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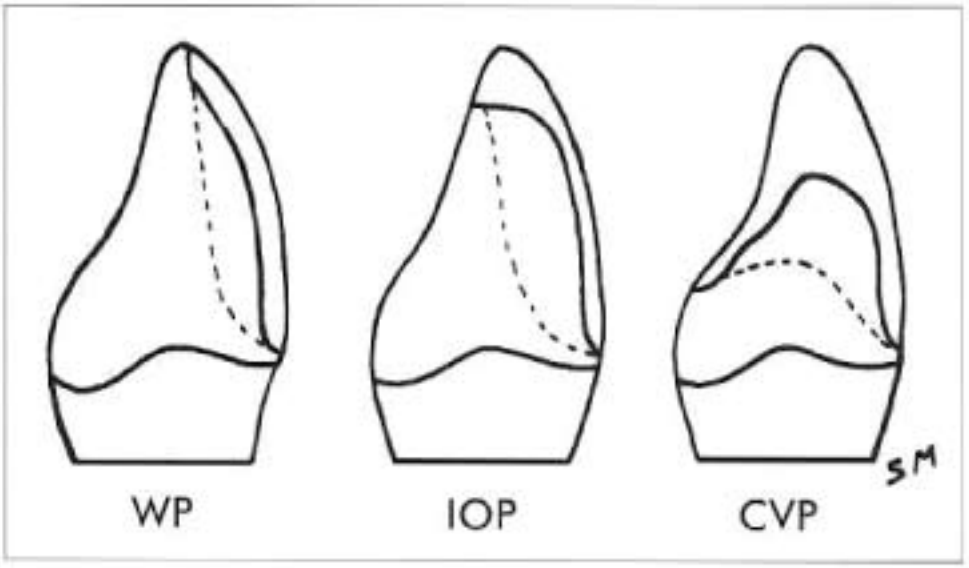
PROSTHODONTICS™

NEWSLETTER

WINTER 2006

IN THIS ISSUE:

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.



A study of porcelain laminate veneers evaluated the longevity and failure loads of 3 different preparation designs: window preparation (WP), incisal overlapped preparation (IOP) and complete veneer preparation (CVP). See *Longevity and Failure Load of Ceramic Veneers*, inside.

Esthetic Dentistry

Esthetic dentistry has become a cornerstone of contemporary prosthodontic practice. Esthetic dentistry can be used to correct unsightly acquired or developmental defects of the dentition, or as an elective procedure to improve a patient's smile. This issue of *Prosthodontics Newsletter* reviews a series of articles related to various aspects of esthetic dentistry including the outcome for materials and techniques that are commonly used for esthetic purposes.

Longevity and Failure Load of Ceramic Veneers

Porcelain laminate veneers have become extremely popular. When first introduced over 20 years ago, veneers were commonly placed on unprepared or minimally prepared teeth. Today there is consensus that teeth should be prepared to receive the veneers, but various tooth-preparation designs have been advocated.

Stappert et al from New York University and Albert-Ludwigs University, Germany, investigated the effects of 3 preparation designs on the longevity and failure load of porcelain laminate veneers. Sixty-four extracted maxillary central incisors were divided into 4 groups ($n = 16$). One group of teeth was left intact to serve as a control (NP). Only the facial surfaces were reduced in the window preparation group (WP), maintaining the incisal edges intact. The third group was prepared with an incisal overlap (IOP), which included a 2-mm reduction of the incisal edges of the teeth. In the complete veneer preparation group (CVP), the incisal edges were reduced by 3 mm and the preparations included a 2-mm palatal chamfer. (See the cover illustration for a diagrammatic representation of the preparation designs.)

Porcelain laminate veneers were fabricated from IPS Empress 1 pressable ceramics (Ivoclar Vivadent) and were bonded to the teeth with Variolink II dual-polymerizing composite cement (Ivoclar Vivadent). The roots of the specimens were surrounded by gum resin to simulate periodontal ligaments and embedded in polyester resin at an angle of 135°.

Specimens were dynamically loaded with a force of 49 N at 1.3 Hz for 1.2 million cycles, then thermocycled. Specimens that survived the cyclic loading and thermocycling (fatigue testing) were then loaded on a universal testing machine until failure.

Three specimens from group NP, 2 specimens from group IOP and 1 specimen each from groups WP and CVP failed as a result of the fatigue testing. Median failure loads on the universal testing machine ranged from 519.2 N–713.3 N, but differences among the 4 groups were not statistically significant.

