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SHADE GUIDE LIGHTS: TECHNICAL EVALUATION

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The purpose of this study was to determine if the use of shade guide lights would increase the frequency of which evaluators would select the same tooth shade. Tooth shades were taken of natural teeth using the Efos Esthelite, Vident Lumin Shade Light, ambient room light, and the unit light. Selected shades were recorded and results were analyzed. This evaluation showed that shade lights do not appreciably influence shade selection.

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SHADE GUIDE LIGHTS: TECHNICAL EVALUATION

INTRODUCTION

The ability to determine the correct color of natural dentition has always been difficult.   Apparent color is affected by direct and reflected light. Operatories and dental laboratories have been equipped with a variety of light sources with little consideration of reflectant surfaces.   According to the manufacturers, shade lights are color corrected to normal daylight and provide sufficient illuminance to prevent interference of reflected light source.

The primary objective of shade reproduction is agreement between individuals on shade matching.   The purpose of this study was to determine if the use of various shade guide lights would increase the frequency of which evaluators would select the same tooth shade.

TEST METHODS AND MATERIALS

Using a Vita Lumin shade guide with the shade numbers covered, shades were taken by seven dentists and one dental laboratory technician on five natural teeth using the Efos Esthelite, Vident Lumin Shade Light, dental unit light (Ritter Starlight), and ambient room light (Duro Test Vita-Lite).   Room color conditions were neutral to minimize reflectant light.   To ensure a typical cross-section of individuals, evaluators were not preevaluated for color deficiencies.   Results were then grouped separately according to hue and value.

An ideal light source should allow a diverse group of observers to record similar selections of hue and resultant value; therefore, the results were ranked accordingly.   These rankings were analyzed by determining their Kendall Coefficients of Concordance and resultant "P" values.

The following shade lights were tested:

Efos Esthelite	Unit Cost $300.00	Caulk/Dentsply P.O. Box 359 Milford, DE 19963 1-800-532-2855
Vident Lumin Shade Light	Unit Cost $395.00	Vident 5130 Commerce Dr Baldwin Park, CA 91706 1-800-828-3839

RESULTS

A SpectraScan was completed on each shade light. The results were:

	Esthelite	Lumin shade light
Illuminance in foot candles (fc)	100	130
Color temperature in Kelvin (K)	4647	5668
Dominant wave in nanometers (nm)	485.31	487.15

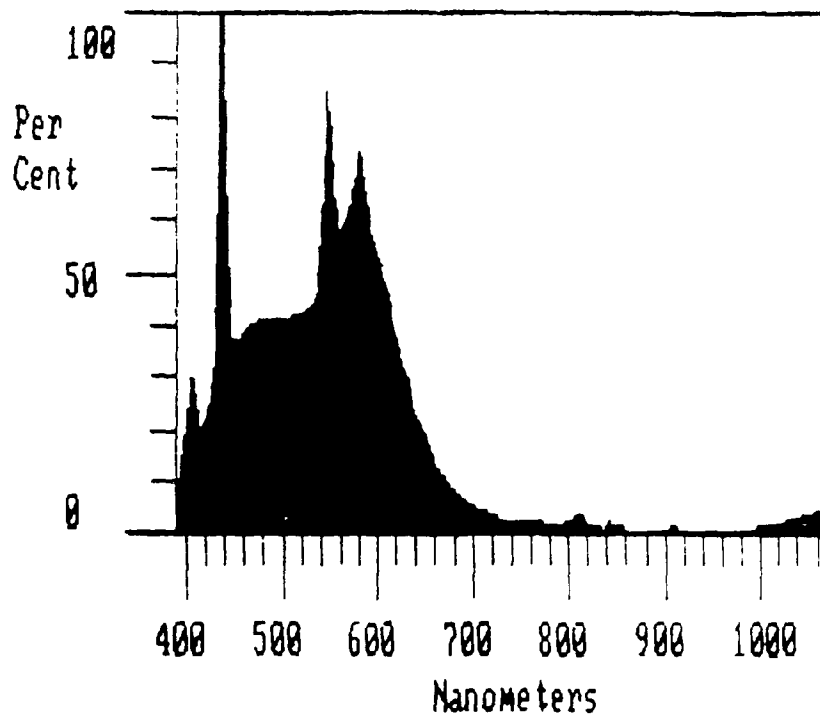The distribution of spectrum-specific energy is shown in Figures 1 and 2.

