Ceramic Shade Determination: Current Technique for a Direct Approach

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A method for selecting the optimal shade of a ceramic restoration is presented. The shade is determined using a direct approach, facilitating communication with the laboratory. The dentist generates a custom shade tab using unfired dental porcelain powder mixed with an organic binder which has a refractive index that is adjusted to the fired material. Hue, chroma, value, and translucency are verified by direct comparison with the tooth to be replicated. Necessary adjustments are ascertained prior to fabricating the restoration, minimizing postfabrication alterations. *Int J Prosthodont 1989;2:131–137.*

Achieving a shade match with a single anterior ceramic restoration continues to be problematic for the restorative dentist, even with increased knowledge of color science. Shade determination and communication are made difficult and demanding because of the limitations imposed by conventional manufactured shade guides. Conventional guides do not cover the shade range of natural teeth, are inconsistent, and do not correspond to the materials or thicknesses used in the actual restoration.[1] Such guides do not provide a means of accurately communicating variations from their predetermined blends. Knowledge of color science and artistic ability must be combined if consistently superior restorations are to be achieved. Maximum use of art and science with existing porcelain systems is enhanced with a direct approach. The development of refractive index-adjusted organic liquid binders allows the visualization of the postfired ceramic shade in the unfired state.[2] The ability to visualize the hue, chroma, and value of an unfired ceramic unit allows the clinician more precise control of shade determination, communication, and realization.[3] The clinician develops the desired shade using a molded tab form and unfired dental porcelain powder.

Technique

Liquid Binder

The most critical component in direct shade determination is the organic liquid binder, which has an index of light refraction and dispersion that allows precise visualization of postsintered color when mixed with unfired porcelain powder. Simply seeing color rather than a white powder is not sufficient. The color perceived for a given thickness of porcelain after firing should be virtually indistinguishable from the unfired porcelain mixture (Fig 1). The organic liquid binder must provide this capability.

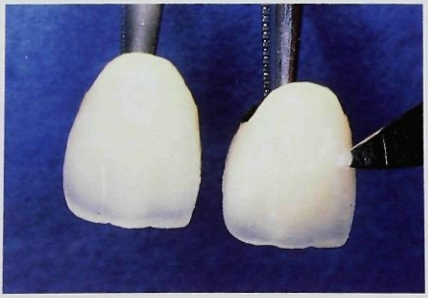


Fig 1 Fired restoration (*left*). The same porcelain, unfired and using organic liquid binder (*right*). (Color-Tru Porcelain Visualization Liquid, Oral Health USA, South Plainfield, NJ.)

Fig 2 Fired porcelain chip (*foreground*). Improper burnout of organic colorant (*left*). Proper burnout of organic colorant (*right*). Note superior match with fired porcelain when the dyes are properly burned out.

Ceramic Powder

Any commercially available dental porcelain system can be used with this technique. However, if the porcelain powders contain organic colorants (eg, pink or blue vegetable dyes added to aid conventional fabrication), they must be completely eliminated before mixing with the organic binder. Burning off the vegetable dyes in a conventional dental porcelain furnace, as has been recommended,[4] will not provide true visualization of the fired porcelain color. Even though the powder appears white after firing, the organic colorant will be incompletely eliminated because most dental porcelain furnaces lack the capability to provide the proper rate of temperature increase. A furnace capable of a pro-

Figs 3a and 3b Porcelain powder mixed with organic binder ready for use.

Fig 4a (*Left*) Preparing contralateral tooth on cast for fabrication of the custom tab.

Fig 4b (*Right*) Custom tab vacuum formed.

grammed temperature increase of 1 °C per minute is required to completely eliminate the organic dyes. When the powder is fired from 40 to 600 °C in air at 1 °C per minute with a 1-hour hold at 600 °C, the organic dye will be eliminated. Improper removal of organic components causes the unfired powder-binder mixture to appear lower in value than the fired porcelain (Fig 2).

After the organic colorants are eliminated, the porcelain powders can be mixed with the binder and stored in jars or ceramic dishes until needed (Fig 3).

