Making Porcelain Veneers with the *Procera AllCeram* System: Case Studies

FREDERICK C.S. CHU, BERNT ANDERSSON, FEI L. DENG AND TAK W. CHOW

Abstract: **Different laboratory techniques are available for making porcelain veneers, and each has its own advantages and limitations. This article describes how high-density alumina core constructed with Computer Assisted Design/Computer Assisted Manufacture (CAD/CAM) technology can be successfully used for making porcelain veneers. Different clinical conditions are also presented to illustrate the use of these bi-layer veneers.**

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Clinical Relevance: **The use of high-density alumina core for making porcelain veneers is a new technique applicable to many clinical conditions, especially when masking of dental discoloration is required.**

Patients with aesthetic dental problems – in terms of discoloration, abnormal morphology and mal-alignment – can often be managed with porcelain veneers when there is sufficient tooth substance for bonding.[1] The use of porcelain veneers is biologically advantageous because the tooth preparation involves the conservative reduction of the labial surface (0.3–0.7 mm), and incisal edge (0.5–1.0 mm) and only minimal palatal chamfer. Therefore, the risk of pulpal involvement is small when compared to the preparations for full crowns. In addition, the gingival tissues are less adversely affected,[2] and the long-term performance of veneers has also been reported to be satisfactory.[3]

However, the fabrication of porcelain veneers using incremental firing and feldspathic porcelain on investment material or platinum foil is technique-sensitive. It is also difficult to achieve an optimal marginal fit because of firing shrinkage, and the thin porcelain margin can be accidentally damaged during the separation of the veneer from the refractory die material or platinum foil. The flexural strength of feldspathic porcelain veneers is low before bonding to the tooth tissues. If the repair of damaged margins is required, then the veneer has to be 'rewaxed' on the master model, and supported with a refractory investment material, such as *Retouch Vest* (Shofu, Kyoto, Japan) or *Spacemaker Refractory* (Whip-Mix, KY, USA) before wax burn-out and the addition of porcelain.

In order to simplify the fabrication process, and to improve the precision fit, many other methods have been introduced. The copy milling technique (e.g. *Celay*, Vita, Bad Sackingen, Germany) was used, but it requires experienced technicians to create all of the fine details of veneers from a dense porcelain block. The 'casting' of leucite-reinforced porcelain veneer with the lost wax technique (*IPS Empress II*, Ivoclar-Vivadent, Schaan, Liechtenstein) is commonly used, but the heat-pressed veneers have to be manufactured in nearly full contour with adequate thickness to resist deformation/warpage during additional firing for surface stains. This does not allow the incorporation of internal characteristics, such as crack lines, mammellon or internal stains and incisal translucency.

PROCERA ALLCERAM SYSTEM

Procera technology (Nobel Biocare,

Figure 1. *Procera scanner.*

Frederick C.S. Chu, *BDS(Hons), MSc, FRACDS, MRD RCS, FADM, FCDSHK, Assistant Professor, Faculty of Dentistry, The University of Hong Kong, Hong Kong, China,* **Bernt Andersson**, *DDS, PhD, Head, SIM/Prosthetic Dentistry, Specialist Dental Service, Molndal, Sweden,* **Fei L. Deng**, *DDS, MS, Associate Professor and Head, Department of Oral Implantology, Guanghua College of Stomatology, Sun Yat-sen University, Guangzhou, China and* **Tak W. Chow**, *BDS, MSc, PhD, FRACDS, FDS RCS, DRD RCS, FADM, FCDSHK, Associate Professor, Faculty of Dentistry, The University of Hong Kong, Hong Kong.*

