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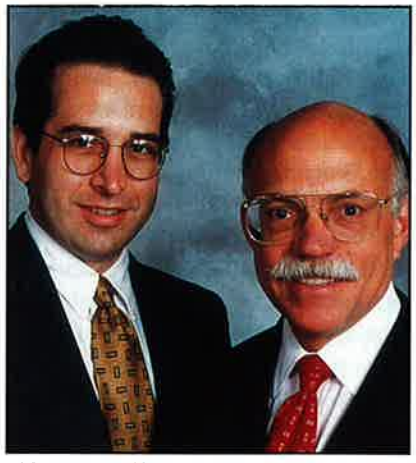
PROSTHODONTIC Insights

A Digest of Recent Trends, Techniques and Clinical Concepts of Dental and Facial Esthetics

Precision Procera Prosthetics

Esthetic Reconstruction Using Procera All Ceramic Crowns



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Ceramometal crowns have been used successfully in prosthodontics for over 30 years. These crowns enable restoration of tooth form and function with reasonable esthetics. Since then many unsuccessful attempts have been made to fabricate ceramic crowns without a metallic substructure. The introduction of Procera all ceramic crowns (Nobel Biocare AB, Göteborg Sweden), however, has been a break through in providing well fitting, esthetically superior crowns.

All ceramic crowns are required in prosthodontics for a number of reasons. Some patients that require full coverage restorations may have an allergy or aversion to metals. Others may demand superior esthetics. All ceramic crowns never show a metallic facial margin; and translucency is possible due to the nature of the core material. In addition, the new computer technology for fabrication (CAD/CAM) insures consistent precision fit of the core while the low fusing porcelain veneering material provides more favorable wear characteristics when opposing enamel.

This issue of Prosthodontic Insights reviews some of the literature supporting the Procera All Ceram System from Nobel Biocare. The following clinical treatment is one of many successful cases restored at Prosthodontics Intermedica using this innovative Procera System.

A 32 year white female presented for initial consultation with the chief complaint of temporomandibular dysfunction, missing teeth and poor esthetics (Fig 2). A thorough clinical and radiographic evaluation was performed. A comprehensive prosthodontic and orthodontic treatment plan was coordinated to address the symptomatic dental malocclusion, replace missing teeth and restore proper form and function. A total of six root form implants were

(Continued on page 2.)

Figure 1a: Smile view showing esthetic enhancement using Procera® AllCeram System.

Figure 1b: Full facial view following delivery of Procera® AllCeram crowns.

Figure 2: Preoperative view showing malocclusion, old style porcelain fused to gold crowns and missing tooth.

Figure 3: Postoperative view following orthodontic treatment and delivery of Procera® AllCeram crowns in maxillary anterior region.

(Continued from page 1.)

placed before and during orthodontic treatment, many of which were used to facilitate orthodontic movement. Orthodontic treatment was completed 2-years later at which time prosthodontic reconstruction was initiated.

Procera crowns were selected for restoration of the maxillary anterior region due to their enhanced esthetic capability and favorable wear characteristics (Fig 3). The old ill-fitting opacious ceramometal crowns were removed from teeth #'s 6, 8 and 9. Post and cores were used to build up endodontically treated teeth #'s 8, 9 and 10. A final impression was taken of teeth #'s 6 through 11. The natural teeth were prepared with chamfered margins and the implant in the area of #7 was impressioned at the fixture level.

In the lab, a custom gold alloy abutment was fabricated for the implant upon which opaque was fired to mask out the gray abutment color. The five dies and the one custom abutment were scanned by the Procera scanning unit (Fig 4a,b) The margins were marked on the computer by the laboratory technician and the information was sent via modem to Sweden for fabrication of the densely sintered aluminous cores (Fig 5). After fabrication, the cores were returned to the laboratory and tried on the appropriate abutments. After the fit was verified, a liner was placed on the cores to facilitate bonding. Additional layers of liner may be placed to block out dark areas in the abutments. Low fusing veneering porcelain (AllCeram, Ducera Dental) was placed over the liner to build the teeth to proper form and function (Fig 6).

