

# Prosthodontics

## NEWSLETTER

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### A Courtesy of:

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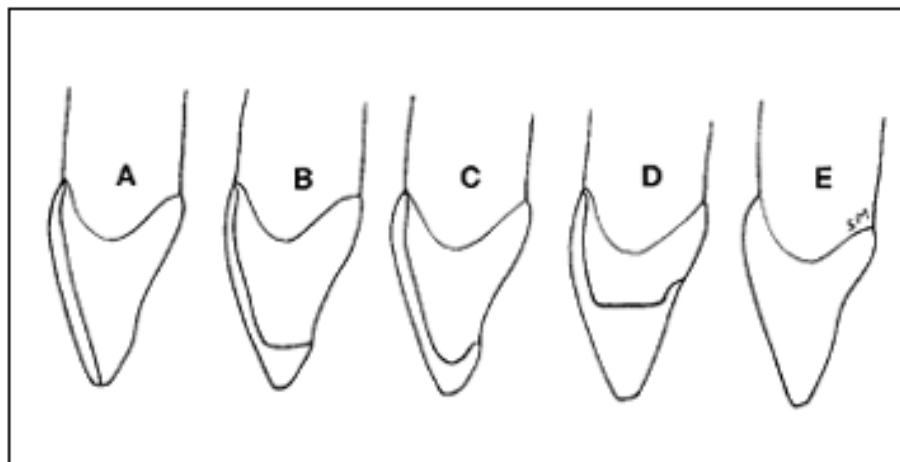
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- Plaque Accumulation And Porcelain Roughness
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- Clinical Trial of All-Ceramic Crowns



A recent study of porcelain laminate veneers evaluated fracture strengths of laminates bonded to teeth with 4 designs of incisal reduction: (A) knife edge incisal finish line; (B) 2 mm butt joint reduction; (C) 1 mm reduction with a lingual chamfer; and (D) 4 mm reduction with 1 mm lingual chamfer. Intact teeth (E) served as controls. (See *Fracture of Ceramic Laminate Veneers*, inside).

## Clinically Relevant Studies on Dental Porcelains

All-ceramic restorations provide exceptional esthetics with their ability to mimic natural teeth. Although improvements have occurred during the last 10 years, limitations exist in the current knowledge of porcelain restorative materials and techniques. Clinically relevant studies are especially useful, and this issue of *Prosthodontics Newsletter* reviews several reports on contemporary dental ceramics with practical application to clinicians.

## Plaque Accumulation and Porcelain Roughness

Adhesive porcelain restorations are commonly ground and polished by the dentist in the mouth after bonding. Although there have been studies related to polishing methods and the surface quality of porcelain, the relationship between porcelain smoothness and plaque retention is not well understood.

A microbiologic study of biofilm accumulation on porcelain disks was conducted by Kawai et al of Osaka University, Japan. Polished porcelain specimens (Vita Celay, Vita Zahnfabrik, Bad Sackingen, Germany) with different roughness values and glazed porcelain disks were used as substrates.

The amount of bacteria and glucans (adherent polysaccharide matrix) increased with incubation time up to 24 hours. Surfaces polished with diamond paste (Dia-Finish, Renfert GmbH, Hilzingen, Germany) accumulated the least plaque. Although the glazed surfaces were smoother than those produced by 2 of the 3 polishing methods, they accumulated the most plaque.

### Comment

Porcelain restorations have been shown to accumulate less plaque compared with other dental restorative materials. Because plaque is a requisite for dental caries and periodontal disease, reductions in plaque will produce a positive biologic effect. Glazing is assumed to be highly desirable and intraoral finishing is commonly accomplished to mimic the clinical appearance of a glaze.

Results of this study suggest that intraoral porcelain polishing with diamond paste would produce a surface with the least potential for plaque re-

tention. This in vitro study evaluated a simulated oral plaque composed of only 1 species of bacterium. Dental plaques are composed of hundreds of different kinds of bacteria, so additional studies are necessary to determine the finish most likely to resist plaque retention.

*Kawai K, Urano M, Ebisu S. Effect of surface roughness of porcelain on adhesion of bacteria and their synthesizing glucans. J Prosthet Dent 2000;83:664-667.*

## Fracture of Ceramic Laminate Veneers

Porcelain laminate veneers have been used to restore esthetically blemished anterior teeth for more than 15 years. Reported failure rates have been relatively low, and the majority of failures were related to fracture of the ceramic material. An in vitro study by Castelnovo et al of Loma Linda University, California, evaluated the strength of laminate veneers bonded to extracted teeth.