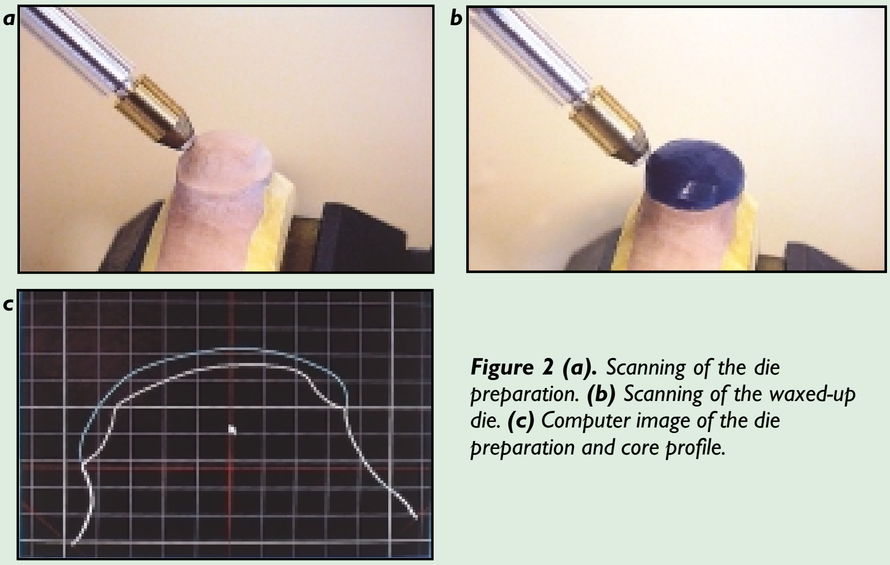

Figure 2 (a). *Scanning of the die preparation.* **(b)** *Scanning of the waxed-up die.* **(c)** *Computer image of the die preparation and core profile.*

Gotebörg, Sweden) was originally used for making titanium copings for crown and bridgework by copy milling and electric discharge machining. The technology was modified to produce ceramic cores for all-ceramic crowns and is now marketed as the *Procera AllCeram* system.[4] For the *AllCeram* system, a special scanner with a sapphire ball tip is used to 'read' the die that is mounted on a rotating table (Figure 1). Each working die is scanned twice for the construction of all-ceramic cores of different thickness. The die preparation is scanned first to obtain the contour of the prepared tooth (Figure 2a). To facilitate the definition of the finishing margin, a layer of wax of the desired core thickness is added onto the preparation, and accurately extended to the margin under a microscope. The waxed up die is scanned again (Figure 2b). The finishing line is indicated by the intersection of the two profiles. The core profile is then recorded by the Computer Assisted Design (CAD) function of the system. A digital file is created and saved for each core (Figure 2c). The files are sent by modem to the manufacturer, which then constructs the cores with alumina powder on working dies that are enlarged to compensate for the shrinkage of the powder during the sintering process. After the cores are returned to the laboratory, they are placed on the working dies for the evaluation of marginal fit and profile. Adjustments are made when required. A laminating feldspathic porcelain (*AllCeram*, Ducera, KG, Germany) is then used to achieve the final shape and colour of the restorations.

All the steps regarding surface treatment and bonding procedures should be followed according to the manufacturer's recommendations. Because the alumina particles are densely sintered, etching by hydrofluoric acid may not produce a sufficiently retentive surface for bonding. The manufacturer for *Procera* recommends sandblasting the fitting surface with 110 micron alumina particles under 4–6 bars for 10 seconds, and cleaning the veneers in an ultrasonic bath for 5 minutes. A laboratory study reported that a durable bond was observed only by using a composite resin containing a special adhesive phosphate monomer (*Panavia*, Kuraray, Osaka, Japan) after sandblasting.[5]

The use of *Procera AllCeram* veneers can be considered for the following conditions:

- Diastema closure;
- Tooth build-up;
- Minor alignment of teeth;
- Masking discoloration.

The following cases illustrate when *Procera AllCeram* veneers can be used to produce an aesthetic outcome.

CASE STUDIES

Case 1

A 28-year-old male presented with a congenitally missing lower central incisor, and complained of poor aesthetics because there were