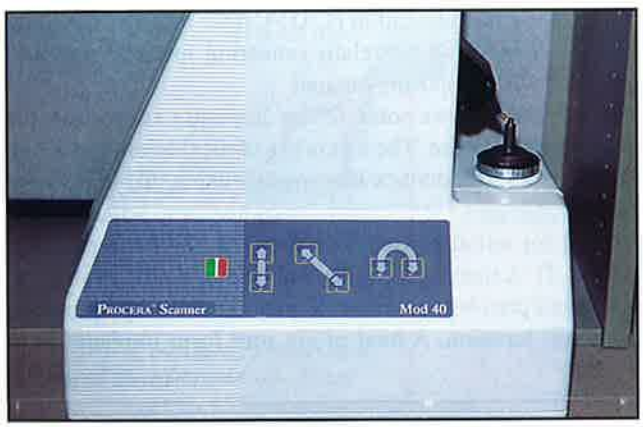

Figure 4a: View of Procera® scanner.

Figure 4b: Procera® scanner used to scan porcelain fused to gold custom abutment for implant.

Figure 5: View of the aluminous copings for the Procera® AllCeram System.

The crowns were tried in the mouth and interproximal and occlusal adjustments were made. The low fusing porcelain enables easy adjustments to the porcelain due to the softer texture. Finishing and polishing can be done chairside using rubber wheels if color alterations are not necessary.

The custom abutment on tooth #7 was screwed into place (Fig 7) and the access hole was covered with composite

(Continued on page 3.)

Figure 6: Completed crowns for teeth #'s 6 to 11 using the Procera® AllCeram System.

(Continued from page 2.)

material. The composite material along with the opaque liner on the implant abutment will mask out any grayness shining through on the translucent Procera cores.

All six crowns were cemented using zinc phosphate cement (Flecks Zinc Phosphate Cement, Mizzy, Inc., Cherry Hill, NJ) (Fig 8). Different shades of zinc phosphate cement are available to further create slight modifications within the translucent crowns at the time of cementation. These Procera crowns provide the patient with an esthetically enhanced reconstruction without sacrificing marginal fit (Fig 1a-b, 3). The low fusing porcelain will exhibit more favorable wear characteristics on the enamel of the opposing natural teeth over time.

The Procera® AllCeram System has changed the way dental laboratories fabricate crowns by incorporating computer technology to provide precision fit using esthetically superior all ceramic restorations. The next phase in the Procera® System will involve all ceramic fixed bridges for short spans in esthetically demanding situations.

Figure 7: Occlusal view of preparations prior to cementation of Procera® crowns.

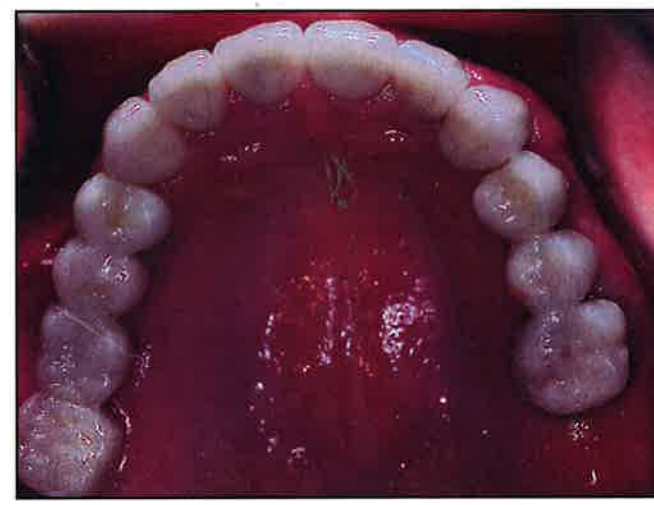

Figure 8: Occlusal view of Procera® AllCeram crowns after cementation.

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Research Evaluations of a New All-Ceramic System

Razzoog and Lang

The demand of patients and the profession for crown restorations with a more natural appearance and the challenge of creating a restoration that defies detection and is consistently excellent, have resulted in the development of a new all-ceramic system (Procera® AllCeram, Nobel Biocare, AB, Göteborg, Sweden). The new restorative concept combines manufacturing techniques for fabricating an aluminum oxide coping with the specific porcelain veneering expertise of the dental ceramist in order to create a strong, esthetically pleasing restoration.

This article presents the results of clinically relevant research projects that have led to the routine application of this all ceramic system. The results are as follows:

Strength of the crown: Analysis of the study data concluded that differences in the coping thickness of 0.5 mm and 0.7 mm produced no significant differences in the fracture resistance of the crowns tested.

Color stability: No clinically detectable color change was measured for the Procera® AllCeram porcelain at the conclusion of a 1200-hour accelerated aging procedure.

(Continued on page 6.)