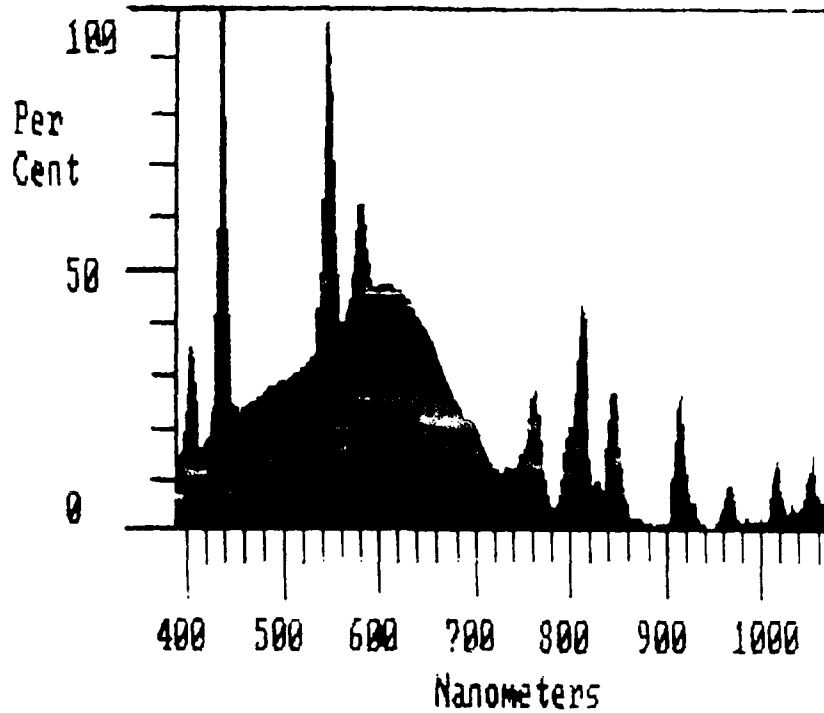Figure 1. Spectrum-specific energy: Vident Lumin Shade Light.

Figure 2. Spectrum-specific energy: Efos Esthelite.

Value Results

The Vita shades were numbered from 1 to 16 according to the resultant value with B1 being the highest value and C4 being the lowest value. Note: The value of each shade does not change in exactly even increments and the following data is useful only when comparing lights against each other. The following data is the average mean and standard deviation of all the shades of teeth:

	Mean	Standard deviation
Ambient Room Light	9.7	2.5
Dental Unit·Light	9.1	3.2
Vident Lumin Shade Light	9.4	2.7
Efos Esthelite	9.5	2.4

Hue Results

Selected natural tooth shades were grouped according to hue, shades A, B, C or D. The appendix contains charts which represent the shades selected and grouped by hue. The following data is a comparison of selected hues:

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	"A" shades reddish brown	"B" shades reddish yellow	"C" shades gray	"D" shades reddish gray
Ambient Room Light	47.5%	27.5%	10%	15%
Dental Unit Light	40%	30%	17.5%	12.5%
Vident Lumin Shade Light	35%	27.5%	5%	32.5%
Efos Esthelite	37.5%	22.5%	7.5%	32.5%

Shade Matching Results

The following data is the percentage of times different individuals selected the exact same shade and also the number of times a shade directly adjacent was selected. These results are based on hue and value.

	Ambient Room Light	Dental Unit Light	Vident Lumin Light	Efos Esthe- lite
Selected same shade based on hue and value	9.4%	8.1%	10%	10%
Selected same shade or adjacent shade based on hue	11.9%	11.2%	12.5%	12.5%
Selected same shade or adjacent shade based on value	12.5%	12.5%	15%	13.8%

"P" Values from the Kendall Coefficient of Concordance

For hue:

Vident Lumin Light	Ambient Room Light	Efos Esthelite	Dental Unit's Light
.096	.24	.30	.86

For value:

Ambient Room Light	Efos Esthelite	Dental Unit's Light	Vident Lumin Light
.0094	.089	.18	.79

DISCUSSION

The ability of different individuals to select the same shade remains a problem. Using all the different light sources, individuals agreed on the exact same shade only 29.3% of the time. The remaining 70.7% of the time a wide variety of shades was selected. While these data are slightly higher than similar studies, this is most likely due to individual variations and light source or object variables.* While we have little control over the observer or the object variables, the light variable can be closely controlled.

Historically the ideal light source for shade selection chair side and in the laboratory is from a black body emitter at 5500 $^{\circ}$K (equivalent to natural sunlight). A characteristic of fluorescent lights is spikes of different wavelengths which are combined to produce a white or neutral light. This increase in spectral energy normally increases the amount of violet, green, and yellow which the light produces. These wavelength spikes may influence how different objects are perceived. The Efos Esthelite has a color temperature of 4647 $^{\circ}$K and the normal fluorescent wavelength spikes. The Vident Lumin Shade Light has a color temperature of 5668 $^{\circ}$K, smaller wavelength spikes, and a more even spectral distribution curve that better represents natural daylight.