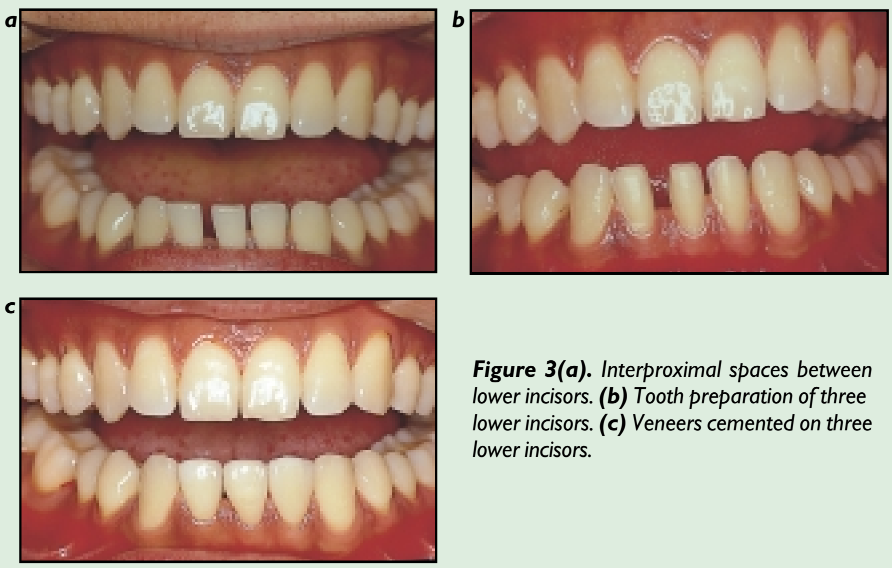

Figure 3(a). *Interproximal spaces between lower incisors.* **(b)** *Tooth preparation of three lower incisors.* **(c)** *Veneers cemented on three lower incisors.*

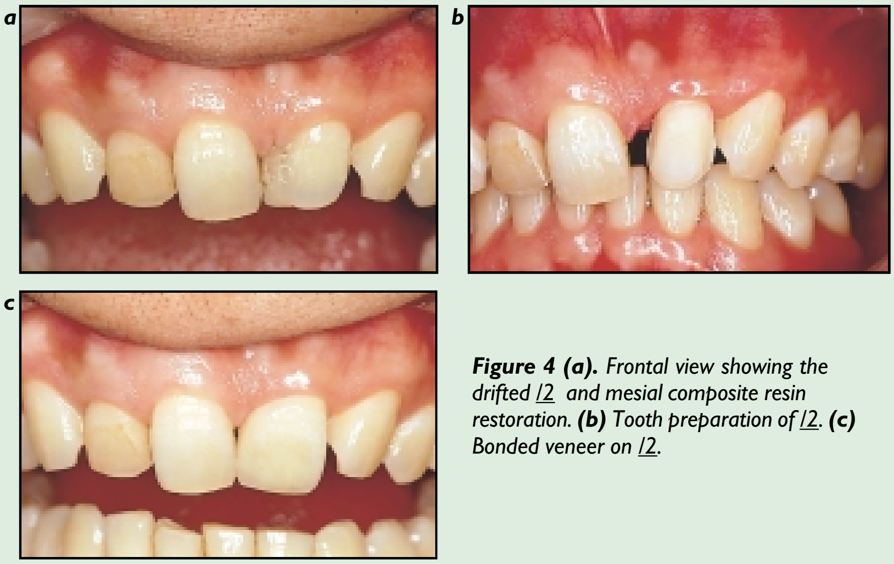

Figure 4 (a). *Frontal view showing the drifted /2 and mesial composite resin restoration.* ***(b)*** *Tooth preparation of /2.* ***(c)*** *Bonded veneer on /2.*

interproximal spaces between his three lower incisors (Figure 3a). He had Class I incisal and molar relationships, and had a stable intercuspal position. Study casts were taken for space analysis, which revealed that only 4 mm of edentulous space could be created by orthodontic alignment of the three lower incisors. The lower incisors were narrow, which did not allow for enamel stripping. Owing to the reduced amount of available space, the replacement of the missing incisor was not feasible without extensive orthodontic treatment. The patient was advised to have resin composite build-up or porcelain veneers to close the spaces. A diagnostic wax-up was prepared and the patient preferred the use of porcelain veneers for the closure of diastemas. Tooth preparation was carried out with the aid of a vacuum-formed matrix, which was formed according to the diagnostic wax-up (Figure 3b). Glass ionomer cement (*Fuji II LC*, Fuji, Tokyo, Japan) was bonded temporarily on the incisal edges of prepared teeth to prevent over-eruption. The porcelain veneers were cemented with resin cement (*Choice PVS*, Bisco, IL, USA)[6] (Figure 3c). The veneers have been in service for 22 months without any complications. However, a recent study reported that a phosphate ester cement (*Panavia*, Kuraray, Osaka, Japan) gave the highest bond strength.[5] However, this material is available in only a limited number of shades and was therefore considered not appropriate in this case.

Case 2

A 42-year-old male lost his upper left central incisor in an accident more than 30 years ago, and the edentulous space was reduced following the mesial movement of 1/2. Resin composite was used to build up the upper left lateral incisor to simulate /1, but he was not satisfied with the appearance, or the plaque accumulation that was associated with the resin composite build-up.

