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Perception of different combinations of tones of lip vermilion and gingiva on smile attractiveness

Hafiza Armish Siraj[a], Waqar Jeelani[b], Maheen Ahmed[c]

Abstract

Introduction: The lip and gingival tones may affect smile esthetics even when a patient has perfect set of teeth. The aim of this study was to determine the effect of different combinations of tones of lip vermilion and gingiva on the smile attractiveness.

Material and methods: A male and female smile photograph were digitally manipulated to create a range of images of different colors of lip vermilion (L1-wheatish, L2-fair, L3-pink, and L4-dark) and gingiva (G1-wheatish, G2-pink, and G3-dark). Thus, two set of 12 photographs each with various combination of lip vermillion and gingival shades were generated for male smile (ML1G1 to ML4G3) and female smile (FL1G1 to FL4G3). 100 laypersons and 100 dentists evaluated the attractiveness of each image according to the visual analog scale.

Results: In general, ML3G1 image for male smile and FL3G2 image for female smile were rated highest with the mean score of 74.84±19.44 and 70.38±19.68, respectively. The lowest scores for male and female smiles were for ML4G1 (34.85±19.77) and FL4G2 (23.58±22.87). There were significant differences in the mean smile attractiveness scores of ML1G2, ML4G1, FL1G2, FL1G3, FL2G2 and FL2G3 between male and female perceivers and of ML3G2, ML4G2, FL1G2, FL2G3, FL4G2 and FL4G3 between laypersons and dentists.

Conclusions: Dark tones of lip and gingiva were consistently rated unaesthetic while the pink and wheatish tones of lip and vermillion were consistently reported to be more esthetic. The harmony between lip vermillion and gingival tones also affected smile attractiveness with dental surgeons' being more sensitive to it.

Keywords: Gingiva; lip; pigmentation; skin; smile

Introduction

The primary aim of the orthodontic treatment is to produce an attractive and pleasant smile while establishing a functional and stable occlusal and jaw relationships.[1] There are several parameters that control the overall attractiveness of the smile which can be broadly classified into two categories i.e., mini-esthetics, that deals with the tooth lip relationship and micro-esthetics that deals with tooth and gingival characteristics. Among mini-esthetics characteristics, the role of smile symmetry, incisal and gingival display, smile arc, midline shift and buccal corridors have been extensively studied and their acceptable ranges are well defined for different population groups in published literature.[2-5]

The micro-esthetics, though not frequently perceived by layperson, also play an important role in the overall attractiveness of smile. The role of tooth height-width relationships, tooth proportions, connectors, gingival symmetry and form, tooth shade and position, and presence or absence of black

[a] BDS; Resident, Orthodontics, College of Dentistry, Bakhtawar Amin Medical and Dental College, Multan.

[b] Corresponding Author. BDS, FCPS, MOrth RCSEd; Director Orthodontic Residency Program, Associate Professor and Head of Department, College of Dentistry, Bakhtawar Amin Medical and Dental College, Multan.
Email: wjeelani@gmail.com

[c] BDS, FCPS, MOrth RCSEd; Assistant Professor, Department of Orthodontics, College of Dentistry, Bakhtawar Amin Medical and Dental College, Multan, Pakistan.

triangles have also been thoroughly evaluated to determine the optimal ranges which give the most attractive smiles.[2-5]

Despite finishing an orthodontic case according to the published standards of mini-esthetics and micro-esthetics it is not uncommon when either the surgeon or the patient finds that the smile for that particular patient is not as attractive as was desired. Similarly, the perception of smile attractiveness by laypersons is also very subjective. In this regard, several parameters, like the patient's age, lip thickness, facial skin complexion, etc. have been studied but there is limited data available to depict the role of tone of lip vermilion and gingiva on the smile esthetics.[6-9]

