

Case Report

The 24-year clinical performance of porcelain laminate veneer restorations bonded with a two-liquid silane primer and a tri-*n*-butylborane-initiated adhesive resin

Mitsuo Nakamura^{1,2)} and Hideo Matsumura^{2,3)}

¹⁾Private Practice, Ichikawa, Japan

²⁾Department of Fixed Prosthodontics, Nihon University School of Dentistry, Tokyo, Japan

³⁾Division of Advanced Dental Treatment, Dental Research Center, Nihon University School of Dentistry, Tokyo, Japan

(Received May 8, 2014; Accepted June 2, 2014)

Abstract: This report describes the bonding technique and clinical course of porcelain laminate veneer restorations applied to discolored maxillary incisors and canines. The patient was an 18-year-old woman, and tooth reduction was limited to the enamel. Laminate veneer restorations were made with a feldspathic porcelain material (Cosmotech Porcelain). After try-in, enamel surfaces were etched with 65% phosphoric acid gel, and a tri-*n*-butylborane-initiated resin (Super-Bond C&B) was applied as a bonding agent. The inner surface of the restorations was etched with 5% hydrofluoric acid gel (HF Gel) and treated with a two-liquid silane primer (Porcelain Liner M), after which the Super-Bond resin was applied. Each restoration was seated with a dual-activated composite luting agent (Cosmotech Composite). After 24 years and 8 months, the restorations are functioning satisfactorily. The luting system and bonding technique described in this report are an option for seating laminate veneer restorations made of silica-based tooth-colored ceramics. (J Oral Sci 56, 227-230, 2014)

Keywords: bonding; hydrofluoric acid; porcelain; silane; tri-*n*-butylborane.

Correspondence to Dr. Mitsuo Nakamura, Department of Fixed Prosthodontics, Nihon University School of Dentistry, 1-8-13 Kanda-Surugadai, Chiyoda-ku, Tokyo 101-8310, Japan
Fax: +81-3-3219-8145 E-mail: ndent@sea.plala.or.jp

doi.org/10.2334/josnusd.56.227
DN/JST.JSTAGE/josnusd/56.227

Introduction

Porcelain laminate veneer restorations are used for patients with discolored dentition, incisal fracture, open spaces including diastema, and dental caries. Although sintered veneer restorations are thin and brittle, the service period of such restorations is acceptable for patients and dentists (1-6). During the last three decades, two-liquid silane primers activated with ferric chloride or carboxylic functional methacrylate have been developed (7-9). However, limited information is available on the clinical performance of restorations bonded with a two-liquid porcelain primer and the related bonding system. This report describes bonding technique and long-term (24 years) clinical performance of porcelain laminate veneer restorations bonded with a two-liquid silane primer and a self-polymerizing bonding agent.

Case Report

An 18-year-old female patient was seen for a chief complaint of esthetic dissatisfaction because of discolored maxillary incisors and canines (Fig. 1). Oral examination revealed discoloration of dentition, placement of metallic inlay restorations at the premolar and molar areas, and crowding around the maxillary lateral incisors. Anamnesis showed that the patient and her mother had used tetracycline antibiotics for treatment of infectious diseases. Although the patient did not request orthodontic treatment, she strongly desired improvement in the appearance of her anterior teeth. Among the proposed options, the patient preferred seating porcelain



Fig. 1 Discoloration of anterior teeth



Fig. 2 Reduction within enamel for porcelain laminate veneer restorations



Fig. 3 Sintered porcelain laminate veneer restorations



Fig. 4 Etching restorations with 5% hydrofluoric acid gel (HF Gel)

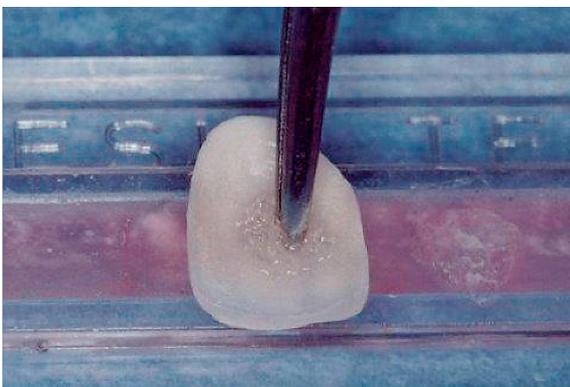


Fig. 5 Application of Porcelain Liner M silane primer



Fig. 6 Etching enamel with 65% phosphoric acid gel

laminate veneer restorations to the six maxillary anterior teeth. The treatment plan was explained to her and her parents before treatment, and consent was obtained.

Facial surfaces within enamel were ground with diamond rotary cutting instruments under water coolant (Fig. 2). An impression for a working cast was made with silicone elastomer, and die stone was poured. A refractory cast was made with an investment material (Cosmotech Vest, GC Corp., Tokyo, Japan), and porcelain (Cosmotech Porcelain, GC Corp.) was sintered

according to manufacturer specifications (Fig. 3). The restoration was tried-in at the next appointment, and the inner surfaces were etched with 5% hydrofluoric acid gel (HF Gel, GC Corp.) for 60 s (Fig. 4), washed with tap water, and ultrasonically cleaned in methanol. The surfaces to be bonded were air-dried and primed (Fig. 5) with a two-liquid primer (Porcelain Liner M, Sun Medical Co., Ltd., Moriyama, Japan) containing methacrylic silane and 4-methacryloyloxyethyl trimellitate anhydride (4-META) (7,8). The ground enamel surfaces



