JKGUI 2003; 10(Edisi Khusus) :21-25
Diterbitkan di Jakarta

Jurnal Kedokteran Gigi
Universitas Indonesia
ISSN 0854-364X

NEW METHOD USING IMAGE ANALYSIS TO MEASURE GINGIVAL COLOR

Takayoshi Tsubai*, Mansjur Nasir, Hasanuddin Thahir**,Mardiana A.Adam**,**
Rungnapa Warotayanont*,J.E. Scott*****

*Faculty of Dentistry University of Manitoba,
** Faculty of Dentistry Hasanuddin University,
***Faculty of Dentistry Thammasat University,

Takayoshi Tsubai, Mansjur Nasir,Hasanuddin Thahir, Mardiana A.Adam, Rungnapa Warotayanont, J.E. Scott: New Method Using Image Analysis to Measure Gingival Color. Jurnal Kedokteran Gigi Universitas Indonesia. 2003; 10(Edisi Khusus): 21-25

Abstract

For many years, observations of gingival color has been a popular area of dental research. However these methods are hard to analyze for any other than the different base conditions and colors. Thus we introduced an alternative method using image analysis to measure gingival color. For the research we performed a dental examination on 30 female students.

The system is set up by aligning the camera area and facial area. The subject's chin is placed in a fixed chin cup mounted 30 cm from the camera lens. Each image is acquired such that comparisons may be made with the original bite holder as well as a standard color scale. After converted to computer we used a curves dialog box for color adjustment. The curves dialog box allows adjustment of the entire tonal range of an image.

The results of the analysis of the free gingiva compared to the attached gingiva are that attached gingiva was more vivid red and yellow compared to the free gingival. In conclusion, the system described herein of digital capture and comparison of color images, analysis and separation in three channels of free and attached gingival surface images and matching with colorimetric scales may be useful for demonstrating the diversity of gingival color as well as analyses of gingival health.

Key words: Image analysis; gingival color

Introduction

For many years, observations of gingival color have been a popular area of dental research. Special colorimetry and color chips have been employed by many researchers to aid in estimation of gingival color [1-5]. However these methods are hard to analyze for any other than the different base conditions and colors. Another method using colorimeter is a convenient method for comparing with visual color matching [6,7]. However this method is limited in use due to the cost of the materials, being generally very expensive to implement. We introduced here an alternative new method using image analysis to measure gingival color.

Materials and Methods

We performed a dental examination on 30 female students in Kansai Woman's College. They were from 18 to 20 years of age and had no obvious periodontal disease. An experimental gingival area was identified between the right lower canine and the left lower canine. The limit of free gingiva and attached gingiva was identified using gutta percha point for mark. Half of the point is inside the gingival pocket and another half is outside. Two images were acquired, one being inside and one outside this point (Fig.1). After taking pictures, converted to computer and image analyzed by application software (Adobe Photoshop 5.5 : Adobe system)

Physical System

The system is set up by aligning the camera area (Sony LCD-700) and facial area as shown in Figure 2. The subject's chin is placed in a fixed chin cup mounted 30 cm from the camera lens. Lip retractors are used to allow uniform lighting of the teeth and obtain unobstructed images [8]. Each image is acquired such that comparisons may be made with the original bite holder as well as a standard color scale (casmach: youwa.Japan) as shown as Fig 3. Analyzing original

