

SHADE SELECTION AND MANAGEMENT

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Abstract:

Esthetic dentistry has always demanded for an excellent outcome. There has been an increase in the patient's awareness regarding the importance of esthetics. To keep up to the expectations of the patient, the dentist and laboratory technician has to have a greater understanding of esthetics in dentistry. As well, a close co-ordination between the dentist and technician is vital for consistent success. One of the procedural aspects includes shade matching and communication. An attempt has been made to understand the protocol of progressive esthetic set up aimed to restore functional stability and natural appearance of the patient.

Key words: Shade Matching, Dentistry, Esthetics, Anterior Restorations, Shade Guide, Laboratory Communication, Ceramics.

The increase in newer types of ceramic restorations and the improving quality of esthetics means the dentist of the 21st century must be trained to detect differences in color and shades in individual teeth, select a shade that reflects the color and exact shade, transmit this information to a dental technician, and then be able to make any necessary adjustments to the restoration. However, there are a number of factors that stand in the way of properly selecting a color match. Subjective faults range from differences in color perception to ocular fatigue and lack of education regarding the basic principles of color. Metamerism may occur if proper lighting is not used during shade selection in the dental office and laboratory. Finally, existing shade guides are limited and require a more extensive range of shades.

Therefore, it is not surprising that color matching for crowns and dentures can be a frustrating and discouraging experience for the dentist, technician and patient. The breakdown in communication over matters ranging from shade guide to laboratory prescriptions must be addressed. This study will review the problems of color matching and will attempt to

guide the reader toward enhancing his or her techniques regarding shade selection and communication with the ceramist.

Tooth vs. Porcelain

Prior to shade matching, the dentist must have an understanding that the human tooth and dental porcelain transmit light waves differently. It is their physical composition that determines the differences in light-wave transmission, absorption, reflection, refraction, scattering and surface gloss. The manner in which light strikes an object determines the total appearance of the material. Transparent materials allow for the passage of light with little change. Translucent materials scatter, transmit and absorb light. Opaque materials reflect and absorb; however they do not transmit. Surface characteristics, such as gloss, curvature and texture, will affect the degree of light diffusion when striking the particular object.

A vital tooth is both naturally translucent and transparent. Enamel rods are transparent and therefore refract and reflect light. Light that strikes the incisal edges of an anterior tooth passes through with maximum transmission because of a high degree of translucency.

Porcelain, however, is a heterogeneous material. It contains transparent properties and metallic oxides that act as opacifiers. These porcelains modify light by absorption, transmission and reflection. Absorption is

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largely responsible for color. It occurs when light passes through the layers of the porcelain. Scattering occurs when light encounters interfaces between the materials (i.e., pigments and glass). The smaller the pigment size, the less light that is absorbed, resulting in less detectable color. The larger the pigment size, the more reflection that occurs as light scatters at the particle surfaces. Scattering light is necessary in dental porcelains to simulate the prismatic effect of enamel. Yet, one must keep in mind that too much dispersed reflection through internal scattering will create an unnatural looking prosthesis.

Light Sources

One of the questions asked when selecting a shade is, what light source should be used? Shade determination should be performed under color corrected fluorescent lighting, which contains a balance of the entire visible spectrum. The operatory should be lit using a luminous ceiling with translucent diffusing panels that are simple to maintain. Clean watt saver lamps having a color temperature of 6500K or higher is advocated. An illumination level of 200 to 250 foot candles is highly recommended. Shade selection should not be made using daylight, because daylight is subject to constant changes.

One must also be concerned with the phenomenon of metamerism, which occurs when the color of two objects looks identical when observed under one light source but different under other light conditions. Metamerism occurs only when two objects have different wavelength distribution and therefore reflect different spectra.

The color of the operatory can also affect shade selection. Colors should be kept at a low saturation level. Walls and cabinets should be glossy enough to maintain brightness without causing a glare. It is recommended that the color of the walls and ceiling be white or off-white.

The dentist should be concerned with "blue fatigue", this occurs when the eye is unable to differentiate between the various shades of blue. However, blue fatigue increases sensitivity to yellow therefore, to improve shade selection in the yellow range, the operator should stare at a blue card or patient napkin between shade comparisons.

It has been suggested that dentists use natural northern daylight for shade matching. Many dental offices have been designed to face the north to enhance the selection process. However, daylight is not at a constant throughout the day and therefore must not be used as the only light source for shade matching.

The Problem with Shade Guides

Shade guides have become the standard for selecting shade, yet there have been many errors associated with the use of commercial shade guides. Problems that may arise include the following: 1. Porcelains do not match the shade guides that they are being compared to. 2. Shade variations occur between different die lots of porcelain from the same manufacturer. 3. Shade guide tabs are 4-5 mm thick compared to the thin 1.5 mm piece of porcelain used for the restoration. 4. Shade guides are not always made with fluorescent porcelain, which causes inconsistencies in color matching. 5. It is difficult to predict the final shade after the layering of opaque, dentin and enamel. 6. Guide tabs lack a metal backing when using porcelain-fused to-metal restorations. 7. Shade tabs are condensed differently than porcelain used for final restorations.