On examination, the gingival tissues were healthy, but the two mesial papillae of 1/ and /2 did not allow the final restoration to provide a proper gingival contour (Figure 4a). Orthodontic treatment was proposed to open up the space for the replacement of tooth /1 and the correction of the midline shift, but the patient declined the extraction of premolars and the retraction of his anterior teeth. To improve the gingival contour of /2 for simulation as tooth /1 , electrosurgery under local anaesthesia was performed to remove the mesial papilla of /2 (Figure 4b). Following tooth preparation for veneer and the taking of a working impression, a temporary veneer was constructed with resin composite (*Spectrum TPH*, Dentsply, Milford, DE, USA) and cemented with a small spot of resin luting cement at the mid-buccal region. The patient was satisfied with the shape and dimensions of the provisional veneer. The porcelain veneer was then constructed using the *Procera AllCeram* system, and bonded with a resin cement (*Panavia-F*, Kuraray, Osaka, Japan) after sandblasting and the application of a silane coupling agent (Figure 4c).

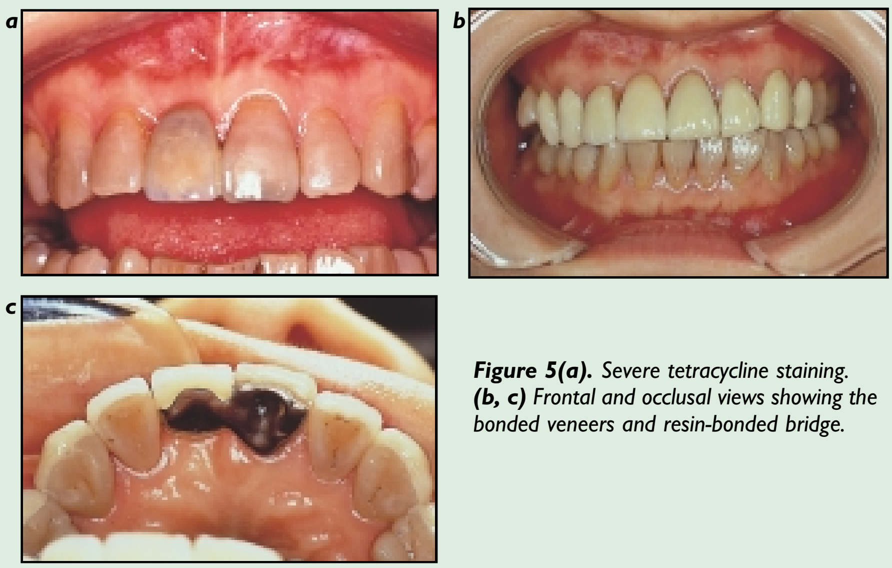

Figure 5(a). *Severe tetracycline staining.* ***(b, c)*** *Frontal and occlusal views showing the bonded veneers and resin-bonded bridge.*

Figures 6(a, b). *Frontal views showing the Class III incisal relationship and severe tetracycline staining.* ***(c)*** *Frontal view after orthodontic treatment.* ***(d, e)*** *Frontal views showing the tooth preparation and bonded veneers.*

Case 3

A 30-year-old female requested to have aesthetic dental treatment because her teeth were discoloured as a result of prolonged antibiotic treatment for a chest infection during childhood. On examination, she had severe generalized tetracycline staining and a cantilevered resin-bonded bridge replacing a missing central incisor (Figure 5a). The patient had marginal gingival inflammation but no periodontal pockets of more than 4 mm. All existing teeth were intact and the occlusion was satisfactory.

Owing to the severity of the tetracycline staining, porcelain veneers were used to mask discoloured teeth 4/ to /4 except 1/. After the cementation of porcelain veneers with resin cement (*Choice PVS*), a new cantilevered resin-bonded bridge to replace 1/ was made, with the pontic matching the colour of the veneered teeth (Figures 5b and c). The lower anterior teeth were subsequently bleached to reduce the colour difference between the upper and lower teeth.

Case 4

A 23-year-old man was referred by his family dentist to an orthodontist for the management of his mal-aligned teeth and protruded mandible. He presented with a Class III skeletal profile, a reverse overjet of 5 mm, mal-aligned upper anterior teeth, a missing /2 and tetracycline staining (Figures 6a and b). Orthognathic surgery (Le Fort I and Hofer) was performed, with pre- and post-surgical orthodontic treatment, to correct the skeletal discrepancy. The upper anterior teeth were aligned with the midline corrected and mesial movement of both canines after the extraction of 2/ (Figure 6c).

