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PROSTHODONTICS™

NEWSLETTER

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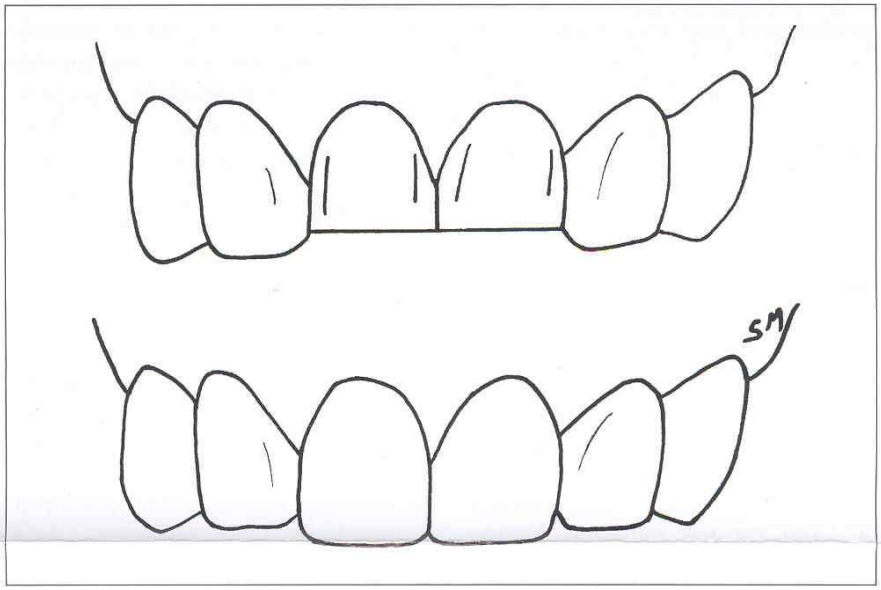
IN THIS ISSUE:

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 prospective clinical study that evaluated the outcome of porcelain laminate veneers placed over a 16-year period reported impressive results. See, *Sixteen-year Clinical Study of Porcelain Laminate Veneers inside*.

Bonded Porcelain Laminate Veneers

Bonding to tooth structure has revolutionized contemporary dentistry. The bonded porcelain laminate veneer technique was introduced in the early 1980s. With time, tooth preparation design, bonding methods, veneering materials and luting agents evolved to what they are today, and this conservative method of esthetically restoring blemished or discolored teeth has become very popular. This issue of *Prosthodontics Newsletter* is devoted to studies related to the bonded porcelain laminate veneer.

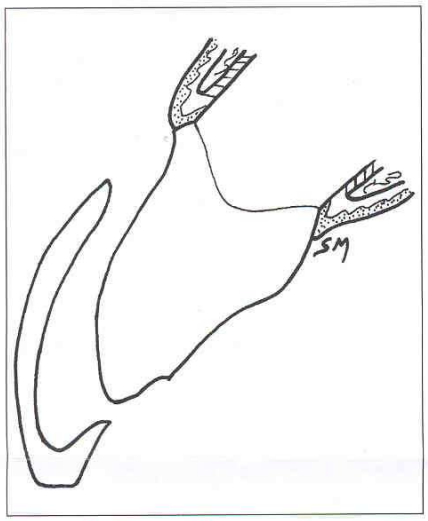


Figure 1. The tooth preparations for this study were accomplished by 1 prosthodontist and were designed with 0.5–0.7 mm facial reduction, chamfer margins and 1–2 mm incisal reduction with palatal overlap.

Sixteen-year Clinical Study of Porcelain Laminate Veneers

Porcelain laminate veneers permit the conservative treatment of tooth misalignments, unesthetic tooth shape and form, discolored teeth and worn teeth. The last decade has seen the introduction of a variety of dental ceramic materials. Within the esthetic ceramics, there are predominantly glassy ceramics (feldspathic glass), moderately filled glassy ceramics (feldspathic glass with 17–25% leucite) and highly filled glassy ceramics (feldspathic glass with 40–55% leucite). Layton and Walton from the Universities of Queensland and Sydney, Australia, conducted a prospective clinical trial of the outcome of 304 feldspathic porcelain laminate veneers placed in 100 patients. A total of 180 veneers had been in situ for 5–11 years, and 61 had been in place for 10–16 years. All veneers were in situ for at least 1 year.

All veneers were placed by the same dentist. The tooth preparations were designed with 0.5–0.7 mm facial reduction, chamfer margins, and 1–2 mm incisal reduction with palatal overlap (Figure 1). The majority of the patients (83%) were females. For all teeth, exposed dentin represented ≤20% of the surface area of the preparation. All veneers were bonded with Vision 2 dual polymerized resin cement (Mirage Dental Systems, Cameleon).

