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Two-year Follow-up of Ceramic Veneers and a Full Crown Treated With Self-etching Ceramic Primer: A Case Report

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Clinical Relevance

The Monobond Etch & Prime seems to be an efficient option for adhesive cementation of ultrathin veneers and full crown ceramic with good properties after two years of clinical follow-up.

SUMMARY

The use of the self-etching ceramic primer combines the stages of acid conditioning and silanization in cementation procedures of ceramic restorations. The protocol is a simpler and safer alternative to the conventional protocol for surface treatment of silica-based ceramics. This case report describes the steps of an esthetic rehabilitation with ultrathin veneers and full crown based on lithium disilicate treated with a ceramic primer (Monobond Etch & Prime, Ivoclar Vivadent, Schaan, Liechtenstein). After two years of clinical follow-up, the restorations presented satisfactory esthetic and functional performance, color stability, surface and marginal integrity, and absence of cracks and debonding. More research is needed to investigate the clinical performance and longevity of the ceramic restorations treated with self-etching ceramic primers.

INTRODUCTION

Adhesion is a key factor for the long-term success of ceramic restorations.[1] For certain restoration types, such as ultrathin veneers, retention to the tooth surface depends solely on the micromechanical and

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Table 1: *Material, Brand, Manufacturers, and Chemical Composition of the Materials Used in This Clinical Case*

Material	Brand	Manufacturer	Composition
Lithium dissilicate ceramic	IPS e.max Press	Ivoclar Vivadent	SiO, Li_2O, K_2O, P_2O_5, ZrO_2, ZnO, and other oxides and ceramic pigments
Fluorapatite ceramic	IPS e.max Ceram	Ivoclar Vivadent	SiO_2, Al_2O_3, Na_2O, ZnO, CaO, P_2O_5, F, other oxides, amd pigments
Self-etch ceramic primer	Monobond Etch & Prime	Ivoclar Vivadent	Butanol, tetrabutylammonium dihydrogen trifluoride, methacrylated phosphoric acid ester, bis(triethoxysilyl)ethane, silane methacrylate, colourant, ethanol, water
Phosphoric acid 35%	Ultra-Etch,	Ultradent Products Inc	Phosphoric acid, cobalt aluminate blue spinel, and siloxane
Adhesive system	Excite F	Ivoclar Vivadent	Bisphenol A-glycidyl methacrylate (Bis-GMA), ethanol. 2-hydroxyethyl methacrylate, phosphonic acid acrylate, urethane dimethacrylate, diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide, potassium fluoride
Resin cement	Variolink Esthetic LC	Ivoclar Vivadent	ytterbium trifluoride, urethane dimethacrylate, glycerin-1.3-dimethacrylate, 1,10-decandiol dimethacrylate

chemical retention between the dental substrate, resin cement, and ceramic veneer.[1,2] The treatment of the internal ceramic surface is fundamental for a higher and stable bond through the creation of micro-retention, increase of surface energy, and formation of a chemically active surface for the adhesive and resin cement.[3,4]

The gold standard for the surface treatment of silica-based ceramics is the application of hydrofluoric acid (HF) and silane.[5-7] Silica-based ceramics are acid sensitive because they have a high amount of glass phase, which is susceptible to a selective dissolution from acid conditioning. This feature, combined with the excellent optical properties, makes glass ceramics the first choice for esthetic restorations.[8] However, despite its wide use and proven efficacy,[9,10] the conventional protocol with HF and silane has some disadvantages such as the high toxicity of HF[11] and the weakening of the ceramic veneer in excessively long acid applications,[12-14] which can affect mechanical resistance.

The self-etching ceramic primer Monobond Etch & Prime (MEP, Ivoclar Vivadent, Schaan, Liechtenstein) has recently been launched as an alternative for the surface treatment of silica-based ceramics to overcome the limitations of conventional procedures. Its composition includes ammonium polyfluoride, which acts as a conditioning agent, and silane methacrylate, which acts as a bonding agent, thus joining the conditioning and silanization procedures into a single step[15] (Table 1). The advantages of this product are the simplification of the technique, single application method for the different types of ceramic systems, prevention of excessive conditioning even after a prolonged application time, and the greater safety and biocompatibility.[16]

The performance of MEP has been investigated by several laboratory studies. The conditioning pattern generated by MEP is more superficial and less evident than that produced by HF.[10,17-21] Despite these findings, the bond strength of ceramic specimens treated with the self-etching primer is similar to that observed with the conventional protocol.[15,17,22-29] However, some authors have reported higher bond strength of specimens treated with HF and silane.[10,21,30,31] The fatigue strength of lithium disilicate–based ceramic samples treated with MEP was lower than that of samples conditioned with 5% HF and silane.[19]

However, there is no clinical trial evaluating the long-term performance of MEP. One case report described an oral rehabilitation with ceramic restorations with follow-up of six months.[22] Considering the scarcity of clinical studies and the promising results of the few laboratory studies with the self-etching primer, the aim of this work was to describe a case report of an esthetic treatment with lithium disilicate–based ceramic restorations treated with MEP and the clinical performance of the restorations in a two-year follow-up.