Precision of Fit of the Procera® AllCeram Crown

May et al

Strength, color stability and precision of fit are requirements of all-ceramic restorations if they are to contribute to the successful rehabilitation of teeth. The Procera® AllCeram crown system, composed of a densely sintered high-purity alumina core combined with a low fusing surface porcelain appears to satisfy most requirements. However, measurement data for marginal fit has not been reported. This investigation was initiated to measure the marginal opening (MO) and internal adaptation of Procera® All Ceram crowns fabricated for premolar and molar dies using the Procera CAD/CAM technology. The method selected to measure the precision of fit between the AllCeram crowns and the dies was Laser Videography. The mean gap dimension at the MO for the molar was 62 um (SD 49) with lower and upper 95% CIs of 55 µm and 70 µm, respectively. The premolar mean MO was 55 µm. (SD 51) with lower and upper 95% CIs of 48 um and 63 µm, respectively. The MOs for both crown groups were well below the clinically accepted 100 µm used to determine an acceptable crown. Based on the findings of this investigation, the clinician can prescribe a Procera® AllCeram crown with confidence knowing that the MO will consistently be less than 70 µm.

May et al	Mean Marginal Opening (MO)	Standard Deviation
Molar	62 µm	49
Premolar	55 µm	51

J Prosthet Dent. 1997(5)p.497-502.

A 5-year Clinical Follow-Up Study of Procera® AllCeram Crowns

Odén et al

This prospective study was initiated to evaluate the clinical performance of 100 Procera® AllCeram crowns after five years in service.

One hundred Procera® AllCeram crowns were fabricated for 58 patients (20 men and 38 women). Patients were treated by four general dental practitioners. Crown placement involved both the anterior and posterior regions of the dental arches. Crowns were examined at baseline and once a year during the five years that followed and evaluated at each appointment with the California Dental Association's quality assessment system.

Of the 97 crowns remaining in the study after five years, only three crowns had experienced a fracture through the veneering porcelain and the aluminum oxide coping material. Two additional crowns were replaced as a result of fractures of only the veneering porcelain. One crown was replaced as a result of recurring caries. All remaining crowns were ranked as either excellent or acceptable for surface/color, anatomic form and marginal integrity.

The five year clinical observations and ranking with the California Dental Association's quality assessment criteria supported the conclusion that Procera® AllCeram crowns may be used in all areas of the mouth.

J Prosthet Dent, Volume 80, #4 (October), 1998, p. 450-455

Flexure Test on Dental Ceramic

Zeng et al

The failure stresses in flexural tests of a densely-sintered high-purity alumina (Procera® AllCeram) were evaluated using three point bend, ring-on-ring, and piston-on-three-ball tests. Glass-infiltrated alumina (In-Ceram) and leucite-reinforced porcelain (IPS Empress) discs with the same dimensions were also tested using ring-on-ring and piston-on-three-ball tests. The failure stresses for all materials were substantially different (up to 50%) with different testing methods, and cannot be directly compared. However, by considering the effective specimen area under the maximum tensile stress, this failure stress data could be compared. The results emphasize the importance of knowing the test method of calculation when comparing data. These three methods were also subjected to Weibull analysis. The Procera® AllCeram had a consistently higher failure stress than the other two materials.

Int J Prosthodont 1996 9 (5) p.434-439.

An Investigation of Enamel Wear Opposing Procera® AllCeram Aluminium Oxide Core

Wilson et al

Fifteen samples of Procera® AllCeram core material were tested against enamel in a custom wear apparatus with human saliva. Silicone impression techniques were used to record the before and after sample profiles. Measurements with a stereomicroscope (64x) showed that wear for the abraded samples ranged from 90 + 180 mm, 15-60 mm for the polished and 210-315 mm for the glazed. When the Procera® aluminium oxide core is exposed and in contact with enamel, wear is reduced when the surface is polished with Brasseler Dialite System.

J Dent Res 1996 75 (spec issue) abstract 393.

Biaxial Flexural Strength and Indentation Fracture Toughness of Three New Dental Core Ceramics

Wagner & Chu

The traditional gold and porcelain fused to metal crowns have been challenged by the esthetic all-ceramic crown materials. However, previous experience with poor mechanical properties, lack of standardized tooth preparation and processing challenges have prevented universal acceptance of all-ceramic crowns. Stronger and tougher ceramics and unique processing methods for ceramics have been developed in the past 20 years.