When selecting a shade of a natural tooth, the light intensity is related to the value of a perceived shade. The lower the illuminance, the lower the selected value. During the test, the illuminance of the ambient room light was 79 fc, thus causing individuals to select lower values. The illuminance of the Efos Esthelite was 100 fc and the Vident Lumin Shade Light was 130 fc. Each shade light produced shades of similar values. The dental unit light had an illuminance of 1200 fc, thus causing individuals to select a tooth shade which was significantly higher in value.

During the evaluation individuals felt the ambient room light did not offer sufficient lighting. The Efos Esthelite required the user to hold the light 5.08-7.62 cm (2-3 in.) from the tooth and to look directly through the light ring for shade selection. Most users felt the Efos Esthelite was better than ambient room light but was still quite dim. The Vident Lumin Shade Light was held 20.3-25.4 cm (8-10 in.) from the tooth, which allowed the user to look through the light ring or to hold the light to one side. This technique and light were preferred by most operators. The dental unit light caused few apparent illumination problems; however, this light source resulted in the greatest variation in shade selection (SD = 3.2). This variation is most likely due to the intensity of the light source, variety of distance each operator placed the light source from the natural teeth, and the angle of the light causing possible glare.

When selected natural tooth shades were grouped according to hue, the shade light results were quite similar. Results varied with the ambient room light and the dental unit light. This variation was most likely due to the possible light reflection of the surrounding surfaces and either poor or inconsistent illuminance. See Appendix for color comparisons.

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*Nakagawa, Y., et al. Color analysis of shade guides. Shikai Tenbo 48(1):1-9, 1976.

Use of the Efos Esthelite or the Vident Lumin Shade Light only slightly increased the observers' ability to consistently select shades. Using either shade light showed an improvement of 0.6% over ambient room light and 1.9% over the dental unit light. The greatest increase (2.5%) was in the comparison of the Vident Lumin Shade Light over the ambient room light and the dental unit light when selecting the same shade or adjacent shade based on value.

Analyzing the "P" values (from Kendall Coefficient of Concordance) gives a measure of agreement for ranking hue and then value, by this group of observers. These analyses do NOT represent exact shade agreement, only shade ranking. A large "P" value indicates a large amount of randomness in their answers. For hue the Vident Lumin Shade Light gave the best agreement, the ambient room light, Efos Esthelite, and finally the dental unit's light in decreasing order of agreement. Since none of the lights gave a "P" value less than .05, these results are not significant.

For value, the ambient room light gave the best agreement, the Efos Esthelite, dental unit light, and finally Vident Lumin Shade Light yielded decreasing degrees of agreement. The ambient room light gave significant agreement between the observers for ranking of value (P <.01), the rest of the lights did not give significant agreements between the observers (P >.05). Note that these analyses do not necessarily mean the observers chose the same value under the room light, but they did rank the value of the selected shades in a similar manner.
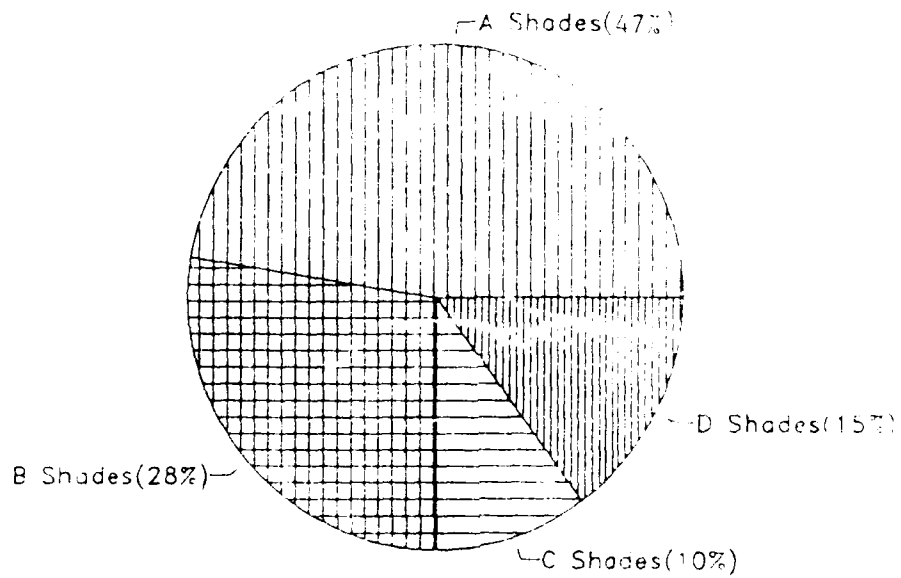
CONCLUSIONS AND RECOMMENDATIONS

Many times tooth shades are selected without consideration as to the type of light in which the patient is most likely to be observed. If shade selection is accomplished under ideal light sources and the patient is most often seen under non-color-corrected fluorescent lighting, possible metamerism will occur. Therefore, every effort should be made to select tooth shades and make all color corrections in each patient's normal light. Regardless of the light source used to take a shade, the exact same light source (same spectral distribution and illuminance) should be used in the laboratory.