Fig. 7 Application of Super-Bond C&B resin as a bonding agent



Fig. 8 Seating the restoration with Cosmotech Composite material



Fig. 9 Restorations bonded to maxillary incisors and canines



Fig. 10 Restorations 3 years after seating



Fig. 11 Restorations 12 years after seating



Fig. 12 Restorations 24 years and 8 months after seating

were etched with 65% phosphoric acid gel for 30 s, rinsed with water, and air-dried (Fig. 6). A tri-*n*-butylborane (TBB)-initiated resin (Super-Bond C&B, a mixture of Ivory and Opaque Ivory, Sun Medical Co., Ltd.) was used as the self-polymerizing bonding agent. A brush-dip technique was used to apply a thin layer of Super-Bond resin to the primed porcelain and etched enamel (Fig. 7). Before setting the Super-Bond resin, a luting composite (Cosmotech Composite, GC Corp.) was applied to the bonding area (Fig. 8), and the restoration was seated to

the abutment teeth (Fig. 9). The patient then entered a maintenance program. Although gradual gingival recession was observed during the period of regular check-ups (Figs. 10 and 11), the restorations have functioned satisfactorily for more than 24 years (Fig. 12).

Discussion

One of the problems associated with bonding porcelain has been bonding durability of luting systems. The authors previously described activation of silane coupler

with ferric chloride and acidic monomers (7-9). Two-liquid primers and three-liquid bonding agents were thereafter released based on findings from that research. These commercially available materials use acidic functional monomers as an activator for the silane monomer. The authors selected one of these two-liquid primers (Porcelain Liner M) for use in the current patient. Bond-strength testing showed that the combination of 4-META and silane to porcelain exceeded the bonding durability of an inactivated silane (7-9).

Moreover, experimental results showed that combined application of the two-liquid primer and Super-Bond resin is desirable for maintaining high bond strength (8). On the basis of the experimental results, the Super-Bond resin was applied as a bonding agent. To control the color of the bonding agent the authors used equal amounts of the Ivory and Opaque Ivory powders of the Super-Bond material. Although a composite material was used as the luting agent, luting with Super-Bond resin alone is recommended when the thickness of the veneer is sufficient to hide tooth color and the appointment time is sufficient for preparation of individual surfaces and the seating of multiple restorations.

Orthodontic treatment was recommended to the patient, to address her esthetic dissatisfaction. The patient, however, only requested an improvement in tooth color. Because of her age, and the somewhat lower bonding strength to dentin of the bonding systems available at that time (5), tooth reduction was limited to the enamel. Edge-to-edge or cross bite is generally considered a contraindication for porcelain laminate veneer restorations, including reduction of incisal edges and canine cusps. Porcelain veneers were clearly contraindicated for the patient's lateral incisors and left canine. The outline forms of the veneers were carefully designed to ensure adequate occlusal contact, esthetic contour, and optimal oral function.

Although gingival recession was observed during long-term follow-up, no dental caries has been detected around the restorations for more than 24 years. Thus, it can be concluded that laminate veneer restorations bonded with an improved bonding system are one of the

most reliable and minimally invasive treatment options for adolescent patients with discolored anterior teeth.

Acknowledgments

This clinical report on adhesive bonding of dental materials was supported in part by a Grant-in-Aid for Scientific Research C 24592934 (2012-2014) from the Japan Society for the Promotion of Science (JSPS). The present bonding procedure was previously described in a Japanese-language report (10).

References

1. Peumans M, De Munck J, Fieuws S, Lambrechts P, Vanherle G, Van Meerbeek B (2004) A prospective ten-year clinical trial of porcelain veneers. *J Adhes Dent* 6, 65-76.
2. Katoh Y, Taira Y, Kato C, Suzuki M, Shinkai K (2009) A case report of a 20-year clinical follow-up of porcelain laminate veneer restorations. *Oper Dent* 34, 626-630.
3. Burke FJ, Lucarotti PS (2009) Ten-year outcome of porcelain laminate veneers placed within the general dental services in England and Wales. *J Dent* 37, 31-38.
4. Beier US, Kapferer I, Burtscher D, Dumfahrt H (2012) Clinical performance of porcelain laminate veneers for up to 20 years. *Int J Prosthodont* 25, 79-85.
5. Burke FJ (2012) Survival rates for porcelain laminate veneers with special reference to the effect of preparation in dentin: a literature review. *J Esthet Restor Dent* 24, 257-265.
6. D'Arcangelo C, De Angelis F, Vadini M, D'Amario M (2012) Clinical evaluation on porcelain laminate veneers bonded with light-cured composite: results up to 7 years. *Clin Oral Investig* 16, 1071-1079.
7. Matsumura H, Tanaka T, Atsuta M, Nakamura M, Nakabayashi N (1987) Bonding of porcelain, quartz and alumina with a silane coupling agent and carboxylic monomers. *Nihon Hotetsu Shika Gakkai Zasshi* 31, 1494-1498.
8. Matsumura H, Kawahara M, Tanaka T, Atsuta M (1989) A new porcelain repair system with a silane coupler, ferric chloride, and adhesive opaque resin. *J Dent Res* 68, 813-818.
9. Kato H, Matsumura H, Ide T, Atsuta M (2001) Improved bonding of adhesive resin to sintered porcelain with the combination of acid etching and a two-liquid silane conditioner. *J Oral Rehabil* 28, 102-108.
10. Nakamura M, Matsumura H (1990) Characteristics and clinical application of the Super-Bond adhesive. *Nippon Shika Hyoron* 575, 137-152.