This orthodontic option was selected by the patient and orthodontist without prosthodontic input because they believed that prosthodontic replacement of the congenitally missing /2 could be eliminated and the canines could be made to simulate the lateral incisors.[7] However, the maxillary canines were very prominent and their mid-axes were tilted. In order to improve the proportion between the central incisors and canines, porcelain veneers were used to increase the length and the width of central incisors, and to reduce the length and labial prominence of the canines (Figures 6d and e).

DISCUSSION

The *Procera AllCeram* technology offers strong all-ceramic cores, which allow repeated firing with laminating porcelain until the desired colour is achieved. However, the exact reproduction of tooth preparation is limited by the size of the scanning tip, and it is therefore important to maintain a cervical chamfer of not more than 0.5 mm.[8] It is also difficult to scan a significant incisal overlap. Additional laboratory time should also be considered because the core manufacturing process is only undertaken in Sweden and America.

In addition to the unique manufacturing process, several properties of the high-density alumina cores have to be recognized for clinical practice. Because of the high-density and optical property of alumina particles, the contrast ratio of the fired core is very high compared with other porcelain products.[9] A high contrast ratio represents a low transmittance of light through the core. The *Procera AllCeram* veneers could then be advantageous if a 'masking effect' is required for severely discoloured dentitions.[6,10] However, if high translucency is required, then porcelain of a lower contrast ratio (e.g. *Ceramco*, Dentsply) should be used.[9] A dual-cure instead of light-cure cement is also preferred to achieve complete polymerization under *Procera AllCeram* veneers. In addition, the high-density alumina core has a minimal glassy matrix, and it is difficult to create a porous surface for bonding by acid etching compared to feldspathic porcelain. Proper sandblasting and selection of a bonding system are necessary for successful bonding. Further studies are required to investigate the long-term survival of these restorations.

Porcelain veneer restorations are useful in many clinical conditions, but the outcome can be influenced by the material used. Each of the existing commercial products has its own merits and limitations, and it is important that clinicians understand the properties and clinical requirements of each product, and communicate well with patients, dental specialists and dental technicians.

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ABSTRACTS

WHAT A GOOD IDEA!
Modified Matrix Adaptation for Sub-Gingival Class II Amalgam Restorations. D.C.N. Chan. *Operative Dentistry* 2003; **28:** 469–472.

When was the last time you found that the caries extended so deeply that it was simply impossible to obtain a satisfactory interproximal margin to your amalgam restoration? The overhang clearly visible on the next bitewing radiograph is a constant reminder of your failings!

This paper describes how a second matrix band may be used to overcome the problem. The first conventional band is fitted as normal, and then loosened slightly. Another matrix band is now taken (only the band, not the retainer) cut in half, and slid lengthwise down inside the first band to protrude into the gingival crevice, but this will pass the deep cavity margin. The occlusally protruding portion may be bent over and pressed against the adjacent tooth. Tightening the first band, and tightly inserting wedges, will give a good marginal seal against which the amalgam may be condensed.

The author of the paper prefers to use the open sandwich type of restoration, with glass ionomer cement at the base of the cavity, and amalgam above, but this may be a matter of personal choice.

A simple tip, certainly worth trying next time you are faced with a deep sub-gingival margin.

REMEMBER THIS NEXT TIME YOU HAVE A POST TO REMOVE!
Bond Strength of Resin Cement to Dentine and to Surface-treated Posts of Titanium Alloy, Glass Fiber and Zirconia. A. Sahafi, A. Peutzfeldt, E. Asmussen, K. Gotfredsen. *Journal of Adhesive Dentistry* 2003; **5:** 153–162.

This research was designed to examine the bond strengths achieved with regard to the successful cementation of endodontic posts. However, as an endodontist my own interpretation was the increasing difficulty in the removal of these posts should re-root treatment become necessary!

The work was carried out *in vitro*. Groups of each of the three post types described in the title were subjected to one of three surface treatments:

- Roughening by sandblasting and hydrofluoric acid etching;
- Application of primer;
- Roughening followed by application of primer – Cojet treatment (3M ESPE, Seefeld).

They were then cemented with one of two cements and bond strengths calculated.

The results showed that the bond strengths were affected by the variables, with the third group (receiving the Cojet treatment) having the best results. It was also found that the two cements tested gave significantly different bond strengths to both the posts and the dentine. *Panavia F* cement was found to give the best results.

Peter Carrotte
Glasgow Dental School