Luminescent Veneers

EDWARD A. McLAREN, DDS

Since the first published articles on etched porcelain veneers,[1,2] there has been a plethora of materials and techniques introduced for this conservative esthetic procedure. Increased patient demands for esthetics have led to widespread use of porcelains as veneering materials. Porcelain veneers are being used more in purely restorative situations and not just for esthetic purposes. Porcelain remains the material of choice for the esthetic veneering of teeth,[3] metal, or high strength ceramic copings. Porcelain has several advantages over resins, being more chemically and color stable and having a coefficient of thermal expansion much closer to tooth structure than composite resin, which promotes a more stable tooth–restoration interface. Because of the etchability of porcelains, a strong micromechanical bond to etched enamel is possible with a resin luting agent.[4] This allows for the more conservative reduction of tooth structure for porcelain veneer techniques as compared to that for metal-ceramic preparations. Porcelain has proven to be highly biocompatible, which favors a healthy gingival response.

The "Achilles heel" of porcelain veneer techniques remains the ability to mask dark teeth without an overly opaque appearance. Several porcelain veneer techniques have been described to mask dark teeth.[5–7] These techniques call for the use of opaque luting agents or more opacious porcelains. The resultant veneers tended to lack a vital appearance, owing to the opacity of the materials used. To mask dark teeth it has traditionally been recommended to do full coverage porcelain-fused-to-metal (PFM) or all-ceramic restorations. This alternative may prove unacceptable to many patients, because it requires the more aggressive tooth removal.

Techniques for porcelain veneer fabrication using newer generation opalescent porcelains have been developed (personal communication). Teeth exhibit an optical phenomenon called opalescence similar to that of an opal. Opalescence is an optical property of a material, in which there is a scattering of the shorter wavelengths of the visible spectrum of light, giving a material a bluish appearance under reflected light, and an orange/brown appearance under transmitted light. This light scattering is caused by particles smaller than the wavelength of visible light that are dispersed throughout a translucent material, and of a much higher refractive index. This property of porcelain presents an improvement over opaque materials when used to mask dark teeth, but excessive use of opalescent materials can lead to a bluish/grey appearance of the restoration.

Recently, porcelain materials have been introduced that are highly fluorescent and are described as optical brighteners. Fluorescence by definition is the absorption of light by a material and the spontaneous emission of light in a longer wavelength. Traditionally, it has been assumed that fluorescence was the absorption by a material of ultraviolet light and the emission

Private practice limited to Prosthodontics, Monarch Beach, California; Lecturer, Graduate Prosthodontics, UCLA School of Dentistry, Los Angeles, California, and Research Associate, University of Oregon School of Dentistry, Portland, Oregon

Luminescent Veneers

Figure 1. Cast of preparations demonstrating incisal edge reduction and incisal wrap design to create room for incisal effects.

Figure 2. Natural teeth displaying varying degrees of incisal effects.

of visible light in the bluish spectrum. Materials could also absorb shorter wavelength visible light and emit it as longer wavelength visible light. Thus, many forms of fluorescence are possible. The fluorescence of original porcelains was caused by inclusions of sodium diuranate, a radioactive material, and they were removed from the market for obvious reasons. New generation fluorescent materials contain naturally occurring fluorescent materials that are nontoxic. Fluorescence in a material tends to give a bright iridescent effect when used properly in dental porcelain. This effect can be used to brighten dark teeth without negatively affecting the translucency. This article is a description of the technique using these new fluorescent materials called luminaries (Vita, Bad Sackingen, Germany) for porcelain veneers.

MATERIALS AND METHODS

Preparations for porcelain veneers should allow for a minimum thickness of 0.4 mm of porcelain, to ensure minimal color shifts. To mask moderate to severely discolored teeth, preparations that allow for 0.8 mm of porcelain are necessary. Ideally the preparation should be confined entirely in enamel, but experience has shown that preparations with at least peripheral enamel are adequate. Preparations with margins in dentin should be

Figure 3. Wax-up of desired form.

Figure 4. Provisional veneers to verify patient acceptance of form alterations.

Figure 5. Silicon index of incisal edge position of provisionals used with refractory cast to allow duplication by the ceramist of the incisal edge position of the provisionals in porcelain.

avoided if possible; if it is necessary to place margins in dentin then a dentin bonding agent should be used (e.g., All-Bond 2, Bisco, Itasca, Illinois; or Scotchbond Multipurpose-Plus, 3M, St. Paul, Minnesota) with caution, because no long-term clinical data support their use.