Various tones of lip vermilion and gingiva may be present in a patient depending on the fluctuations in the quantity of melanin production and its content in the keratinocytes.[10] In different population groups, there are wide variations in the tone of lip vermilion and gingiva which are primarily determined by the genetic background of a particular individual.[11] Literature emphasize that the lip and gingival tones and the tooth shade should synchronize for optimal smile attractivess.[12] There is significant variation in the skin color in sub-continent region, with the lip tone ranging from fair to dark which is more dramatic than any other ethnic group.[13-16]

The tone of lip vermilion is directly associated with the overall smile esthetics. However, little literature is available to depict the most pleasing lip and gingival tones contributing to smile attractiveness. The aim of the current study was to determine the effect of different combinations of gingival and lip vermilion tones on the smile attractiveness of adult males and females as perceived by dental surgeons and laypersons.

Material and Methods

A cross-sectional study was conducted at the Department of Orthodontics, Bakhtawar Amin Medical and Dental College, Multan. A close-up photograph of an adult male and female with pleasing smile attributes was modified by Adobe Photoshop CC (version 2014, San Jose, CA) digitally along CIELab L* (light–dark), a* (red–green), and b* (yellow–blue) axes. To create different combinations of lip and gingival colors most prevalent in subcontinent population. Rakhewar et al[17] found the four different skins i.e. wheatish fair, pink and dark tones to be most prevalent in subcontinent population. The lip vermilion shade was modified to create these four tones (L1: wheatish, L2: fair, L3: pink, and L4: dark). The gingival shade was altered into three different colors (G1: wheatish, G2: pink, and G3: dark). Thus, two sets of 12 digitally modified photographs using various combination of lip vermillion and gingival shades were generated for males (ML1G1 to ML4G3) and females (FL1G1 to FL4G3), respectively (Figure 1 and 2). An ethical approval was obtained from the institutional research board of Bakhtawar Amin Medical and Dental college (ERC No. 597/21) prior to the data collection.

The sample size was calculated using the findings of Ghani et al.[9] The power was set as 80% and the alpha was set at 0.05. That showed that we needed at least 86 subjects in each group. The sample was inflated to 100 in each group to increase the power of the study. The total sample comprised of 200 subjects, divided into two equal groups i.e., laypersons and dental surgeons. Each group contained equal number of males and female participants. A non-probability consecutive sampling technique was utilized using the following inclusion criteria: dental surgeons who have graduated with a bachelor's level degree in dentistry and adult lay-person aged 18-60 years of age. The color blind individuals were excluded from the study.

The photographs were displayed to study participants using iPad Air (4th generation) in a form of a slide show. The first slide was of the Ichihara chart for evaluation of color blindness followed by various smile combinations randomly ordered for males and females smiles images, respectively. The data from dental clinicians was collected from dental clinicians working at three different

teaching hospitals of Multan. The data for the laypersons was collected from the patient attendants falling in our inclusion criteria at the outpatient departments of three different dental hospitals.

The process of showing photographs was carried out in a quiet room with dim lights. The presentation was displayed to the study participants at a time convenient for them. The photographs were shown in a random order to each participant. A rest period of 5 seconds was given to reduce eye fatigue after each photograph. A blue color slide was displayed in this rest period. The participants were asked to grade the smile attractiveness of each photograph from a grade of 0 to 100 with the 0 being least attractive and 100 being the most attractive. The participants were allowed to take as much time as needed to grade a photograph.

The data was analyzed using SPSS Version 20.0. The mean attractiveness rating was calculated for each photograph using descriptive statistics. The Shapiro-wilk test was applied to check the normality of the data that showed a normal distribution that parametric tests were used to analyze our data. The mean attractiveness ratings for each smile photograph were compared between males and females and dental surgeons and laypersons using independent sample t-test. A p-value <0.05 was considered as statistically significant.

