The DOPI is scaled according to the following designations: 0 = no clinical pigmentation; 0.06 to 2.00 = moderate gingival pigmentation; and 0.09 to 3.00 = heavy gingival pigmentation.

Extraoral tissues (eg, the cheeks) appear to be an indication of the color of the mucosa in about 85% of all cases.⁵⁻⁷ Even in the same person, the mucosa can vary considerably in color intensity and contour.⁸ Brown⁹ found that the pigmentation of the gingiva decreases with age, whereas that of the lips, cheeks, and palate increases with age; others found no correlation.⁵ No relationship was found between oral pigmentation and gender, or the color of the skin of the forehead. Pigmentation appears to be more constant on the lips and cheeks than on the gingiva and palate, and more common in the mandible than maxilla. It must be acknowledged that with residual ridge reduction following teeth loss, it may be difficult to determine what the original mucosa pigmentation was like.

The literature therefore suggests the following considerations:

- It is difficult to predict the color pattern of mucosa for an individual on the basis of the skin color.
- The mucosa of an edentulous arch may not provide a reliable indication of the original pigmentation.
- It is not possible to construct a standard profile on the basis of race or ethnic grouping.

The purpose of this preliminary study was to explore the distribution in oral pigmentation around the natural dentition in non-Caucasians and classify these variations into a chart of oral pigmentation, as well as analyze its reproducibility. The premise was that the resultant chart may become a useful clinical adjunct in color and color distribution for the acrylic resin part of removable prostheses.

Materials and Methods

Fifty-three non-Caucasian outpatients attending the Academic Centre for Dentistry Amsterdam (ACTA) were selected for the study, as were 53 non-Caucasian volunteers from the University of California Los Angeles (UCLA). Volunteers were recruited, as the Dutch investigator was not permitted to engage in any patient treatment at UCLA. Five volunteers enrolled at UCLA were not included the final sample because of photographic errors. All participants had 20 or more natural teeth and ranged from 20 to 55 years of age, with a mean of 36.5 years. Only participants with a disease that could cause pigmentation, like Addison's disease or melanoma, were excluded. They filled in a questionnaire answering items on their age, gender, place of birth, and ethnic background. For the participants from UCLA, the options for the last question were as follows: 1 = non-white, non-Hispanic; 2 = non-white, Hispanic; 3 = black; 4 = Asian; or 5 = other. The ACTA participants were asked to give the origins of their parents; one of the researchers later divided the ethnic backgrounds into the same categories as had been used at UCLA. In all other aspects, the collected data were identical and completed for all participants.

Four color photographs were taken of each participant as he or she sat in a dental chair. The mouth was illuminated with an overhead lamp. A Cosina camera with a circular flash and manually controlled setting was used for the photographs. An acrylic resin plate in the color of normal Caucasian mucosa (Vertex No. 5, Vertex Dental) was placed alongside the mouth while taking the photographs. The film used was a standard Kodak roll film (ASA 200, Gold 36, Eastman Kodak). The shutter setting was kept at 22. The rolls of film were developed in two laboratories at ACTA and UCLA.

The first photograph taken was a picture of the lower half of the face with the mouth closed. For this photograph, the camera was set at ∞ ; this meant taking the picture at a distance of about 39 cm from the mouth. The second photograph was taken using lip retractors and at a setting of 0.5; this was taken at a distance of approximately 16.5 cm. The third photograph of the same situation was taken with a setting of 0.7 and at a distance of approximately 21 cm. For the second and third photographs, the above-mentioned

	ACTA		U		
Group	Male	Female	Male	Female	Total
Non-white, non-Hispanic	3	5	0	1	9
Non-white, Hispanic	0	0	2	11	13
Black	22	18	11	9	60
Asian	2	3	5	11	21
Other	0	0	2	1	3
Total	27	26	20	33	106

Table 1 Distribution of Participants in Both Locations, by Gender and Ethnic Background

ACTA = Academic Centre for Dentistry Amsterdam; UCLA = University of California Los Angeles.

acrylic resin plate was held up on the left side of the front of the mouth so that the color of the gingiva could be compared with the standard. In this way, it was also possible to see whether the photographs were comparable in terms of color. For the fourth photograph, the same setting was used as for photograph three, but the photograph was taken without the plate. The aim here was to assess the pattern of the pigmentation and compare the symmetry of the left and right quadrants of the picture. In all cases, only the area between the nose and chin was photographed to maintain anonymity of the participants.

For analyzing the intra- and interobserver agreement, four observers categorized the pictures of the participants at UCLA with an interval of at least 1 week. They were instructed by explaining the aim of the study and the differences in the categories of the chart; then, they were trained with the help of several photos involved in the study. Each rater was blinded to the rating of the other investigators. Cohen's kappa was then calculated using SPSS.

Results

Table 1 shows the 106 participants from both locations grouped by gender and ethnic category. Forty-seven were men, and 59 were women. Participants categorized as black formed the largest group, with more subjects than all other categories combined.

Based on the evaluation of the participants from ACTA, a classification scheme describing the pattern of the oral pigmentation was proposed and defined; the Oral Pigmentation Chart is presented in Fig 1. Six categories of pigmentation were defined. All participants were subsequently allocated to one of the categories (Table 2). Only 1 of the 101 participants could not be satisfactorily placed in the drafted classification.