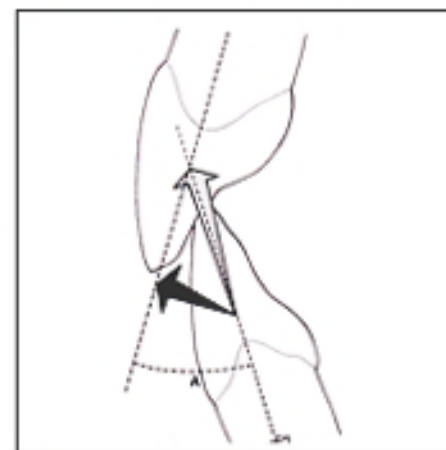


Figure 1. Overlap of incisors produces an interincisal angle (A) and labially directed component of force (solid arrow) during closure (shaded arrow). A 90° loading angle was selected to test strength of laminate veneers.

Four different designs of incisal tooth reduction were investigated, and intact teeth served as controls (see cover illustration). IPS Empress veneers (Ivoclar, Schaan, Liechtenstein) were bonded to the prepared teeth with Variolink resin cement (IPS Empress Cem Kit, Ivoclar). The teeth were subjected to a 90° load on the lingual surface with a universal testing machine until failure occurred (see Figure 1).

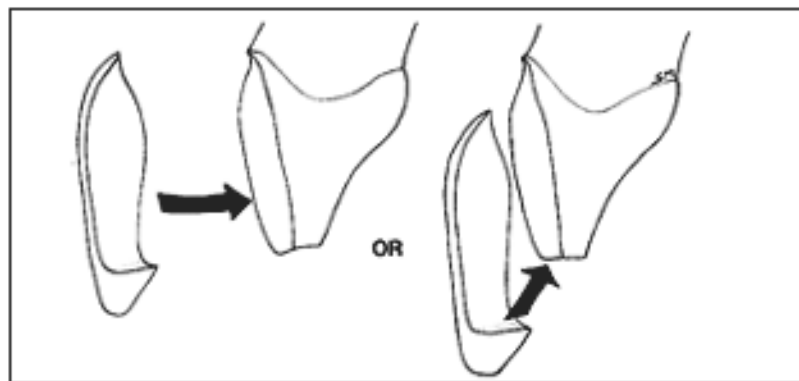
Results indicated that the veneers with 2 mm of unsupported porcelain combined with a lingual butt joint (cover illustration, tooth B) and those with an incisal knife edge finish line (cover illustration, tooth A) were statistically as strong as the intact teeth. The placement of a lingual chamfer did not improve the fracture threshold of the samples. Veneers with 4 mm of unsupported porcelain and a lingual chamfer (cover illustration, tooth D) were as strong as veneers with 1 mm of incisal reduction and a lingual chamfer (cover illustration, tooth C).

### Comment

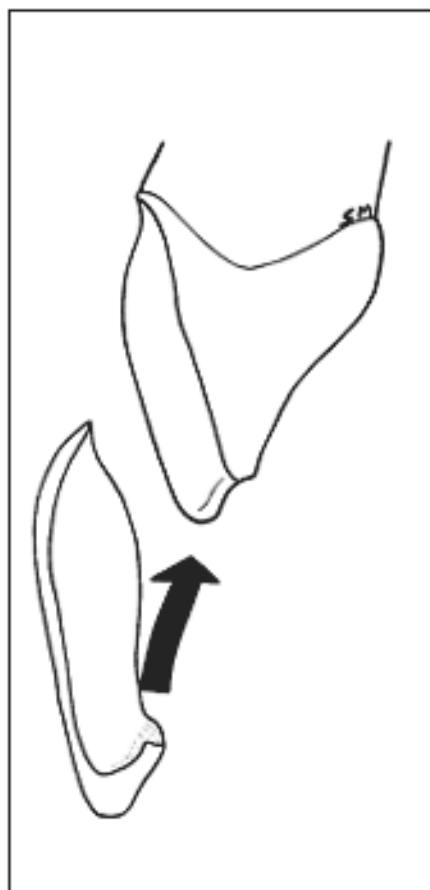
A tooth preparation with 1 mm of incisal reduction that wraps around the incisal edge to form a lingual chamfer has been very successful and is commonly regarded as optimal. Results of this study suggest that a preparation with flat incisal reduction that terminates as a lingual butt joint should perform at least as well.

Flat incisal reduction has several practical advantages, including ease of preparation and unrestricted seating of the finished veneer (see Figure 2). The veneer with a lingual chamfer margin can only be seated from an inciso-cervical direction, which is inconvenient for the technician and dentist (see Figure 3).

The failure threshold for the veneers with 4 mm of incisal porcelain was not statistically different from the



**Figure 2.** Veneer for tooth preparation with butt joint incisal reduction can be seated from multiple directions.



**Figure 3.** Veneer for tooth preparation with 1 mm incisal reduction and lingual chamfer can only be seated from an inciso-cervical direction.

traditional wraparound preparation with 1 mm of incisal porcelain. Therefore, results suggest that a veneer that restores up to 4 mm of lost incisal tooth structure can be as successful as a conservative veneer with 1 mm of incisal porcelain.

