Tooth Shade Measurements Under Standard and Nonstandard Illumination and Their Agreement with Skin Color

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> **Purpose:** The purpose of this study was to examine the relationship between skin color (shade) and tooth shade under standard and nonstandard illumination sources. Materials and Methods: Four hundred Jordanian participants (200 males, 200 females, 20 to 50 years of age) were studied. Skin colors were assessed and categorized using the L'Oreal and Revlon foundation shade guides (light, medium, dark). The Vita Pan Classical Shade Guide (VPCSG; Vident) and digital Vita EasyShade Intraoral Dental Spectrophotometer (VESIDS; Vident) were used to select shades in the middle thirds of maxillary central incisors; tooth shades were classified into four categories (highest, high, medium, low). Results: Significant gender differences were observed for skin colors (P = .000) and tooth shade guide systems (P = .001 and .050 for VPCSG and VESIDS, respectively). The observed agreement was 100% and 93% for skin and tooth shade guides, respectively. The corresponding kappa statistic values were 1.00 and 0.79, respectively (substantial agreement, P < .001). The observed agreement between skin color and tooth shades (VPCSG and VESIDS) was approximately 50%. Conclusions: The digital tooth shade guide system can be a satisfactory substitute for classical tooth shade guides and clinical shade matching. There was only moderate agreement between skin color and tooth shade. Int J Prosthodont 2014;27:458-460. doi: 10.11607/ijp.3826

Correct tooth shade selection for a prosthesis requires understanding of the influence of different variables in shade selection procedures such as light illumination relative to hue, value, and chroma, and how these shades are interpreted.¹

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Some studies have reported an inverse relationship between skin color and natural tooth shades.^{1,2} Conversely, other studies have found no relationship between skin color and tooth shades, suggesting the selection of artificial teeth with proper shade for an edentulous patient, with no preextraction records of teeth shade, may be a matter of personal judgment and the patient's preferences.³ This study aimed to assess the relationships (agreement) that may exist between skin color and tooth shades under standard (intraoral dental spectrophotometer) and nonstandard (visual measurement) illumination sources.

Materials and Methods

Ethical approval for the study was granted by the institution of the research board at the Jordan University of Science and Technology (JUST). Overall, 400 Jordanian students attending JUST (200 males and 200 females), ages 20 to 50 years, who had all maxillary and mandibular anterior teeth with satisfactory oral hygiene, healthy periodontium, no history of endodontic therapy, tooth development abnormalities, intrinsic/extrinsic staining, or restorations in the anterior teeth, were selected and studied.

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Assessment of Skin Color (Shade) and Tooth Shade

Two reliable calibrated examiners who passed the tests for color blindness and Ishihara color vision deficiency performed the examination in the same examination room and same lighting settings. To avoid possible cone fatigue of the examiners' retinas, a rapid shade selection (10 seconds²) in natural daylight within 30 minutes of noon was carried out. The face of each participant was positioned upright so that his or her mouth was at the level of the clinician's eyes; participants were placed an arm's length distance from the investigator. This upright position minimized the effect of direct illumination shining into surrounding tissues, which may, in turn, affect shade selection. Participants were asked not to wear any makeup, lipstick, or lip gloss.

Skin shade determination was measured twice on the inner aspect of the wrist of participants, using the skin shade method developed by Revlon (USA) and L'Oreal (France) for makeup foundation shades (Table 1).

Tooth shade was recorded twice, using the Vita Pan Classical Shade Guide (VPCSG, Vident) and the digital shade guide, Vita EasyShade Intraoral Dental Spectrophotometer (VESIDS, Vident; see Table 1). The VPCSG's shade tabs were positioned adjacent to the maxillary central incisors; the clinician focused only on the middle thirds of the facial surfaces, with more color consistency, for determination of the correct shade. Further, the shade tabs were moistened and lined up with the incisal edges of the upper central incisors in natural daylight.

Statistical Analysis

For assessing the agreement (observed agreement and Kappa statistics) between the tooth shades and skin colors, the four tooth shade groups (see Table 1 footnotes) were further combined into three groups.

Results

Significant gender differences were observed for skin colors (P = .000) and tooth shade guide systems (P = .001 and .050 for VPCSG and VESIDS, respectively; see Table 1).

There was a 92.5% observed agreement ($\kappa = 0.794$, P = .000) between manual and digital tooth shade guide methods (Table 2). The skin color guides (L'Oreal and Revlon) showed 100% observed agreement ($\kappa = 1.00$, P = .000; Table 3). No significant agreement was found between skin color and tooth shade in this Jordanian population (P > .05). The

Table 1Gender Distribution of the Study Sample
According to Skin Color and Tooth Shade

| Variable | Male n (%) | Female n (%) | Total n (%) | P value (χ2 test) | |
|-----------------------|---------------|-----------------|----------------|----------------------|--|
| Skin color* | | | | | |
| Light | 65 (32.5) | 142 (71.0) | 207 (51.8) | | |
| Medium | 86 (43.0) | 54 (27.0) | 140 (35.0) | .000 | |
| Dark | 49 (24.5) | 4 (2.0) | 53 (13.3) | | |
| Tooth shade (VPCSG)* | | | | | |
| Highest value | 143 (71.5) | 169 (84.5) | 312 (78.0) | | |
| High value | 20 (10.0) | 21 (10.5) | 41 (10.3) | 001 | |
| Medium value | 21 (10.5) | 6 (3.0) | 27 (6.8) | .001 | |
| Low value | 16 (8.0) | 4 (2.0) | 20 (5.0) | | |
| Tooth shade (VESIDS)* | | | | | |
| Highest value | 150 (75.0) | 169 (84.5) | 319 (79.8) | | |
| High value | 25 (12.5) | 20 (10.0) | 45 (11.3) | 050 | |
| Medium value | 12 (6.0) | 7 (3.5) | 19 (4.8) | .050 | |
| Low value | 13 (6.5) | 4 (2.0) | 17 (4.3) | | |

VESIDS = Vita Easy Shade Intraoral Dental Spectrometer; VPCSG = Vita Pan Classical Shade Guide.