If the porcelain cannot be supported by enamel, it is critical to design the preparation so the cemented veneer is subjected to minimal or no tensile or shear stresses, by not extending the incisal edge. Laminated structures such as porcelain–enamel or porcelain–dentin are, by definition, constant strain systems.[8] In such systems, when stress is applied, the material with the higher modulus of elasticity (i.e., the stiffer material) absorbs most of the stress. Dentin, being a lower modulus material (i.e., more flexible) than porcelain, would flex more than enamel, under a given load, thus subjecting the veneered porcelain to higher tensile and shear stresses. Ceramic, being a brittle material, fails at a critical strain of 0.1%,[9] thus bonding ceramic to the more flexible dentin could lead to early failure.

To prevent over contouring and provide for proper masking, it is necessary to prepare teeth in the gingival third, and prepare a light chamfer to have a definitive finish line. If there is peripheral enamel, the author prefers to prepare the incisal edge to allow for 1 to 1.5 mm of incisal porcelain (Figure l). This creates room internally to build incisal effects that are present to varying degrees on natural teeth (Figure 2). Preparations for severely discolored teeth that require lightening more than two shades should allow for a thickness of 0.8 mm of porcelain.

Figure 6. Dimples created on the lingual of the refractory die in the middle and incisal third.

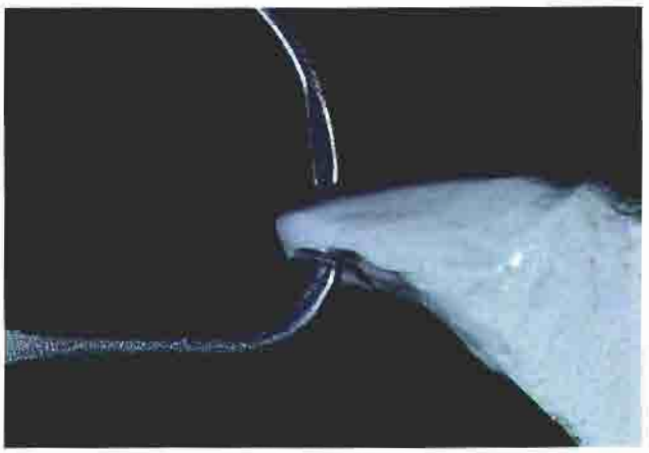

Figure 7. Baseline measurement of the refractory die to have a reference to control the thickness of the porcelain veneer.

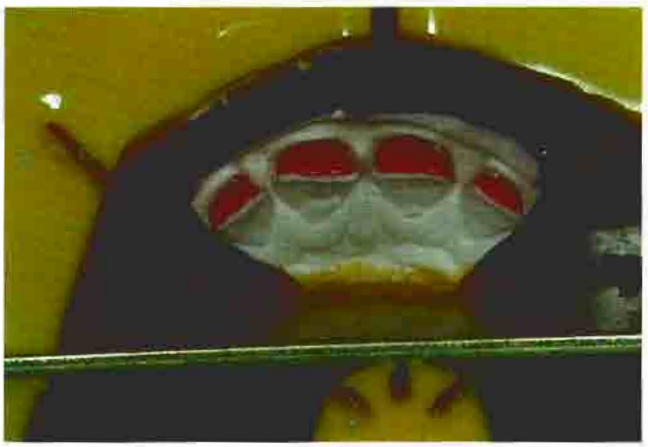

Figure 8. Master cast ready for duplication to generate refractory dies.

Figure 9. Master cast with removable refractory dies with high heat ceramic pins. The refractory dies are interchangeable with the master dies.

For veneer cases in which a change in form is indicated, it is recommended to complete a treatment wax-up of the desired final form (Figure 3). This can be used for patient communication and for the development of provisionals (Figure 4). Provisionals can be altered until there is agreement between the patient and the dentist as to the final form of the veneers. This information can then easily be transferred to the ceramist, via a study cast, which then leaves nothing to speculation as to shape and contour. The ceramist can then fabricate silicon indexes of incisal edge position and facial contours to facilitate veneer fabrication (Figure 5).

Figure 10. Luminaries are built in gingival areas to create chroma (pink area) and anywhere necessary to create a masking effect. Whitish-yellow (blue area) luminary is placed to mask a discolored band of tooth structure.

Figure 11. Luminaries fired on the refractory dies as a separate firing from the body and incisal build-up.