The outcomes were defined as follows:

- **Success:** no evidence of retreatment other than maintenance procedures, such as dental prophylaxis or smoothing of minor chips in the porcelain;
- **Survival:** the referring dentist or patient confirmed that there had been no retreatment other than maintenance;
- **Unknown:** the patient could not be traced;
- **Dead:** patients who died during the 16-year period and had no known relevant retreatment outcomes;
- **Repair:** veneers that required repairs that did not involve their marginal integrity; and
- **Failure:** veneers that were partially or totally lost, had loss of marginal integrity or were dislodged more than twice.

Data were collected, and Kaplan-Meier survival analysis was used to estimate the cumulative survival of the veneers. The analysis revealed a cumulative survival of 96 ± 1% at 5–6 years, 93 ± 2% at 10–11 years, 91 ± 3% at 12–13 years, and 73 ± 16% at 15–16 years. Statistical analysis indicated that reduction in the survival rates with an increase in the number of years in situ was significant.

Sixteen veneers in 14 patients failed. Reasons for failure included esthetics (31%), mechanical complications (31%), periodontal problems (12.5%), loss of retention more than twice (12.5%), dental caries (6%) and tooth fracture (6%).

Comment

Although the chances of failure increased significantly with time, the results in general can be considered very favorable. Only 16 out of 304 veneers failed, and almost one third of these failures were veneers that were replaced because the patients were dissatisfied with the esthetic results. Because the shade of the veneer will be influenced by the shade of the underlying tooth structure and the cement, it can be difficult to predict the final shade of a veneer with certainty after the luting agent is polymerized. Try-in pastes are available to help predict the final shade, but they are not fool-proof.

Because there were so few veneers in the 15–16 year group, the calculated survival of 73 ± 16% should be viewed with caution. A confidence interval of ± 16% indicates that the survival estimate could have been as high as 89% or as low as 57%, which is highly unlikely, considering other reported high survival rates. These results are promising and suggest that when traditional veneering tooth preparations and procedures are used and ≥80% of the surface area of the tooth preparation is in enamel, there is a high probability of success.

Layton D, Walton T. An up to 16-year prospective study of 304 porcelain veneers. Int J Prosthodont *2007; 20:389-396.*

Fracture Resistance of Porcelain Laminate Veneers

For more than two decades, resin-bonding systems have been developed to improve the strength and reliability of bonding to tooth structure, as well as to dental porcelain. Bonding to enamel is predictable; however, bonding to dentin is technique sensitive and less reliable. An in vitro study by Piemjai and Arksornnukit from Chulalongkorn University, Thailand, measured the fracture strength of porcelain bonded either to enamel or dentin with the use of 4 resin adhesive systems.

Previously frozen human molars collected and stored in deionized water were used within 3 months of extraction. Porcelain specimens 3 mm × 3 mm were fabricated in 2 thicknesses, 0.5 mm and 1.0 mm, to form 120 flat enamel specimens that were divided into 4 groups of 30 specimens. Ten 0.5-mm thick porcelain and enamel specimens were subjected to a compressive load without bonding resin (control) in a universal testing machine.

The porcelain specimens, either 0.5- or 1.0-mm thick, were bonded to the enamel surfaces with 4 different bonding systems: All-Bond 2 + Choice (Bisco Inc.); Panavia 21 (Kuraray Co.); Scotchbond + Opal (3M ESPE Dental Products Division); and Super-Bond C&B (Sun Medical Co.). Bonded specimens were stored in water at 37° ± 2°C for 24 hours before fracture-strength testing in a universal testing machine. After the enamel-bonding test, the dentin for each tooth specimen was exposed, and the above-mentioned tests, including the control test, were performed to measure the strength of porcelain-dentin bonding with the 4 cements.

The compressive strengths of cemented porcelains associated with different tissue substrates, porcelain thicknesses and adhesive cements were analyzed by using a 3-way ANOVA and Tukey test (SPSS version 10) at $p < .05$. Student's t test was used to analyze the fracture strengths of non-cemented porcelains on enamel and dentin (control groups).

Results indicated that the Super-Bond C&B system produced a higher resistance to porcelain fracture when compared with the other resin cements. Porcelain bonded to enamel was stronger than porcelain bonded to dentin for all cements except the All-Bond 2 + Choice cement, which produced the opposite results. The 1.0 mm-thick porcelain groups recorded higher mean fracture strengths when compared with the 0.5 mm-thick groups. No significant difference was found between the 2 control groups.

Comment

In this study, the 1-mm porcelain specimens were stronger than the 0.5-mm specimens. However, making porcelain veneers 1 mm in thickness for a patient would require removal of approximately 1 mm of tooth structure, which would likely expose considerable dentin. This study suggests that, as a bonding substrate, traditional preparations that conserve as much enamel as possible are likely to produce favorable results.