Results

The mean ages of the laypersons and dental surgeons who participated in this study were 23.00 ± 2.98 and 24.59 ± 3.26 years, respectively. In general, the ML3G1 image (pink lips, wheatish gingiva) for male smile and FL3G2 image (pink lips, pink gingiva) for female smile were rated highest with the mean score of 74.84 ± 19.44 and 70.38 ± 19.68, respectively. The lowest scores for male and female smiles were for ML4G1 image (dark lips, wheatish gingiva) and FL4G2 image (dark lips, pink gingiva) with the mean attractiveness scores of 34.85 ± 19.77 and 23.58 ± 22.87, respectively.

When the gender based comparisons were made for male and females smiles, there were significant differences in the mean attractiveness scores of ML1G3 and ML4G1 for male smile and FL1G2, FL1G3 and FL2G2 and FL2G3 for female smiles (p<0.05) (Tables 1).

The ML3G1 and FL3G2 images were graded as the most attractive by both dentists and laypersons. There were significant differences in the mean smile attractiveness scores of ML3G2, ML4G2, FL1G2, FL2G3, FL4G2 and FL4G3 between laypersons and dentists (p<0.05) (Table 2).

Table I: Comparison of smile attractiveness scores for different smile photographs between male and female participants

Smile Image	Male Mean±SD N = 100	Female Mean±SD N = 100	p
ML1G1	65.60±22.243	65.09±25.378	0.880
ML1G2	63.98±21.038	60.18±22.365	0.217
ML1G3	51.77±24.222	44.57±22.889	0.032*
ML2G1	42.43±24.850	38.61±24.193	0.272
ML2G2	33.62±19.621	36.08±19.946	0.380
ML2G3	40.48±22.788	39.46±20.049	0.737
ML3G1	74.43±20.332	75.25±18.603	0.766
ML3G2	67.62±20.859	64.42±19.005	0.258
ML3G3	41.14±22.158	39.86±19.476	0.665
ML4G1	33.65±16.725	38.74±17.692	0.038*
ML4G2	39.07±21.128	36.31±18.585	0.328
ML4G3	46.50±21.136	47.14±20.897	0.830

FL1G1	65.53±20.748	70.99±19.268	0.055
FL1G2	55.16±23.376	63.92±22.962	0.008*
FL1G3	54.74±23.728	62.10±23.508	0.029*
FL2G1	41.09±22.144	47.14±24.760	0.070
FL2G2	42.11±21.098	49.03±21.724	0.023*
FL2G3	41.34±20.920	49.16±21.586	0.010*
FL3G1	66.78±19.299	65.79±19.652	0.997
FL3G2	72.00±20.865	68.75±18.400	0.244
FL3G3	34.47±19.045	29.55±23.291	0.093
FL4G1	23.64±22.115	26.66±23.472	0.350
FL4G2	23.07±21.719	24.08±24.070	0.756
FL4G3	34.74±25.940	36.79±27.602	0.589

Independent Sample T-test; *p value< 0.05

M-male; F-female; L-lip; G-gingiva

Table II: Comparison of smile attractiveness scores for different smile photographs between laypersons and dentists

Smile Image	Laypersons Mean±SD N = 96	Dentists Mean±SD N = 104	p
ML1G1	64.65±23.940	66.04±23.767	0.681
ML1G2	59.90±22.426	64.26±20.918	0.157
ML1G3	50.31±23.383	46.03±24.098	0.204
ML2G1	39.98±25.256	34.81±19.186	0.756
ML2G2	34.89±20.440	34.81±19.186	0.977
ML2G3	41.22±19.548	38.72±21.314	0.410
ML3G1	73.64±19.577	76.04±19.331	0.384
ML3G2	62.86±20.853	69.18±18.613	0.025*
ML3G3	39.91±20.346	41.09±21.366	0.690
ML4G1	38.59±16.839	33.80±17.626	0.051
ML4G2	42.29±19.786	33.09±20.085	0.021*
ML4G3	44.74±22.147	48.90±19.638	0.196
FL1G1	69.14±20.401	67.38±19.976	0.538
FL1G2	62.30±25.180	52.78±21.517	0.007*
FL1G3	62.55±24.407	54.29±22.646	0.024
FL2G1	46.79±23.214	41.44±23.854	0.110
FL2G2	46.90±22.097	44.24±21.199	0.386
FL2G3	46.90±23.792	35.60±19.051	0.010*
FL3G1	66.46±19.918	65.11±21.030	0.642
FL3G2	71.90±20.236	68.85±19.107	0.274
FL3G3	34.13±21.099	29.89±21.540	0.161
FL4G1	23.93±21.961	26.37±23.650	0.451
FL4G2	23.48±22.271	35.67±28.326	0.003*
FL4G3	31.49±28.326	40.04±24.278	0.012*