^{*}After recording the skin colors with two guides (L'Oreal and Revlon), they were combined and recategorized into three groups: light, which included Vanilla, Shell, and Nude shades from the Revlon foundation tones and N1, W1, C1 shades from the L'Oreal foundation tones; medium, which included Natural Beige and Cool Beige shades from the Revlon compact tones and C2, W3, C3 (Medium) and N4, N7, C7 (Medium Dark) from L'Oreal foundation tones; and dark, which included the Golden Beige Shade from the Revlon foundation tones and W8 from the L'Oreal foundation tones. Tooth shades were also divided as follows: highest value group (shades A1, B1, A2, B2); high value group (shades C1, D2, A3, D4); medium value group (shades B3, B4, C2, D3); and low value group (shades A3.5, C3, A4, C4).

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| Tooth shade | Tooth shade value (VPCSG) | | | | | Карра | |
|-------------------|---------------------------|------|--------|-----|-----------|--------------------------|--|
| value (VESIDS) | Highest | High | Medium | Low | Agreement | value, <i>P</i> value | |
| Highest | 307 | 3 | 6 | 1 | | | |
| High | 3 | 35 | 6 | 2 | 02.5 | 0.70% 000 | |
| Medium | 1 | 2 | 14 | 3 | 92.5 | 0.794, .000 | |
| Low | 1 | 1 | 1 | 14 | | | |

Table 3 Observed Agreement and Kappa Value between the L'Oreal and Revlon Skin Shade Guides

| Skin shade – (Revlon) | Skin s | hade (ĽO | real) | 0/6 | Kappa valuo |
|--------------------------|--------|----------|-------|-----------|----------------|
| | Light | Medium | Dark | Agreement | <i>P</i> value |
| Light | 207 | | | | |
| Medium | | 140 | | 100 | 1.000, .000 |
| Dark | | | 53 | | |

| | | Skin color | | _ | |
|---|-------|------------|------|-------------|---------|
| | Light | Medium | Dark | % agreement | P value |
| Visual measurement (VPCS | G) | | | | |
| Highest and high* | 187 | 13 | 7 | | |
| Medium | 119 | 12 | 9 | 50.75 | .130 |
| Low | 47 | 2 | 4 | | |
| Measurement under standard illumination (VESIDS) | | | | | |
| Highest and high* | 189 | 12 | 6 | | |
| Medium | 126 | 6 | 8 | 49.5 | .853 |
| Low | 48 | 2 | 3 | | |

| Table 4 | Observed Agreement Between Skin Color and Tooth Shade Among |
|---------|---|
| | 400 Study Participants |

*For assessing the agreement between tooth shades and skin colors, the four tooth shade

groups were further combined into three groups.

skin color and VPCSG tooth shade values were in agreement on 50.75% of the study sample with no significant agreement (P = .130). The skin color and VESIDS tooth shade values were identical in 49.5% of the study sample with no significant agreement (P = .853; Table 4).

Discussion

The findings of this study suggest that the L'Oreal and Revlon foundation shade guides can determine the correct skin shade with good agreement. The method used to assess the agreement was previously used in the literature.⁴ However, there was approximately 50% agreement between skin shade and tooth shade in this Jordanian population. This finding is similar to the reports of Sabherwal et al.⁵ One message that can be taken from this study is that selecting a proper shade of artificial teeth in edentulous patients should be primarily considered through patient preference and color perception of the dentist. The digital tooth shade guide (VESIDS) can be a satisfactory substitute for classical shade guides to speed up tooth shade selection, as reflected by the substantial agreement between the two guides.

Illumination characteristics can influence the color determination.³ The present study used natural daylight when the visual judgments were performed. However, the International Commission on Illumination (CIE) in 2004 recommended the use of illuminants such as the D65 illuminant (light source simulating the spectral relative irradiance of the CIE standard illuminant D65) for the color evaluation to perform the visual judgments in identical experimental conditions. The visual assessment can be influenced by the observer experience, the quality of the

lighting source, the shade type, and the evaluator's eye color adaptation and metamerism.^{3,5} The present visual assessment of tooth shade and skin color are subjective and somehow lack external validity; therefore, the interpretation of the findings of study should be done cautiously because of the limitation of the research protocol used. Instruments such as the VESIDS select the shades objectively,^{3,5} are less reliant on observer experience (particularly the less experienced operators), and provide more repeatability of the results.^{3,5}

Acknowledgments

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References

- Jahangiri L, Reinhardt SB, Mehra RV, Matheson PB. Relationship between tooth shade value and skin color: An observational study. J Prosthet Dent 2002;87:149–152.
- Sharma V, Punia V, Khandelwal M, Punia S, Lakshmana R. A study of relationship between skin color and tooth shade value in population of Udaipur, Rajasthan. Int J Dent Clin 2010;2:26–29.
- 3. Lagouvardos PE, Tsamali I, Papadopoulou C, Polyzois G. Tooth, skin, hair and eye colour interrelationships in Greek young adults. Odontology 2013;101:75–83.
- Borzabadi-Farahani A, Borzabadi-Farahani A. Agreement between the index of complexity, outcome, and need and the dental and aesthetic components of the index of orthodontic treatment need. Am J Orthod Dentofacial Orthop 2011;140: 233–238.
- Sabherwal RS, Gonzales J, Naini FB. Assessing the influence of skin color and tooth shade value on perceived smile attractiveness. J Am Dent Assoc 2009;140:696–705.

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