Piemjai M, Arksornnukit M. Compressive fracture resistance of porcelain laminates bonded to enamel or dentin with four adhesive systems. J Prosthodont *2007;16:457-464.*

Resin Bonding to Dental Ceramics

Recent progress in technology and research related to new dental materials has resulted in an increased number of materials commercially available for esthetic restorations. Because ceramics have the capacity to replicate the esthetically pleasing characteristics and vitality of natural teeth, there is an ever-increasing demand for metal-free restorations. The long-term prognosis for prosthetic metal-free ceramic restorations is largely a function of the choice of ceramic primer and cementing agent, durability and content of the adhesive bond.

Yoshida et al from Nagasaki University, Japan, evaluated a new resin bonding system with 5 ceramic materials: Vintage feldspathic porcelain (Shofu); Cerec Vitablocs Mark II machinable ceramics (Vita); In-Ceram Alumina glass-infused ceramics (Vita); Procera AllCeram alumina ceramics (Nobel Biocare); and Cercon zirconia ceramics (DeguDent).

For each specimen, 2 ceramic discs were cleaned with phosphoric acid, treated with primer (Clearfil Ceramic Primer, Kuraray) and bonded together with an automix dual-polymerized resin luting agent (Clearfil Esthetic Cement, Kuraray). The cement film thickness was approximately 50 µm. The cement was lightly polymerized from 4 directions for 20 seconds.

The specimens were then randomly divided into 2 subgroups. One subgroup was stored in water for 24 hours (control). The other subgroup was thermocycled 10,000 times between 4° and 60°C, with a dwell time of 1 minute in

each bath. Specimens were then subjected to a shear bond test in a universal testing machine.

Results indicated mean bond strengths ranging from 35.1 ± 9.0 to 45.5 ± 2.2 MPa for the control groups and 34.1 ± 2.9 to 41.2 ± 5.1 MPa for the groups thermocycled 10,000 times. No significant differences were found among control groups and thermocycled groups for all materials.

Comment

Dental restorations are subjected to cyclic temperature changes in the mouth. This system shows promise as a bonding method for a variety of ceramic materials. Recorded bond strengths were high, and the strengths did not degrade as a result of thermocycling.

Yoshida K, Kamada K, Atsuta M. Shear bond strength of a new resin bonding system to different ceramic restorations. Int J Prosthodont *2007; 20:417-418.*

Masking Ability of Three Types of Ceramic Veneers

Ceramic veneers are commonly used to mask discolored tooth structure. The masking ability of a ceramic material can be determined by measuring the color difference (ΔE*) when the test material is placed on a black background and then on a white background. The contrast ratio (CR) can be determined by dividing the illuminance (Y) of the material when placed on a black background by the illuminance when the material is placed on a white background (CR = Yb/Yw).

Chu et al from the University of Hong Kong, China, and Northwestern University, Illinois, investigated the masking ability of 3 types of ceramic veneers: Procera aluminum oxide (Nobel Biocare AB); Empress 2 lithium disilicate pressed ceramics (Ivoclar Vivadent); and Vitadur Alpha aluminum-oxide (10%) reinforced feldspathic porcelain (VITA Zahnfabrik).

Disk-shaped specimens, 0.7 mm in thickness, of Shade A2 (Vita Lumin) were made from the 3 types of ceramic systems. The illuminance and color (CIE L*a*b*) of the specimens were measured with a colorimeter (Model CS-100; Minolta) when specimens were placed on a black background and a white background to determine the CR of each material. Masking ability was determined by calculating the ΔE*.

The mean CR for Procera ceramics was 0.50 ± 0.02. The mean CR for Empress 2 ceramics was 0.46 ± 0.05, and the mean CR for Vitadur Alpha was 0.39 ± 0.02. Mean ΔE* between the black and white backgrounds was 24.46 ± 1.03 for the Procera specimens, 25.80 ± 1.03 for the Empress 2 specimens and 31.08 ± 1.19 for the Vitadur Alpha specimens. All differences were statistically significant except for the mean ΔE* values between the Procera and Empress 2 groups.

Comment

The CR is a measure of the opacity of a material. A higher CR indicates a more opaque material with better masking abilities. The ΔE* value is a measure of the color difference between a black background and a white background. A perfect masking ability would produce a ΔE* = 0, so the lower the value, the better the masking ability.

Procera ceramics are 99% aluminum oxide, whereas Vitadur Alpha contains 10% aluminum oxide. The higher content of aluminum oxide, which intercepts incident light, can explain the differences.

Although the mean CR values for the Procera and Empress 2 groups were significantly different, their masking abilities (mean ΔE* values) were not. It appears that these 2 systems would be a better choice than Vitadur Alpha veneers when attempting to mask discolored teeth. Nevertheless, their ΔE* values were not zero, so there may be some masking problems with severely discolored teeth.

Chu FCS, Chow TW, Chai J. Contrast ratios and masking ability of three types of ceramic veneers. J Prosthet Dent *2007;98:359-364.*

NEXT:

- Masticatory performance with implant-supported overdentures
- Remounting complete dentures
- Occlusal schemes for complete dentures

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.