Independent Sample T-test; *p value< 0.05

M-male; F-female; L-lip; G-ginigiva

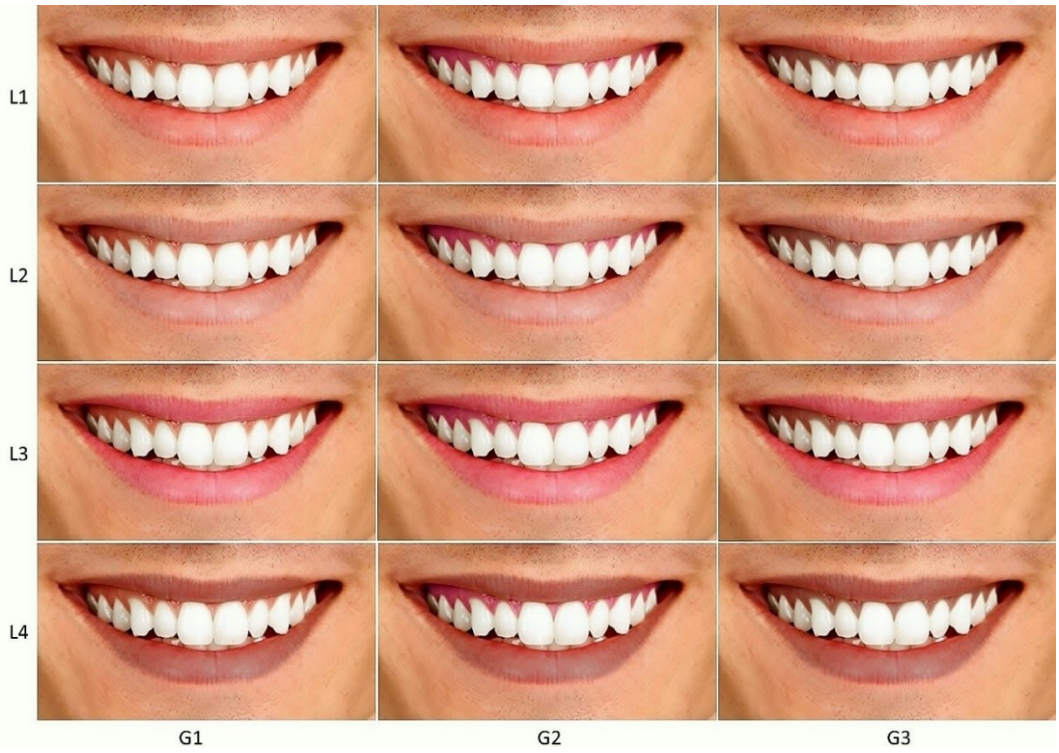

Figure 1: Different combinations of lip vermillion and gingival tones for male smile. Lip vermillion colors (L1-wheatish, L2-fair, L3-pink, and L4-dark), gingival tones (G1-wheatish, G2-pink, and G3-dark)