The Shade Tab

Tabs to hold the blended porcelain can be vacuum formed using a 0.20-inch-thick temporary splint or coping material. For optimal results, the tab is made on a diagnostic cast. The contralateral tooth is isolated by scoring the interproximal surface. After vacuum forming the polyvinyl material on the cast, the tab is cut out (Figs 4a and 4b). The use of a custom tab form made on a diagnostic cast offers the most precise shade determination and communication. Using a tab that is the correct size and shape of the anticipated restoration eliminates the interpolation necessary with preformed tabs that are not custom made (Figs 5a to 5c). For less demanding situations, preformed tabs of an average dimension for maxillary central or lateral incisors may be used. The incisal edge of the tab is cut to the desired length. Each tab is designed with a 1-mm lip to control the thickness of porcelain and a depression in the shape of a coping to allow placement of opaque powder (Fig 6).

Opaque Porcelain Application

The opaque porcelain is mixed to a thick consistency with the organic liquid binder and placed in the tab. The surface texture of the opaqued tab should simulate the fired opaque porcelain. This can be accomplished prior to clinical use, facilitating chairside procedures (Fig 7).

Fixation of Opaque

After performing any desired modification, the opaque layer is fixed by covering it with a thin layer of cyanoacrylate adhesive. A drop of cyanoacrylate material is applied to the opaque porcelain and sprayed with an appropriate accelerator. This pre-

Fig 5a Shade selection with conventional shade tab.

Fig 5b Custom-formed tab having same size and shape as anticipated restoration.

Fig 5c Custom tab shown in Fig 5b with completed shade determination using unfired porcelain.

Fig 6 (*Left*) Preformed tab of average dimension with 1-mm peripheral lip to control porcelain thickness.

Fig 7 (*Right*) Comparison of standard size tab with unfired opaque porcelain and opaque porcelain fired on metal.

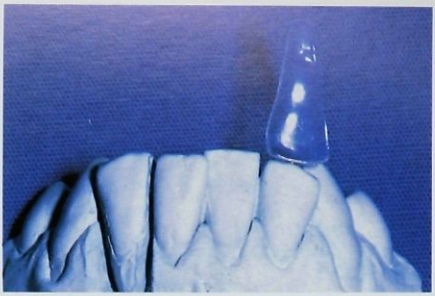


Fig 8a Custom tab formed on contralateral tooth for shade determination of mandibular left lateral incisor.

Fig 8b Modified opaqued tab fixed with cyanoacrylate compared to tooth.

Fig 9 Conventional tab compared to tooth. Note difference in size.

vents it from mixing with subsequent dentin applications (Figs 8a and 8b).

Shade Determination

The conventional shade guide is used first to make an initial shade selection. Normal guidelines for environmental control should be followed during all selection procedures (Fig 9).

Dentin Shade Verification

Approximately 1 mm of dentin porcelain corresponding to the shade selected from the conventional guide is placed in the tab over the opaque

Figs 10a and 10b (*Left*) Applying unfired dentin porcelain to opaqued tab. (*Right*) Dentin shade verification.

Fig 11a Cutting back dentin porcelain.

Fig 11b Applying incisal porcelain.

Fig 11c Completed custom shade tab matching mandibular left lateral incisor.

porcelain and held next to the tooth to be matched (Figs 10a and 10b). Needed shade adjustments are then made using body modifier or stains.

Determination of Transition Zone

After determining the proper dentin shade, the desired transition between dentin and incisal and/or translucent porcelain is established. The dentin porcelain in the tab is cut back or shaped to simulate the incisal portion of the tooth to be matched. Translucent and/or incisal porcelain is then added between the mamelons, on the line angles, and, as necessary, to the incisal edge (Figs 11a to 11c).

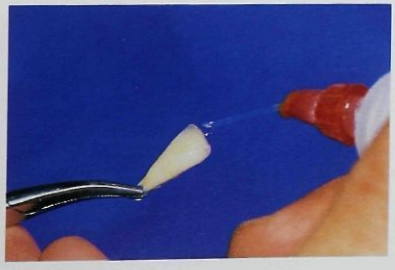
Characterizations

After the basic shade is determined, characterizations such as craze lines, opacifications, etc, can be created using stains or modifiers mixed with the organic binder. Such final modifications in the three color dimensions allow precise shade communication (Fig 12).

Fig 12 Three-dimensional communication with custom shade tab (*left*) as compared with conventional tab (*right*). The completed restoration is in the center.

Fixation and Surface Texture

When the shade has been determined, the surface is fixed by blotting and then covering it with a thin layer of cyanoacrylate adhesive, which is then sprayed with an accelerator (Figs 13a and 13b). If a



Figs 13a and 13b Fixation of tab using cyanoacrylate.