This evaluation showed the use of shade lights only slightly improves results on selecting the same shade or adjacent shade, but does not increase the probability of agreement between operators. Because of the lack of agreement of these observers, shade lights apparently do not appreciably influence shade selection. Individual conditions and techniques will determine if a shade light will be effective; however, the user must be aware of other determining factors for effective shade selection.
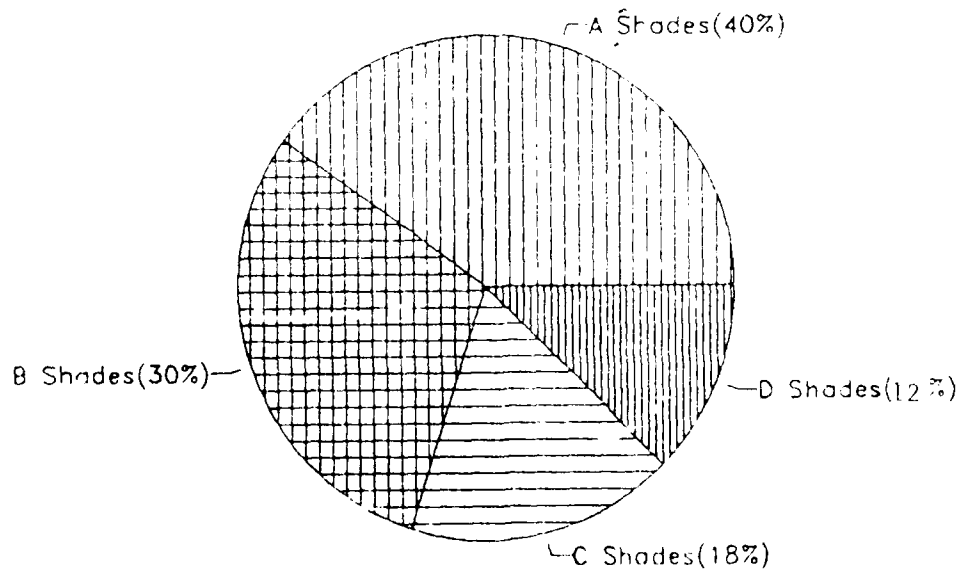
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APPENDIX

COLOR COMPARISON CHARTS

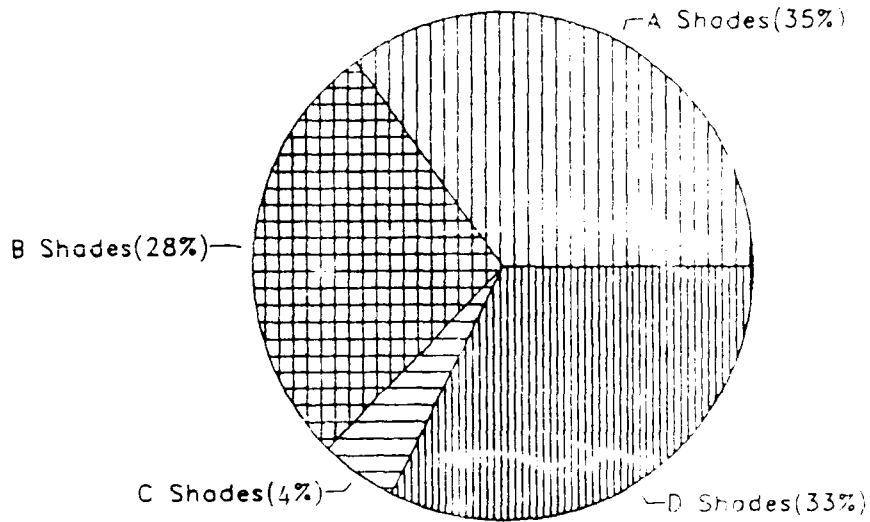Following are charts which represent the shades selected and grouped by hue.

Color Corrected Fluorescent Room Lights

A Shades(47%)

D Shades(15%)

B Shades(28%)

C Shades(10%)

Ritter Starlight

A Shades(40%)

B Shades(30%)

D Shades(12%)

C Shades(18%)

Vident Lumin Shade Light

A Shades(35%)

B Shades(28%)

C Shades(4%)

D Shades(33%)

Efos Esthelight

A Shades(38%)

B Shades(23%)

C Shades(6%)

D Shades(33%)

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