Veneer Fabrication

Veneers can be fabricated by either the refractory die or the foil technique. The author prefers the refractory die technique. One criticism of this technique is that it is not possible to know the thickness of the veneer until it is divested, which could lead to over or under contouring. One solution to this problem would be to score the dies on the lingual prior to porcelain application (Figure 6), measure the labial/lingual thickness at these points, and record this measurement. Subsequent measurements after porcelain application minus the previously recorded values would give veneer thickness (Figure 7). This, along with the silicone indexes, would ensure proper contour. A refractory technique that allows the use of the master cast with interchangeable master and refractory dies is preferred.[10] Figures 8 and 9 demonstrate the fabrication of the master cast with

Figure 12. Dentin build-up cut back ready for incisal framing.

Figure 13. Incisal edge framed with enamel and translucent porcelains.

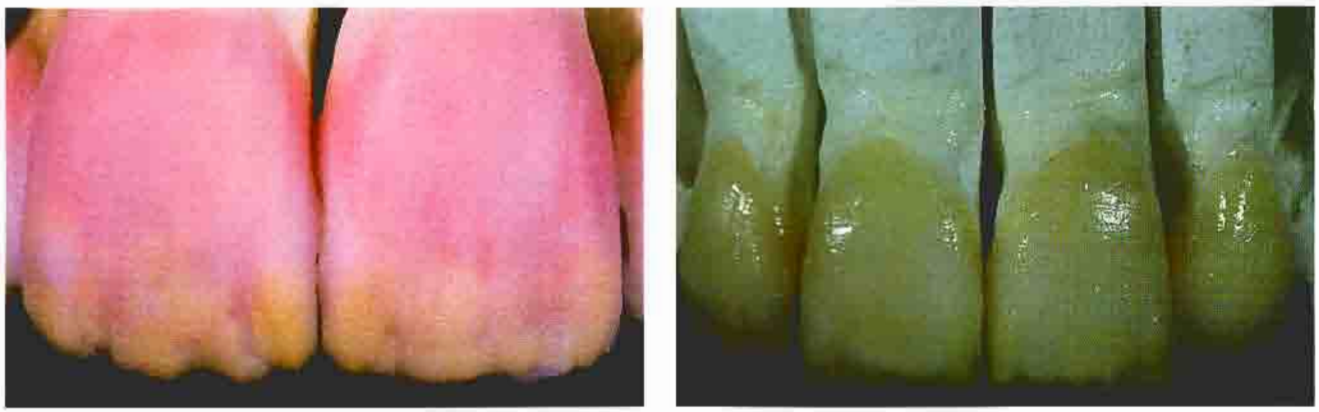

Figure 14. Left, *Mamelon or incisal effects layered in the incisal third, using highly chromatic porcelains.* Right, *Veneer after dentin firing.*

interchangeable refractory and master dies, using the DVA model system (Dental Ventures of America, Anaheim, California). Vitadurvest (Vita) is used as the refractory, because its coefficient of thermal expansion is matched to that of the luminaries.

The luminaries are built up on the die in a manner similar to that used for opacious dentins (Figure 10). Generally 0.2 mm of luminary of the desired shade is adequate to mask dark teeth. For severely discolored teeth 0.3 mm to 0.4 mm may be necessary, which would have been accounted for in the preparation. This is fired separately from the body and incisal build-up (Figure 11). The sintering temperature is significantly higher than for the veneer porcelains, which allows it to be used as a shoulder porcelain for the Vita In-Ceram and Spinell techniques. Alpha dentins (Vita) are then built and cut back to allow for incisal framing of enamel and translucent porcelains, as in conventional techniques (Figure 12). Enamel and translucent porcelains are built-up, framing the lingual half of the incisal edge (Figure 13). Special highly chromatic porcelains to create mamelon effects are layered on the incisal third, and then the dentin firing is accomplished (Figure 14). The entire facial is then covered with translucent porcelains of varying opacities, and the translucent layer is fired (Figure 15). Contouring is completed using diamond and stone abrasives to duplicate the form and texture of the provisionals. Glazing and polishing are accomplished in the usual manner. Divesting the

Figure 15. Left, *Translucent porcelains built up.* Right, *Translucent layer fired.*

Figure 16. A, *Case 1. Veneers fitted back on the master cast.* B, *Case 2. Veneers fitted back on master cast, with one demonstrating the use of a removable gingival matrix.*

veneers should be performed with great care to protect the delicate margins. Once divested, the veneers are then fit back to the master cast (Figures 16 and 17); they are then etched with hydrofluoric acid and are ready for cementation.

