The Impact of Age on Tooth Color

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ABSTRACT

The aim of this study was to determine the impact of age on tooth color. Characterizing tooth color by matching intact human teeth with fabricated shade guides of porcelain or plastic is difficult to repeat due to lighting conditions and grader bias. Contact colorimeter measurements are invasive and cumbersome. A method was developed that allows for repeatable, non-contact, objective reporting of intact human tooth color using the PhotoResearch PR650 spectrophotometer. Tooth color is reported in CIELAB color space, and a circular area of 5.25 mm diameter was selected as the target area of each central maxillary incisor. Reproducibility of L*, a*, b* was found to be <0.5 units for each parameter. Changes noted in tooth color can be examined by individual parameters. 213 subjects, ranging in age from 13 to 65 were assessed for tooth color. The color parameters were reported as L* (lightness), a* (red-green) and b* (yellow-blue). Four age groups were monitored: 13-17, 18-34, 35-44, and >45. Using the Student-Newman-Keuls test, differences in L* were significantly reduced ($p<0.05$) at each age group; 13-17 and 18-34 age groups were significantly increased from 35-44 and >45 age groups on the b* parameter.

	13-17 n=45	18-34 n=53	35-44 n=70	45+ n=45
L*	76.5 ± 3.0	73.3 ± 3.6	70.7 ± 3.7	69.6 ± 3.8
a*	5.8 ± 1.0	5.8 ± 1.2	5.9 ± 1.3	6.9 ± 1.8
b*	17.3 ± 2.8	18.4 ± 2.5	20.4 ± 3.1	21.1 ± 3.3

This study showed quantitatively the effects of age on tooth color to be a decrease in lightness (L*) and an increase in yellow (b*) using a non-contact spectral measurement system.

MATERIALS AND METHODS

Instrumentation: Tooth color measurements were taken of each subjects' facial, maxillary central incisors using a PhotoResearch PR650. This instrument is a non-contact spectrophotometer manufactured by PhotoResearch, a division of Kollmorgan Instrument Laboratories, CA. Capabilities included are spectral reflectance and chromameter instrumentation.

The PR650 is mounted ~30 cm from the plane of the tooth surface. Lighting is simulated D65 Northern Daylight (without the UV component) using four Dedolight lamps and OSRAM Xenophot HLX 12V, 100W bulbs, with heat and polarizing filters.

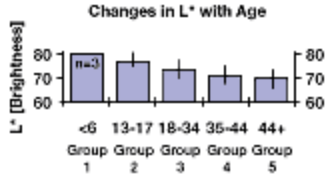
The angle of incident light was 45° and the observation angle 0°. The voltage was regulated to maintain constant lighting conditions over time. The PR650 was calibrated every hour using a white reflectance standard.

Figure 1. Set up for color measurements

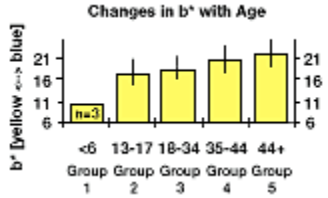
Subjects were instructed to brush their teeth with Crest® AFC dentifrice prior to measuring, and used cheek retractors to permit proper illumination of the tooth surfaces. Subjects were also asked to align the incisoral tips of the upper and lower teeth.

A circular area of 5.25 mm diameter centered on each incisor of tooth # 8 and 9 were measured in duplicate and the data averaged for each individual. The averaged data were grouped according to subjects' age and statistically analyzed by the Student-Newman-Keuls test.

RESULTS



All age groups are significantly different from one another ($p<0.05$)



Groups 2&3 are significantly different from groups 4&5 ($p<0.05$)

Group 1 is sized too small for significance testing

After the study, a small group of children's teeth were measured to include the color of deciduous teeth.

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A digital image of each subject was captured using a Fujix HC1000 digital camera to retain a visual record of the overall appearance of the teeth. Following is a representation of the average tooth color for age groups 1, 3 and 5.

Group 1

Group 3

Group 5

CONCLUSION

Within the age groups chosen for this study, as a tooth ages, it becomes darker (- L*) and more yellow (+ b*). All age groups shown are significantly different from one another with respect to L*. The PR650 is a consumer friendly, reproducible (< 0.5 units) method for assessing tooth color. An advantage of this non contact method is -- by illuminating the whole tooth surface and measuring a small observation area, tooth translucency is accounted for.

Note: Literature suggests this decrease in L* is due in part to continual intratubular dentin formation, the retraction of odontoblastic processes within the dentinal tubules, and erosion of the enamel. (ten Cate, 1997) Habits and practices, diet, trauma, medications and tooth orientation also can contribute to the color of teeth.

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