After one understands the potential problems that arise when selecting shade, it is imperative that the dentist have a proper education in color. However, we must assume that not every dentist will seek out for the proper courses. The dentist must decide for himself or herself how much information is enough to guarantee the replication of the restored teeth.

Shade Selection Guidelines

The dentist must have a working knowledge of the basic principles of color. This allows for accurate shade selection. Munsell described the three dimensions of color as hue, value and chroma.

There are a number of methods that can be employed to intensify the shade selection. They are as follows: 1. if patient is wearing bright clothing, drape him or her with a neutral colored cover and remove lipstick or other makeup. 2. Clean the teeth of all stains and debris. 3. Have patient's mouth at dentist's eye level. 4. Determine shade at the beginning of the appointment to avoid ocular fatigue. 5. Shade comparisons should be performed at five-second intervals so as not to fatigue the cone cells of the retina. 6. Obtain value levels by squinting. 7. Compare shade under varying conditions (i.e., wet vs. dry lips; retracted lip vs. pulled down lip). 8. Use the canine as a reference for shade because of the highest chroma of the dominant hue of the teeth. 9. If unable to precisely match shade, select a shade of lower chroma and higher value. 10. Grind off the necks of the shade tabs because they tend to be darker than the rest of the shade tab.

Custom Shade Guides

To improve the communication with laboratory a custom shade guide should be acquired. Each custom shade guide should include the ceramist's metal, porcelain, staining kits, equipment and techniques. The technician needs to send a chart along with the guide for jotting down any additional information that will allow for a better understanding of the particular shade. The dentist may choose to create a luster tab and send it to the laboratory with the prescription. The technician will then have a visual aid for what he must fabricate. Numerous techniques regarding custom shade guides have been noted in the literature.

Laboratory Prescriptions

With few exceptions, laboratory work authorizations do not request enough

information from the dentist. This could be because there is not enough space on the prescription to record it. It is, therefore, important to use a laboratory that fully understands the need for shade matching. Each laboratory prescription should contain enough space to record clinical information about each ceramic component of the restoration for example, different shades of porcelain and opaque, and where to place them on the tooth. The authorization should include numerous diagrams of the tooth so that the dentist can draw helpful notes on them (i.e., shade, translucency, staining, glaze and surface texture). Also the dentist should be in contact with the ceramist to ensure that the technician fully understands what the dentist is requesting. It is through these methods that the dentist builds a relationship with the technician. Ceramists will usually return the quality that the dentist sends to them.

Models

Along with the laboratory prescription, preoperative models give the ceramist information about occlusion, tooth alignment, position of soft tissue, diastema, surface texture, wear facets, and more. A diagnostic wax-up will aid in the occlusion and form of the restoration. Matching shade is obviously only part of the task of replicating the natural tooth.

Photography

It has been said that, "The photograph is the cosmetic dentist's radiograph." It helps to evaluate the color of a particular tooth, see craze lines, stains, surface texture and luster. Multiple pictures should be taken at different angles and under different light sources. The patient's occlusion should also be photographed. It is best to include pictures of the patient's smile. These photographs can tell the technician about the patient, his/her age, personality and character.

It is a good idea to photograph the prosthesis at the try-in stage. If color adjustments are necessary, the technician will have a visual aid

to help make the proper corrections. Written instructions alone are not enough information for the technician. They leave a tremendous amount of room for interpretation.

Computers

Computers have become a valuable communication tool for the dentist and laboratory. Cosmetic imaging can take the place of photographs. The dentist can take a picture with an intraoral camera and send it over the internet to the laboratory. The ceramist can use these images to fabricate the proper prosthesis.

With the addition of modems and capture boards, the dentist and ceramist can engage in real-time consultations. This has the potential to allow for making immediate decisions about the restoration and will decrease the number of office visits the patient has to make.

Colorimeter

Photometric analysis techniques of porcelain surfaces may enhance our abilities to evaluate and design an esthetic restoration. Color matching and reproduction in dentistry appear to be more difficult than in the other industrial fields. There are many reasons for these difficulties, including the following: 1. Teeth are semi-translucent. 2. The size of teeth & the prosthesis are small. 3. Surrounding components of the tooth are complex. 4. Tooth surface is irregular. 5. Prosthesis may be composed of a number of materials. 6. There are many variables in fabricating prosthesis.

Because of these errors, the accuracy of color measuring devices is subject to great variability. Therefore, the practical and routine use of measuring shade with these types of instruments is of little value to the dentist. However, a research is being conducted continuously to create a computerized shade matching program. This program may change the way color matching is performed and may allow for more accurate shade selection and communication.

Conclusion

The introduction of advanced materials and techniques has and will continue to increase the degree of success in shade communication. As stated previously, "How much information is enough?" This decision is left up to the dentist. It depends on the dentist's philosophies in practicing dentistry and how much pride he or she takes in his or her work.

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