Comment

In this study, 76.6% of the specimens fractured exclusively within the natural tooth structure, and results of the failure-load testing suggest that teeth restored with the 3 different tooth-preparation designs were as strong as intact, unprepared teeth. Nevertheless, subcritical cracks were noted in 80% of the veneers in group CVP after fatigue testing. Although these cracks did not produce overt failure, they are cause for concern. This type of preparation probably should be avoided when possible because it produces a thin extension of porcelain in an area of high tensile stress (Figure 1).

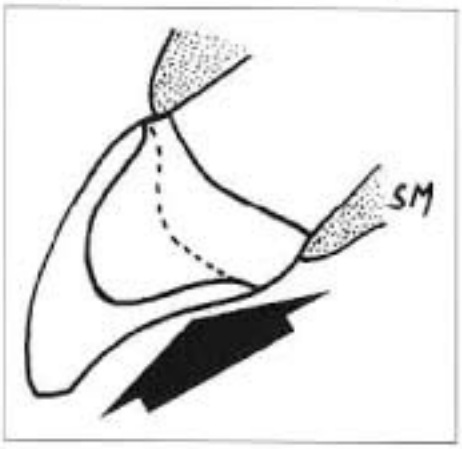


Figure 1. Functional and parafunctional occlusal contacts can produce tensile stresses in thin porcelain extensions, predisposing to crack formation.

Probably the most popular preparation is the IOP design. This preparation is relatively easy to do, allows excellent control of esthetics and produces a veneer restoration with high strength.

Stappert CFJ, Ozden U, Gerds T, Strub JR. Longevity and failure load of ceramic veneers with different preparation designs after exposure to masticatory simulation. J Prosthet Dent *2005; 94:132-139.*

Prosthodontic Treatment of Amelogenesis Imperfecta

Amelogenesis imperfecta is a rare genetic disease that results in defective tooth enamel. In 1890, this disorder was described as "hereditary brown teeth" because of the unesthetic appearance of the teeth. When the dentition is severely affected, the recommended treatment has been extensive reconstruction of the dentition with fixed prosthodontics. Little is known about the prognosis of these reconstructions.

Lindunger and Smedberg from Eastman Dental Institute and St. Erik's Hospital, Sweden, performed a retrospective study of 15 patients with amelogenesis imperfecta who had received extensive fixed prosthodontic treatment. Patients were evaluated clinically by the investigators to assess the overall status of the prosthodontic treatment. Patients completed questionnaires

Figure 2. An example of the esthetic deformity associated with amelogenesis imperfecta.

asking about their satisfaction with the outcome of treatment.

There was a total of 213 prosthodontic restorations in the mouths of the 15 patients. The median age of the restorations was 60 months. Of the restorations present at examination, all but 1 were rated satisfactory to excellent. Prosthodontic complications were relatively rare and included loss of retention (2% of the restorations), porcelain fracture (2%) and dental caries (6%).

The questionnaire revealed that the patients were disturbed by the esthetic deformities of their teeth prior to treatment (Figure 2). All patients indicated a strong positive effect on their self-esteem after prosthodontic rehabilitation. Most patients wished that they had received prosthodontic treatment at least 1 year earlier than when it had been provided.

Comment

Recorded complications were relatively rare and are comparable to complications reported for patients with normal enamel. This outcome is logical, because although the enamel is defective with amelogenesis imperfecta, the dentin is normal.

Because of the young age of the patients and the need to restore most or all of the teeth, patients with amelogenesis imperfecta are often managed by a team of dental specialists. Results suggest that the prosthodontist plays a key role in the multidisciplinary management of these patients.

Lindunger A, Smedberg J-I. A retrospective study of the prosthodontic management of patients with amelogenesis imperfecta. Int J Prosthodont *2005; 18:189-194.*

Shear Bond Strength Of a Light-polymerized Resin Luting Agent

Dual-polymerized resin luting agents represent the most commonly used material for cementing esthetic all-ceramic restorations. These resin cements polymerize through chemical action (autopolymerization) and light activation. However, autopolymerization alone will produce a cement film with inferior mechanical properties.

Light-emitting diode (LED) devices have been introduced recently for light polymerization, with the expectation that improved polymerization will result. However, the effects of these high-strength LED units on the mechanical properties of the luting resin are not well understood.

Nalcaci et al from Ankara University, Turkey, evaluated the effects of different modes of high-powered LED polymerization on the shear bond strength of a dual-polymerizing resin luting agent. Heat-pressed ceramic cylinders (IPS Empress 2; Ivoclar Vivadent) were bonded to the dentinal surfaces of extracted teeth with Rely X ARC cement (3M ESPE).