Samples were neither thermocycled before testing nor dynamically loaded, limiting this in vitro study. Nevertheless, the results provide very useful information that should improve our understanding of the physical properties of the materials and the reliability of techniques used for porcelain laminate veneers.

*Castelnuovo J, Tjan AHL, Philips K, et al. Fracture load and mode of failure of ceramic veneers with different preparations. J Prosthet Dent 2000;83:171-180.*

### Bonding of Glass-Infiltrated Aluminous Ceramics

Bonding of all-ceramic crowns with an adhesive cement has been shown to reduce the fracture rate of the restoration after it is put in service. With most all-ceramic materials, the fitted surface of the crown is

etched with hydrofluoric acid and coated with a silane-coupling agent before bonding.

The internal surface of the In-Ceram crown (Vita Zahnfabrik, Bad Sackingen, Germany) is a glass-infiltrated aluminous porcelain that does not etch well. Two studies evaluated surface treatments of In-Ceram core material and their effects on bonding capabilities of the material to resin cements.

Madani et al of the University of Hong Kong varied the treatment of the surfaces of the core material by using 2 different concentrations of hydrofluoric acid. A third group was sandblasted (not etched) with 50  $\mu$ m aluminum oxide. A porcelain known to etch effectively (Vitadur Alpha, Vita) served as a control.

For all specimens, Clearfil coupling agent (Cavex Holland BV, Haarlem, Netherlands) was applied and Panavia 21 cement (Kuraray, Osaka, Japan) was used for bonding. A successful bond, comparable to the control, was achieved for the In-Ceram material without etching.

In the second study, Sen et al of Istanbul University, Turkey, air abraded In-Ceram samples with either diamond particles or 50  $\mu$ m aluminum oxide, and bonded them with Panavia-Ex cement (Kuraray) or Super-Bond cement (Sun Medical Co., Ltd., Kyoto, Japan). Shear bond strengths were highest for the group air abraded with diamond particles and bonded with Panavia-Ex cement.

#### Comment

The Panavia brand of cements is composed of a phosphate-monomer composite resin. These cements apparently produce an ester bond with the ceramic oxide and air abrading increases the surface area for bonding. Although diamond particles produced a stronger bond, there was less

## Next:

- Adhesive cements and new post materials
- Dentin thickness after post-space preparation
- Fluoride and direct core materials

loss of surface material with aluminum oxide abrasion.

Results suggest a clinically acceptable bond can be achieved with a Panavia cement and simple air abrasion without etching.

*Madani M, Chu FCS, McDonald AV, Smales VJ. Effects of surface treatments on shear bond strengths between a resin cement and an alumina core. J Prosthet Dent 2000;83:644-647.*

*Sen D, Poyrazoglu E, Tuncelli B, Goller G. Shear bond strength of resin luting cement to glass-infiltrated porous aluminum oxide cores. Prosthet Dent 2000;83:210-215.*

## Clinical Trial of All-Ceramic Crowns

All-ceramic crowns can provide a more lifelike appearance. However, their fracture strengths are lower than those of conventional metal ceramic crowns. An all-ceramic crown composed of a glass-infused aluminous core veneered with feldspathic porcelain (In-Ceram, Vita Zahnfabrik, Bad Sackingen, Germany) was introduced approximately 10 years ago with claims of superior physical properties.

Although several in vitro studies have suggested improved resistance to fracture, there have been few clinical investigations of the performance of this system. Clinical data taken from

a private dental office involving 408 In-Ceram crowns for 107 patients were recently reported by McLaren and White of the University of Southern California.

This prospective study of data collected from 1990 to 1997 included crowns that had been in service from 1 to 86 months. Of the 223 crowns with at least 36 months of follow-up, a failure rate of 1.3% per year was calculated. Approximately 79% of all fractures for the total sample involved molars, which represented 32% of the teeth in the study. The highest success rate was recorded for anterior crowns, which showed a 3-year survival rate of 98%.

### Comment

This prospective clinical trial is impressive. It represented a relatively large sample size and all treatment was provided by 1 prosthodontist in a private practice. Only 9 patients were lost to follow-up among the entire study population and over half the crowns were followed for at least 36 months.

The strength of the evidence from a study with this design and of this magnitude is relatively good, and results are encouraging. Although this study indicated that excellent success with In-Ceram crowns can be expected for at least 3 years, the prognosis is best when the crowns are placed on anterior teeth. The primary advantage

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

of an all-ceramic crown is superior esthetics. The prognosis for this crown system is highest for the most esthetically demanding situations.

*McLaren EA, White SN. Survival of In-Ceram crowns in a private practice: a prospective clinical trial. J Prosthet Dent 2000;83:216-222.*

*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.*