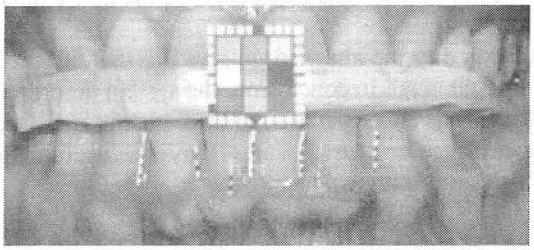

Fig.1. The limit of free gingiva and attached gingiva

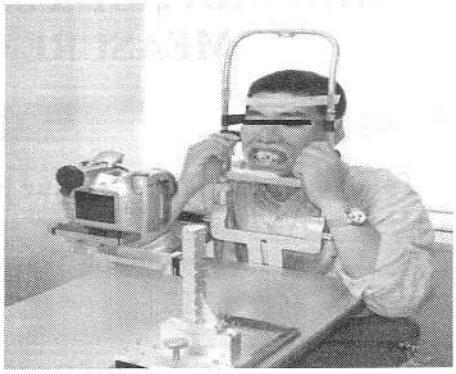

Fig.2. The system is set up by aligning the camera and facial area

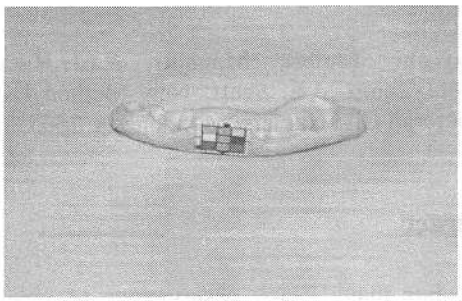

Fig.3. Original bite holder with standard color scale

Analysis of the photo image is done in the following manner:

1. File > Open
   Open your original file by digital camera
2. Toolbox> the marque tool
3. Image> Crop
   Use the marque tools to limit the area for analysis
4. File> Save as
   Save file as another name

1. Window> Show channels> Color channels > Red (Green, Blue) Fig.4
2. Image> Mode > Grayscale >Discard other channels >OK
   Change RGB color to Grayscale Fig.5
3. Toolbox > the eyedropper tool
   Click the eyedropper tool to your request (color bar)
4. Window > Show color
   Read Lut index on the color bar (better to include Black and White color)
5. File > Save as.
   Save as (for example 0001R.bmp)

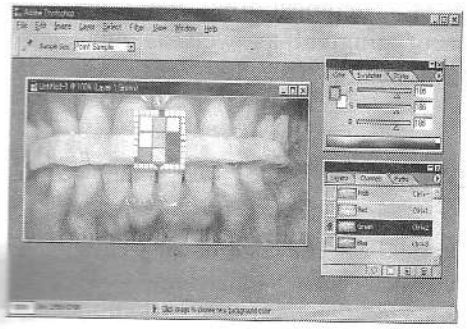

Fig. 4. RGB color channels

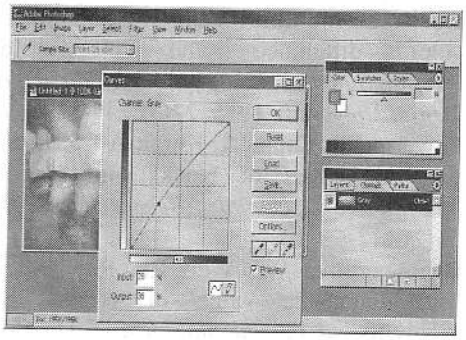

Fig. 5. Gray scale

Analysis of many images at the same time and with the subjects in identical positions allows the determination of an average index (standard location index). Thereby providing comparison reference points for validity of the measure as well as a means for comparison for future measures.

Color adjustments and Analysis of gingival color

1. In this study we used a curves dialog box for color adjustment. The Curves dialog box allows adjustment of the entire tonal range of an image. With Curves you can adjust any point along a 0-255 scale (LUT index). You can also use Curves to make precise adjustments to individual color channels in an image. After adjusting all images to standard index, analysis of each gingival color is possible. File> Open
   Open your original grayscale file (for example 0001R.bmp)
2. Image > Adjust > Curves
   Put input value % (original index) output value % (standard index). Black color makes shadows and White color makes Highlights
3. Toolbox > the eyedropper tool
   Click the eyedropper tool to gingiva area and analyzing color scale. If color scale is 100% this means Lut index is 0.Lut index = 255-(255 × color scale(%))
   Analyzing other colors similar to that outlined above for the red scale.