Try-in and Cementation

The veneers can be tried on the tooth, using glycerine as an intermediary; the optical effect will be

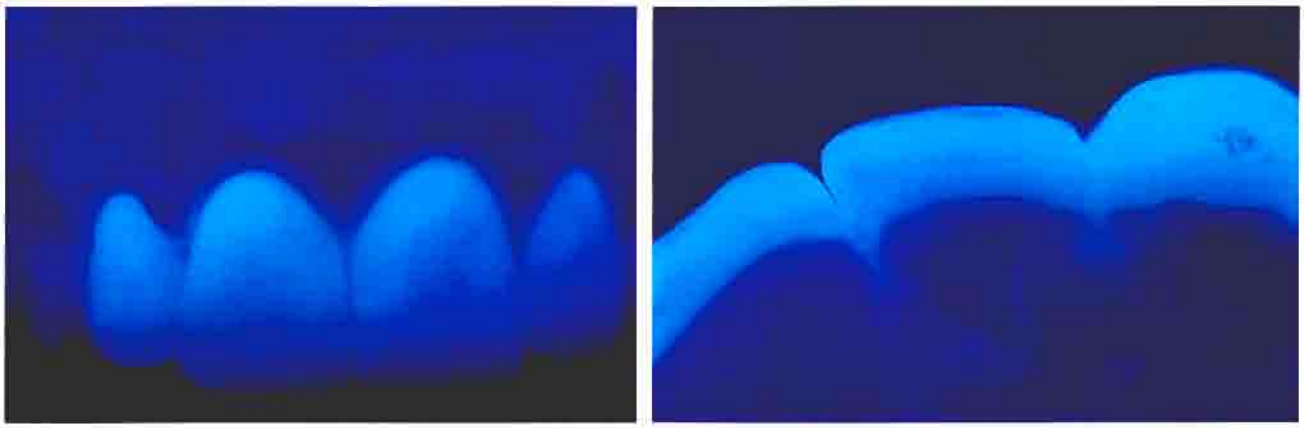

Figure 17. Demonstrating the fluorescence of the luminaries.

similar to that seen with a clear resin cement. Try-in pastes that are available from various manufacturers can be used if color modification is necessary. These pastes come in varying shades and give the ability to preview the final optical effects created by the cement prior to actual cementation. The author prefers the 3M Opal Porcelain Cementation Kit, due to its selection of warm and cool shades of varying opacities. The 3M system also provides the option of dual curing or light curing.

The teeth are etched with a 32% phosphoric acid (All-Etch, Bisco); if dentin is exposed, a dentin bonding agent is used, such as All-Bond 2 (Bisco) or Scotchbond Multipurpose-Plus (3M), as per manufacturers' directions. The teeth are then dried thoroughly, and an unfilled resin is applied to the tooth and the veneer and blown thin. The chosen shade of luting resin is applied, using a Centrix ribbon syringe. The veneer is gently pressed to place using finger pressure, allowing excess luting agent to be expressed at the margin, and the excess cement is carefully removed with an explorer, with care taken not to create a void at the margin. Photopolymerization using a composite curing light with a 5-mm tip is initiated. Recent recommendations call for initially curing for only 5 seconds and then turning the light off for 20 seconds.[11] The intermittent curing allows for flow of the composite, which helps reduce polymerization stresses at interfaces,[12] thus reducing the risk of crack development within the veneer.[13] After two incremental curings, complete curing of all aspects of the veneer for a minimum of 1 minute is accomplished. The author prefers to cement only one veneer at a time. Excess cement is removed with a composite carving instrument or a No. 12 surgical blade. It is not recommended to use a rotary instrument of any kind on the margins of the veneers, as this can create surface flaws that can lead to premature failure, and it is extremely difficult, if not impossible, to repolish the porcelain. Figures 18 and 19 illustrate two cases using this technique for fabricating veneers.

Figure 18. A, *Clinical case 1 prior to preparation.* B–F, *Cemented veneers.*

SUMMARY

The ultimate esthetic dentistry takes into account the conservation of healthy tooth structure integrated with biologic and long-term functional requirements. Materials and techniques that address these inseparable issues are necessary for true excellence. One such material has been presented for the fabrication of porcelain veneers without the need for overt tooth destruction to create masking ability and without an unsightly opaque appearance.