In this study, three new ceramic crown core materials were tested to compare their biaxial flexural strength and indentation fracture toughness. Ten specimens of Empress, In-Ceram and Procera® AllCeram ceramics were prepared according to their manufacturers' recommendations.

The results revealed significant differences in flexural strength for the three materials (p 0.05). The average flexural strengths of AllCeram, In-Ceram and Empress ceramics were 687 MPa, 352 MPa, and 134 MPa respectively. There was no statistically significant difference between the fracture toughness of Procera® (4.48 MPa • $m^{1/2}$) and In-Ceram ceramics (4.49 MPa • $m^{1/2}$); however, both ceramics had significantly higher fracture toughness ($p<0.005$) than Empress ceramic (1.74 MPa • $m^{1/2}$).

J Prosthet Dent 1996(2)p.140-144.

	Flexure Strength
Procera® AllCeram	687 MPa
In-Ceram® (Vita Zahn-fabrik)	352 MPa
Empress (IVOCLAR)	134 MPa

Use of the Procera® CAD/CAM System for Metal-free Crowns on Single-Tooth Implants

Hegenbarth

Metal abutments or margins showing through ceramic can significantly reduce the total esthetic impression of a restoration. The region where the cervical coronal portion meets the abutment is particularly critical. Bluish gingival discoloration can complicate shade adaptation to the adjacent teeth. A further difficulty is the difference between the cross section of the implant abutment and that of the root of the natural tooth. Adaptation of the natural tooth form at the site of eruption of the crown from the gingiva should be sought.

Precise positioning of the implant and appropriate design of the provisional restoration play important roles in the outcome of the eruption site. The round, 4 mm diameter cross section of the implant abutment in the region of the gingiva nonetheless complicates esthetic optimization. Shine-through of the metal abutment in a restoration is hardly avoidable, particularly when the gingival taper is thin.

Aluminum oxide copings veneered with a special ceramic material (AllCeram, Ducera Dental) have been fabricated for several years using the Procera® CAD/CAM system and have shown positive results. However, use of this system for fabrication of metal-free crowns supported by Brånemark single-tooth implants is new. The complete procedure involves an aluminum oxide abutment (Ceradapt, Nobel Biocare), which is custom ground and fitted with a scanned Procera® crown. The Ceradapt abutment is screwed to the Brånemark implant with a gold screw and the Procera® crown is fastened thereon.

An alternative to the ceramic Ceradapt abutment is placement of a custom coping, produced using Procera®, on a Brånemark implant with a CeraOne abutment (Nobel Biocare). The combination of an individually ground CeraOne abutment and the all-ceramic crown mounted thereon offers yet another clinical/dental laboratory variant to provide optimum esthetics.

Based on positive experience with Procera® crowns over a period of several years, the prognosis is good for use of the Procera® system for metal-free crowns on single-tooth implants.

QDT 1998, Vol 21, P. 27-37

(Continued from page 3.)

Masking properties: Use of an opaque material to mask an underlying stain, discoloration from a post and core, or amalgam buildup of the preparation was found to be unnecessary.

Wear characteristics: The Procera® Porcelain AllCeram occlusal surface does not wear the opposing natural dentition.

Precision fit: A treatment plan can be established with confidence, as the marginal opening of a Procera® AllCeram crown will consistently be less than 70 µm.

Cementation Procedures for the Crown: The results of a study on the effect of different cements on the fracture resistance of the Procera® AllCeram crown indicate that Procera® AllCeram crowns can be used successfully as restorations in all areas of the mouth.

The application of Procera® AllCeram is presently restricted to single crown restorations. However, with the continued development, multiple unit, all-ceramic anterior and posterior fixed partial dentures may be future indications. During the past several years, the Procera® AllCeram System has demonstrated favorable characteristics throughout several clinical evaluations. By combining CAD/CAM technology with densely sintered, high-purity copings, the Procera® System enables the fabrication of restorations which are durable, color-stable, and biocompatible with opposing dentition.

Hacker et al	Mean wear of restorative materials opposed by	Mean wear of enamel opposed by
Olympia gold	0.32 µm	9.0 µm
AllCeram porcelain	4.3 µm	60 µm
Ceramco porcelain	3.7 µm	230 µm

Hacker C; Wagner WC; Razzoog ME. - An in vitro investigation of the wear of enamal on porelain and gold in saliva. - J Prosthet Dent 1996 75 (1) p. 14 - 17. - ISSN 0022-3913

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