Figs 14a and 14b Surface texture created by grinding fixed tab.

smooth surface is desired, a second thin layer of cyanoacrylate material is applied and allowed to air dry. If texture is desired, multiple coats of cyanoacrylate cement can be applied and the surface ground to create the effect (Figs 14a and 14b). To ensure that it does not dry out, it is best to place the finished tab in a small jar of organic binder (Fig 15).

Fig 15 Finished tab placed in organic binder to prevent drying out.

Laboratory Authorization

The dentist can precisely communicate the desired shade to the technician by fabricating the custom tab in the dental operatory and recording what porcelain powders were used to make the custom shade tab. The technician can then more easily recreate the desired shade of the restoration (Figs 16a and 16b).

Discussion

A custom shade tab made with unfired porcelain alleviates many of the communication problems that are often encountered by the dentist and technician. It allows the dentist to better anticipate the clinical result with a given porcelain system and to make necessary adjustments in standard shades to achieve an acceptable match in the completed restoration. By making color modifications before laboratory fabrication, the dentist can prevent many disappointments and frustrating postfabrication modifications. The time is spent determining what is desired, not correcting what has been fabricated. The

Fig 16a Custom tab matched to contralateral tooth.

Fig 16b Finished restoration, maxillary left lateral incisor, fabricated using custom-generated tab.

patient's confidence and satisfaction increase and clinician-technician rapport is improved.

References

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2. Riley EJ, Sozio RB, Amdur BH, Sanderson IR: Color visualization during porcelain buildup using an organic liquid binder. *Quint Dent Technol* 1985;9:637–641.
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Literature Abstracts

Die implantatgesicherte Totalprosthe im zahnlose Uterkiefer. Eine klinische Longitutinalstudie mit Ergebnissen nach vier Jahren (The Implant-Supported Complete Mandibular Denture. Results of a Four-Year Longitudinal Clinical Study).

This survey evaluated the viability of modified hollow ITI Implants Type F (Institut Straumann, Waldenburg, Switzerland), fitted with individual Dalbo-Rotex-Anchor attachments or a transverse bar. Seventy-four implants were provided for 373 subjects with a mean age of 64 years. The mean length of service was 32 months; only one implant failed. All patients subjectively assessed the treatment as satisfactory. The implants were in a suitable anatomic position in 63% of subjects, and the peri-implant gingiva was complete in 33%; oral hygiene and probing depths were good in 62% of subjects. Easily corrected occlusal errors occurred in 50% of subjects. The relatively unfavourable values for these parameters are largely attributed to the stringent evaluation criteria. Except for poorer oral hygiene in patients with the bar connector, no significant differences were found between the parameters of implants with the two different types of attachments.

Mericske-Stern R. *Schweiz Monatsschr Zahnmed* 1988;98:931–936. **References:** 29. **Reprints:** Dr Regina Mericske-Stern, Klinik für Zahnärtzliche Prothetik, Universität Bern, Freburgstrasse 7, CH-3010 Bern, Switzerland.—*M.J. Shapiro, Abstract Editor (Non-English)*

Implantate in der Totalprothetik. Die Verankerung der Totalprothese im zahnlosen unterkiefer durch zwie Implantate mit Einzelattachment (Implants in Complete Denture Prosthodontics. Retention of a Complete Mandibular Denture by Two Implants with Individual Attachments).

The authors used osseointegrated implants to upgrade an edentulous mandible to the environment of an overdenture. Modified hollow ITI Implants Type F (Institut Straumann, Waldenburg, Switzerland) fitted with individual Dalbo-Rotex-Anchor attachments were used; an internal thread provided increased osseointegration surface. An unusual but essential feature of the technique is the construction of the prosthesis before insertion of the implants. The denture is then worn for 1 year with careful reviews and adjustments. For optimal surgical positioning of the implants, color markings on the fitting surface of the prosthesis are transferred to the mucous membrane. After a 3-month healing period, the denture is rebased incorporating the Dalbo matrices and cobalt-chromium strengthener. **This extremely cost-effective method makes osseointegration available to patients for whom this has previously been economically prohibitive.**

Mericske-Stern R, Geering AH. *Schweiz Monatsschr Zahnmed* 1988;98:871–875. **References:** 10. **Reprints:** Dr Regina Mericske-Stern, Klinik für Zahnärtzliche Prothetik, Universität Bern, Freburgstrasse 7, CH-3010 Bern, Switzerland.—*M.J. Shapiro, Abstract Editor (Non-English)*