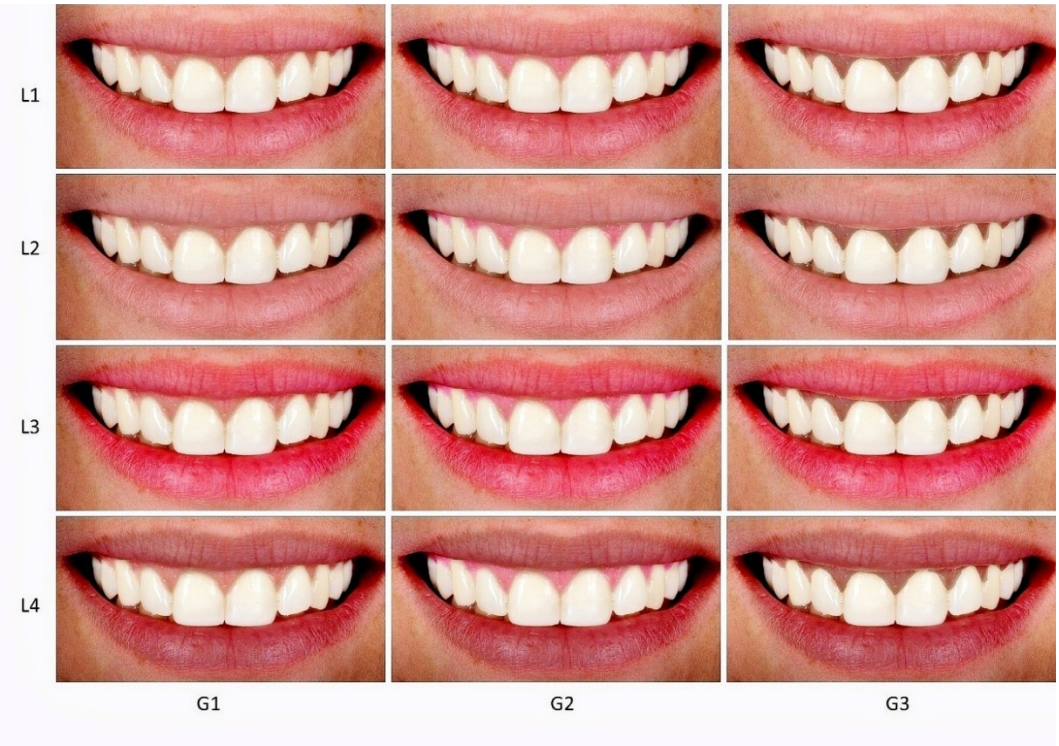

Figure 2. Different combinations of lip vermillion and gingival tones for female smile. Lip vermillion colors (L1-wheatish, L2-fair, L3-pink, and L4-dark), gingival tones (G1-wheatish, G2-pink, and G3-dark)

Discussion

In the modern era, patients' autonomy in the decision-making process is more important than ever. Every treatment plan must be thoroughly discussed to achieve adequate patient satisfaction especially when esthetics are considered. The teeth, lips and gingiva form basic elements to achieve an ideal smile via which patients deem a treatment successful. The primary objective of this study was to determine the preference for the lip vermillion and gingival shade so that a multidisciplinary team approach may be utilized to achieve maximum patient satisfaction.

In the current study, pink and wheatish lip tones were consistently given better scores than the fair and dark lip tones. The pink and wheatish lip tones were associated with greater deviation towards red and yellow in CIELab a* (red–green), and b* (yellow–blue) axes, respectively. While the dark lips had deviation towards dark and blue in L* (light–dark) and b* (yellow–blue) axes, respectively. The reddish tone of lip is associated with youthfulness, freshness and better health while the dark bluish tone of lip is associated with racial pigmentation, old age, smoking and dryness.[18,19] Our findings for the most attractive and least attractive lips tones are in accordance with the findings of previous studies.[14,15,18-20]

Labban et al[15] reported that the lighter tooth shades were preferred for lighter skin tone and darker tooth shades were preferred for darker skin tones.[15] The wheatish (FL2G2, FL2G3) and fair (FL1G2, FL1G3) lip tones for female smile were significantly rated higher by female participants than the male participants, showing their acceptance of a less pink/red tone. However, male participants gave more scores to the female smile with pink lips as compared to the female participants, but this difference was statistically insignificant.