A conventional halogen light (Optilux; Demetron Kerr) served as the control; an LED unit (Mini LED; Satelec) used with 3 different modes of polymerization formed the 3 experimental groups. The 4 polymerization modes used were (a) halogen light (600 mW/cm^2, 40 seconds [s]), (b) LED fast mode (1100 mW/cm^2, 10 s), (c) LED pulse mode (1100 mW/cm^2, 10 s) and (d) LED exponential mode (0-1100 mW/cm^2 within 10 s, then hold at 1100 mW/cm^2, 10 s). The fast, pulse and exponential modes were preset in the LED unit by the manufacturer.

Bonded specimens were subjected to shear loads on a universal testing machine until failure. Shear bond strengths were similar for specimens polymerized with a halogen light and those polymerized with the LED unit in the exponential mode. Specimens polymerized with the LED fast or pulse mode recorded significantly weaker bond strengths.

Comment

Although the higher intensity of light produced by the LED unit would be expected to produce a higher crosslinking during the polymerization process with resultant improved mechanical properties of the resin luting agent, shear bond strengths were similar or lower than the strengths produced with the conventional halogen system. One explanation for these unexpected results is related to polymerization shrinkage. Perhaps this high-inten-

sity light source produced more pronounced and more rapid polymerization shrinkage. This shrinkage could create tensile stresses at the resin-dentin/resin-ceramic interfaces, weakening the bond and increasing the chances of failure of the esthetic restoration as a result of debonding.

Nalcaci A, Kucukesmen C, Uludag B. Effect of high-powered LED polymerization on the shear bond strength of a light-polymerized resin luting agent to ceramic and dentin. J Prosthet Dent *2005;94:140-145.*

Stain Resistance of Provisional Restorative Materials

A provisional crown or fixed partial denture must provide function and esthetics until the definitive restoration is placed. Color stability of the provisional restoration is an important concern, especially when the restoration must be used for an extended period.

There are a number of materials commercially available for the fabrication of provisional fixed restorations, and their susceptibility to staining could vary, depending on the material, the type of polymerization, filler particles and type of staining solution. A study by Guler et al from Ondokuz Mayis University, Turkey, evaluated the effects of 9 different solutions on the color stability of 5 provisional restorative materials.

The staining solutions were (a) distilled water (control), (b) coffee, (c) coffee with sugar, (d) tea, (e) tea with sugar, (f) red wine, (g) coffee with artificial creamer and sugar, (h) cola and (i) sour cherry juice. The restorative materials were (a) autopolymerizing bis-acryl composite (Protemp II; 3M ESPE), (b) light-polymerizing resin composite (Revotek LC; GC Dental Products Corp.), (c) reinforced microfill composite (Micronew; Bisco Inc.) and (d) 2 brands of microhybrid resin composite (Filtek Z250; 3M ESPE and Herculite XRV; Kerr).

Specimens were made of the restorative materials and divided into 9 groups ($n = 5$). The color of the specimens was measured with a colorimeter before exposure and then after storage in each of the 9 solutions for 24 hours at 37°C. Color differences were expressed as ΔE. The authors suggested that 24-hour storage in the solutions would be equivalent to 3.2 cups of coffee per day over a 1-month period.

The reinforced microfill composite was more color-stable than the autopolymerizing bis-acryl composite, the light-polymerizing resin composite or the 2 microhybrid composites. The most pronounced color change was observed with the light-polymerizing composite, and the presence of sugar in coffee and tea tended to increase the staining potential of the solutions. Most changes in color were >3.7 ΔE, indicating that these color changes would be visually perceptible.

Comment

The microfill resin exhibited less staining. Perhaps the smaller size of the filler particles improved the color stability of the material. Unfortunately, an unfilled resin was not included in the study design. Inclusion of an unfilled resin would have helped to determine the effect of filler particles on staining of the materials. Also, in this study, specimens were ground and not polished. Most dentists polish provisional restorations before cementing them. It is possible that polished restorations would resist staining better than unpolished restorations.

The study also showed marked staining potential for coffee, tea and red wine for all the materials tested. Patients with provisional restorations in the esthetic zone should be advised of the potential for these liquids to stain their provisional restorations, as well as the ability of sugar in tea and coffee to further increase the staining potential.

Guler AU, Yilmaz F, Kulunk T, et al. Effects of different drinks on stainability of resin composite provisional restorative materials. J Prosthet Dent *2005;94:118-124.*

NEXT:

- Fixed partial dentures connecting teeth and implant abutments
- CAD/CAM ceramic inlays for pulpless maxillary premolars
- Effects of size and shape of implants on clinical success rate

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.