Results

The results of the analysis of the free gingiva compared to the attached gingiva are shown in Table 1. Comparison of three colors showed that Red was brightest, followed by Green and Blue. Although the largest difference was not observed when comparing Red between the free gingiva and attached gingiva, significant differences were measured in the comparison of free gingival and attached gingival surfaces in both Green and Blue. Next RGB color coordinates of the images were converted into CIE by the simple method. This analysis showed that attached gingiva was more vivid red and yellow compared to the free gingival.

Table 1. The results of the free gingiva compare to the attaced gingiva

	Free gingiva		Attaced gingiva	
	average	SD	average	SD
R	210.6	6.5	206.6	6.7
G	153.2	7.7	140.8	10.3
B	147.8	8.0	132.4	10.7

Discussion

Gingiva exists in the oral cavity in a continuity of complicated and curved surfaces.[1] Therefore, as a method of choice rather than colorimetry by optical instruments, the method of visual color matching by arranging attendant color chips were employed in this study for gingival color. We used a digital camera interfaced with a computer, because it was capable of acquiring digital images for comparison with a color bar, measuring Lut index and displaying and quantifying the computed results.[9]

We can separate the resulting color image into multiple channels by using image analyzing techniques for example RGB. Images accrued in the lab have three channels; CMYK images have four channels. RGB assigns an intensity value to each pixel ranging from 0 (black) to 255 (white) for each of the three RGB components in the color image. For example, a bright red color might have an R (red) value of 246, a G (green) value of 20, and a B (blue) value of 50. On the other hand when the values of all three components are equal, the result is a shade of neutral gray. When the value of all components is 255, the result is pure white; when the value is 0, pure black. For examination of gingival color it is easier to separate each channel rather than analyze all at once. In present study, the results show marked differences between the color compositions of the free gingiva compared to the attached gingiva. The Blue and Green levels especially in the Lut index were considerably higher than the Red. Most previous visual research of the gingival color indicates considerable contributions of red and violet, suggesting. Blue and green are important for display. Since color analysis of the most refractive colors indicate additive complementary colors, in this case Blue and Green are additive complementary colors to red and violet. Thus it is important to measure alterations of Blue and Green colorations in the examination of both the free and attached gingival surfaces. In conclusion, the system described here in of digital capture and comparison of color images, analysis and separation in three channels of free and attached gingival surface images and matching with colorimetric scales may be useful for demonstrating the diversity of color of gingival as well as analyses of gingival health.

References

1. Ibusuki M. The color of gingiva studied by visual color matching. Part II. Kind,location, and personal difference in color of gingiva. *Bulletin of Tokyo Medical & Dental University* 1975; 22(4):281-92
2. Ibusuki M. The color of gingiva studied by visual color matching. Part I.Experimental studies on the discrimination threshold for color difference and effect of training.*Bulletin of Tokyo Medical & Dental University* 1975; 22(3):249-61
3. Powers JM, Capp JA, Koran A . Color of gingival tissues of blacks and whites. Journal of Dental Research 1977; 56(2):112-6
4. Baumgarartner WJ ,Weis RP, Reyher L : The diagnostic value of redness in gingivitis. *J Periodontal* 1961; 32, 261-267
5. Ishiwaka N. A study on colormetric method for gingiva *(in Japanese).* Kokubyo Zasshi 1958; 25: 611-621
6. Matis BA, Mousa HN, Cochran MA, Eckert GJ. Clinical evaluation of bleaching agents of different concentrations. *Quintessence International* 2000; 31(5):303-10
7. Douglas RD, Przybylska M. Predicting porcelain thickness required for dental shade matches. *Journal of Prosthetic Dentistry.* 1999;82(2):143-9

8. Ogata C,Tsubai T, Koike T, Hata Y, Iwai Y, UedaM Imai H. Effect of light source on digital images *(in Japanese). Journal of Osaka Odontological Society* 2002; 65(3) 217-224
9. Takiwaki H, Kanno Y, Miyaoka Y, Arase S. *Computer situmilation of skin color based on a multilayered skin model.* Skin Research and Technology 1997; 3 36-41