There are several reports that assess the relationship between various lip tones and tooth shades. However, fewer studies assessed the relationship between gingival tones and smile attractiveness.[9,13,16,17] Gingival pigmentation usually does not present as an area of concern for majority of the patients but whenever there is excessive gingival display on smile it affects smile attractiveness.[21] Gingival display during social smile vary from none to several millimeters. Öz et al[20] reported that gingival display more than 3mm and buccal corridor width greater than 16% should be avoided to achieve accepted smile esthetics. In the current study, we used smile images with normal gingival display to allow raters to focus on lip and gingival tones.

The current study reports that the dark gingival tones are consistently rated lower than the wheatish and pink gingival tones. There is a strong relationship of facial skin complexion with gingival tissue pigmentation. People having fair skin complexion tend to have mild gingival tissue pigmentation, whereas people having darker skin complexion tend to have a moderate to severe gingival tissue pigmentation respectively.[22,23] The usual color of gingiva in Caucasians is pale pink to coral pink,[16] while African and Asian have brown to blue black gingiva tone.[24] When esthetics is a major consideration, the gingival hyperpigmentation can be treated by periodontal plastic surgical procedures or gingival display may be reduced using surgical or orthodontic treatment modalities.[25] Tal et al[26] reported an increasing frequency of patients seeking treatment for unaesthetic gingival pigmentation. Depigmentation is not a necessary and compulsory procedure but a treatment of choice where patient is much more conscious about esthetics.[23]

As far as different attributes of smile esthetics are considered, the literature reports considerable variation in perception of smile esthetics between patients and dental surgeons.[4-6,18,20] For example, Tosun et al[4] concluded that laypersons preferred more lip coverage of the maxillary incisors as opposed

to Orthodontists. Similarly, in the current study, there were significant differences between the perception of laypersons and dental surgeons about the smile attractiveness of different combinations of lip vermillion and gingival tones; particularly, where the lip vermillion and gingival shades were not in harmony with each other (i.e. ML3G2, ML4G2, FL1G2, FL2G3, FL4G2). The most dramatic drop in attractiveness score were recorded when the most attractive lip tone L3 (pink) was used in combination with least attractive gingival tone G3 (dark). Interestingly, dental surgeons gave significantly better scores to FL4G3 (dark lips, dark gingiva) as compared to the laypersons. These results suggest that the dental surgeons are more sensitive to the color harmony between lips and gingiva as compared to the laypersons.

Lakshami et al[27] modified the Fitzpatrick scale, von Luschan scale and the scale of dermatological assessment of skin complexion according to the Indian population and classified skin tones into seven broad categories. Similarly, there are several methods reported in literature to categorize gingival tones and pigmentations.[13,16,17] In the current study, we aimed at investigating the effect of those lip and gingival tones that are more prevalent in subcontinent population.

The limitation of our study include that only limited number of combinations of lip vermillion and gingival tones were evaluated. Secondly, only the most prevalent shades in subcontinent population were assessed in the current study. Thus, the results of the current study cannot be generalized to other population groups which have different tones of lip and gingiva and have different perception about smile esthetics. Since, the lip and gingival depigmentation is become more common, a universal shade guide system should be commercially available to standardize the clinical treatment and research from all around the globe.

Conclusions

The variations in color of lip vermilion and gingival color had a major role in smile attractiveness. Dark tones of lip and gingiva were consistently rated unaesthetic by both laypersons and dental surgeons. The pink and wheatish tones of lip vermillion were consistently found to be more esthetic. Female participants had the tendency to give better scores to fair and wheatish lips than the male participants. The harmony between lip vermillion and gingival tones also affected smile attractiveness. Dental surgeons' were found to be more sensitive to the harmony between the lip vermillion and gingival tones.

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