Pigmentation category 4 (pigmentation is irregularly spread over the mucosa) was found to be the most common, and category 5 (mucosa is completely pink, with the exception of a number of symmetric "islands" of pigmentation) was the least common. In 3 of the 16 persons of Asian origin from the UCLA group, pigmentation category 4 was observed. This was in contrast with the findings for the ACTA group, where pigmentation category 6 (mucosa is completely pink) was found for all participants in the Asian group.

The results of the intra- and interobserver agreement scores for the maxilla, using Cohen's kappa, are presented in Table 3. Two pairs of observers (CK–NG and CK–JK) had acceptable interobserver reliability scores, .55 and .51, respectively; all intraobserver scores were acceptable (.58 or higher).

Discussion

An oral pigmentation chart was developed using initial data from one university (ACTA) and expanded to include the data from the participants at a second university (UCLA). The chart suggested the merit of classifying a diverse sample of mucosal pigmentation distributions into a restricted number of categories. Permitting its use in dental offices with non-Caucasian patients, this would truly encourage patients to select the kind of pigmentation they prefer in the visible parts of new complete dentures. Clinicians would then be able to communicate this information to the dental technician and implement the suitable acrylic resin color choice.

The data presented in Table 2 provide information on the characteristics of the pigmented mucosa in non-Caucasian people. The different manifestations of this pigmentation are categorized in the chart. Diversity was accomplished by sampling data at both ACTA and UCLA, although this certainly does not purport to give a representative picture of the Dutch and US non-Caucasian populations. In fact, subjects with a dark ("black") skin coloring are overrepresented in this study. The frequency per category is therefore not indicative of the frequency of the categories in these populations. This is an obvious limitation of the study, albeit its preliminary nature.

No attempt was made to determine the quantity of distribution of the pigmentation,⁴ and only a simplified categorization scheme, based on visual interpretation of the image, is proposed. Because the pigmentation of

68



Fig 1 Oral Pigmentation Chart.

Table 2 Participants Categorized Based on Oral Pigmentation Chart, by Location and Jaw

	ACTA		UCLA		Total	
Category*	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
1	10	1	5	1	15	2
2	8	8	5	2	13	10
3	16	3	7	4	23	7
4	14	27	11	22	25	49
5	1	2	0	0	1	2
6	4	11	19	16	23	27
Not classified	0	1	1	3	1	4
Total	53	53	48	48	101	101

*See Fig 1.

ACTA = Academic Centre for Dentistry Amsterdam; UCLA = University of California Los Angeles.

mucosa and facial skin can differ between photographs as a result of the photographic protocol, an acrylic resin plate (Vertex No. 5) was used as a reference. The records of the plate, however, were not stable across images. For these reasons, the results were only used to determine the diversity in pigmentation distribution, not the diversity in the color of mucosa and skin.

Intraobserver agreement was acceptable (kappa > .50), but interobserver agreement showed variable results: Agreements of two combinations of observers were acceptable, whereas those of the others were not (Table 3). This means that both the clinician and dental technician using the Oral Pigmentation Chart have to be calibrated; otherwise, the results will be inconsistent. This problem is solved when clinician and dental technician directly communicate during prosthetic treatment, which is increasingly common.

It is obviously preferable to determine the specific features of oral pigmentation before teeth extractions. However, this information is generally not present at the time of denture fabrication. Hence, the Oral Pigmentation Chart may be a useful adjunct for both clinician and dental technician in designing a distribution of pigmentation to be used in making dentures for edentulous non-Caucasian patients. The chart will facilitate discussion with patients regarding the original distribution of mucosal pigmentation of the acrylic resin parts of the prosthesis. Patients may prefer acrylic resin in their dentures that matches that of Caucasian subjects, yet this chart may provide the opportunity to choose a type of oral pigmentation that might harmonize with the original mucosa. This may enhance the esthetic result and level of satisfaction.

Acknowledgments

This study was initiated and financially supported by Vertex Dental, Zeist, The Netherlands. The authors would like to thank Eddie Tai, Roland McFarland, and John Kevin. **Table 3**Agreement of Four Observers Using the OralPigmentation Chart for Maxillary Mucosa

Observer/pair	Карра		
Intraobserver			
СК	.79		
ET	.74		
JK	.74		
NG	.58		
Interobserver			
CK-ET	.19		
CK–JK	.51		
CK-NG	.55		
ET–JK	.16		
ET-NG	.15		
JK-NG	.40		

References

- 1. Douglass CW, Shih A, Ostry L. Will there be a need for complete dentures in the United States in 2020? J Prosthet Dent 2002;87:5–8.
- Langlais RP, Miller CS. Color Atlas of Common Oral Diseases. Philadelphia: Lea & Febiger, 1992:70–71.
- 3. Dummett CO. Oral pigmentation. J Periodontol 1960;31:356-360.
- Dummett CO, Gupta OP. The DOPI assessment in gingival pigmentation. J Dent Res 1966;45:122.
- Cicek Y, Ertas U. The normal and pathologic pigmentation of oral mucous membrane: A review. J Contemp Dent Pract 2003;3:76–86.
- Gaeta GM, Satriano RA, Baroni A. Oral pigmented lesions. Clin Dermatol 2002;20:286–288.
- Dummett CO. The relationship of facial skin complexion to oral mucosa pigmentation and tooth color. J Prosthet Dent 1980;43: 392–396.
- Dummett CO, Barens G. Pigmentation of the oral tissues: A review of the literature. J Periodontol 1967;38:369–378.
- Brown T. Oral pigmentation in the Aborigines of Kalumburu, Northwest Australia. Arch Oral Biol 1964;9:555–564.

Copyright of International Journal of Prosthodontics is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.