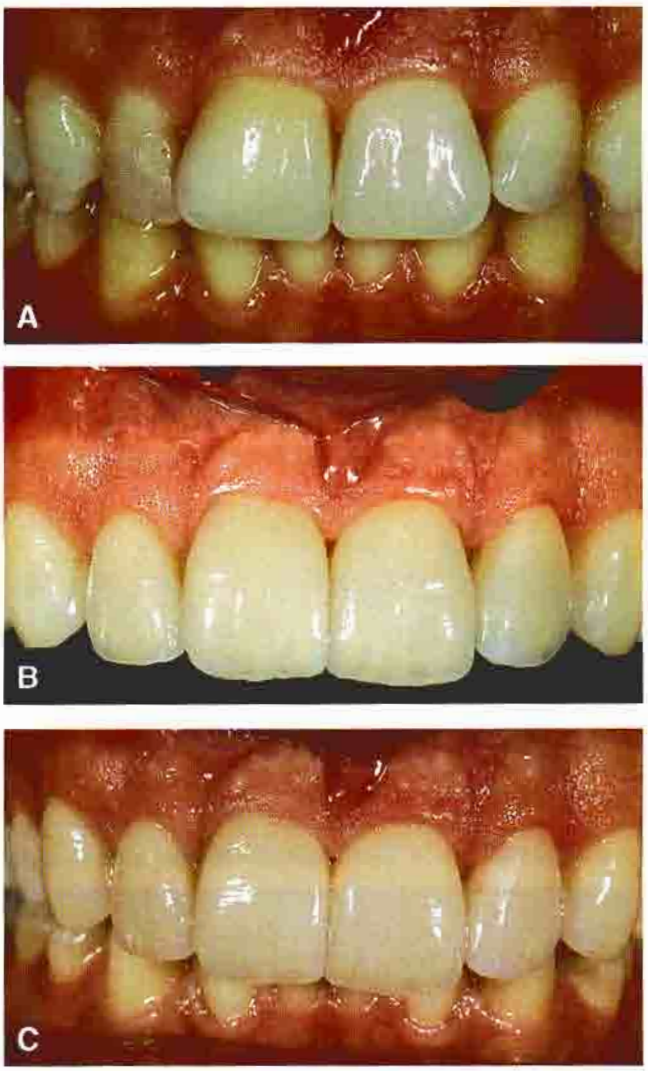

Figure 19. A, *Clinical case 2 prior to preparation.* B *and* C, *Cemented veneers.*

7. *Garber DA, Goldstein RE, Feinman RA. Porcelain laminate veneers. Chicago: Quintessence, 1988.*
8. *McLean JW. Long-term esthetic dentistry. Presented at the Newport Harbor Academy of Dentistry, Newport Beach, California, May 21, 1993.*
9. *Jones DW. The strength and strengthening mechanisms of dental ceramics. In: McLean JW, ed. Dental ceramics. Proceedings of the First International Symposium on Ceramics. Chicago: Quintessence, 1983:83–91.*
10. *Sheets CG, Taniguchi T. A multidie technique for the fabrication of porcelain laminate veneers. J Prosthet Dent 1993; 70:291–295.*
11. *Nicholas J. Dental materials update. Presented at the California Dental Association, Anaheim, California, April 16, 1994.*
12. *Unterbrink GL, Muessner R. Relationship of light intensity to physical properties and shrinkage stress. J Dent Res 1994; 73:105. (Abstr 30)*
13. *Sorensen JA, Strutz JM. Marginal fidelity and microleakage of porcelain veneers made by two techniques. J Prosthet Dent 1992; 67:16–22.*

Reprint requests: Dr. Edward A. McLaren, 32241 Crown Valley Parkway, St. 240, Monarch Beach, CA 92629

REFERENCES

1. *Horn HR. Porcelain laminate veneers bonded to etched enamel. Dent Clin North Am 1983; 27:671–684.*
2. *Calamia JR. Etched porcelain veneers: the current state of the art. Quintessence Int 1985; 16:5–12.*
3. *Boksman L. Custom laminate veneers: porcelain and composite. In: Clark JW, ed. Clinical dentistry. Vol. 4. Philadelphia: Harper and Row., 1986:1–20.*
4. *Simonson RJ, Calamia JR. Tensile bond strength of etched porcelain. J Dent Res 1983; 62:297. (Abstr 1154)*
5. *McLaughlin G. Controlling color in the porcelain laminate. Compend Cont Educ Dent 1987; 8:363–366.*
6. *McInnes PM, Zinck JH, Weinberg R. The effectiveness of opaque and color modifier materials. A laboratory study. J Am Dent Assoc 1987; 114:205–209.*