CASE REPORT

A 22-year-old male patient sought specialized dental care for a restoration fracture on tooth 9. The following characteristics were observed through clinical examination: midline deviation, extensive restoration with moderate color change in the labial surface of tooth 9, diastemas between the central

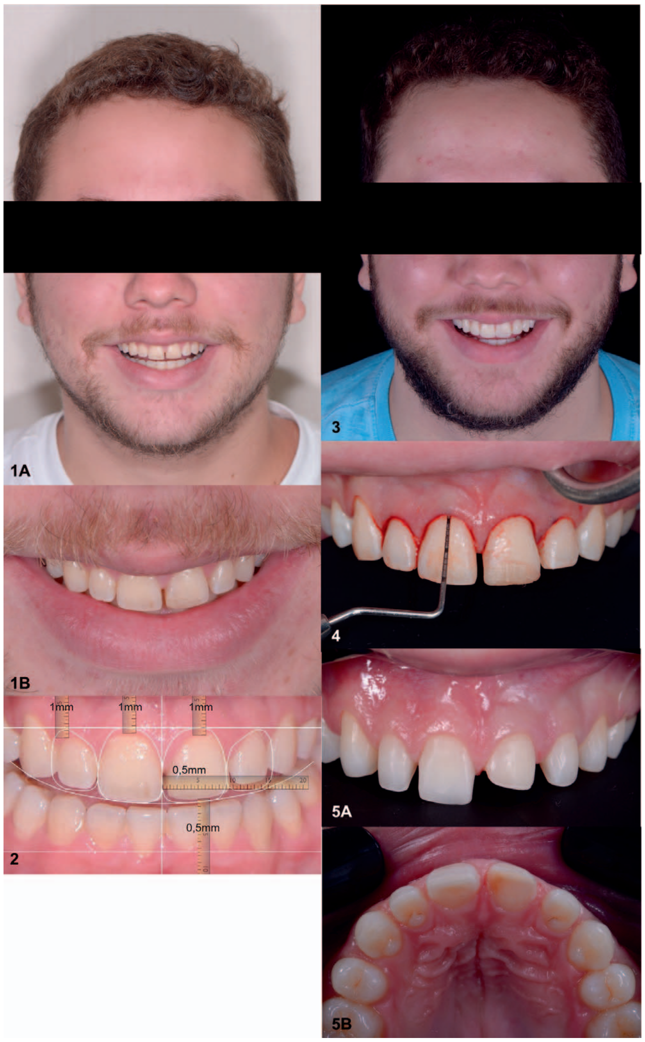

Figure 1. *(A) Initial photographs of the face and (B) smile of the patient showing the restoration in tooth 9 with moderate color change, diastemas and deficient dental proportion.*

Figure 2. *Digital analysis of the smile showing midline deviation, planning of the gingivoplasty and dental proportion correction.*

Figure 3. *Evaluation of the mockup planning.*

Figure 4. *Gingivoplasty for regularization of gingival zenith and increase of clinical crown.*

Figure 5. *(A) Minimally invasive preparation for full crown in tooth 9 and for ultrathin veneers in the other teeth. (B) Occlusal view of the preparations of teeth 6 to 11.*

and lateral incisors, unfavorable dental proportion, and gingival zenith with a negative impact on gingival harmony (Figure 1A,B).

After digital smile planning, the correction of the gingival contour by clinical crown increase of the central and lateral incisors (Figure 2) was proposed. An orthodontic treatment was also suggested for a better distribution of the interdental spaces, thus increasing the predictability of the case. Afterward, study models were created from impressions made with vinyl polysiloxane/silicone (Express XT commercially available in the United States as Express VPS, 3M ESPE, St Paul, MN, USA) and sent to the laboratory for diagnostic wax-up for teeth 6 to 11. The mockup was performed with Protemp bis-acryl resin A1 (3M ESPE) (Figure 3). In this phase, the occlusal contacts and eccentric movements were evaluated clinically with metallic articulating film (Arti-fol 12 μm, Bausch Articulating Papers Inc, Nashua, NH, USA). After esthetic and functional approval by the patient, gingivoplasty was recommended for the regularization of gingival zenith (Figure 4).

Sixty days after the surgical procedure, the prosthetic procedures for the veneers were started. The restoration on tooth 9 was removed, and the tooth was prepared for full crown; the remaining teeth from 6 to 11 were prepared to receive ultrathin veneers (Figure 5A,B). Tooth preparations were minimally invasive and done with a diamond bur (#8862.314.012, Komet, Lemgo, Germany). All angles were rounded, and the margins were chamfered, continuous, and well defined.[32] The preparations were finished and polished with a multilaminated bur and an Arkansas polisher (#H48L.314.012 and #649.314.420, Komet) mounted on a multiplier contra-angle (Kavo, Biberach, Germany). Preparations were guided by an index made with condensation silicone[32] (Zetaplus/Zhermack, São Paulo, SP, Brazil) (Figure 6). Impressions of the preparations were made by the two-impression technique with vinyl polysiloxane/silicone (Express XT) and sent to the laboratory. Temporary veneers were then made with Protemp Bis acryl resin A1 (Figure 7A,B).

The cast models were scanned for fabrication of the lithium disilicate veneers (IPS e.max Press, Ivoclar Vivadent) in a computer-aided design and computer-aided manufacturing (CAD/CAM) system (Amann Girrbach, Koblach, Austria). For better esthetics, the incisal and labial surfaces of the ceramic restorations were stratified with fluorapatite ceramics (IPS e.max Ceram, Ivoclar Vivadent) (Figure 8A-C). After dry-testing to check the marginal fit, the color of the resin cement was selected (Variolink Veneer Try-In, Ivoclar Vivadent) (Figure 9). The pieces were then washed and dried with air jets.

The surfaces of the veneers were treated with MEP (Ivoclar Vivadent), which was applied and rubbed onto the surfaces for 20 seconds with a microbrush (SDI Limited, Baywater, VIC, Australia)

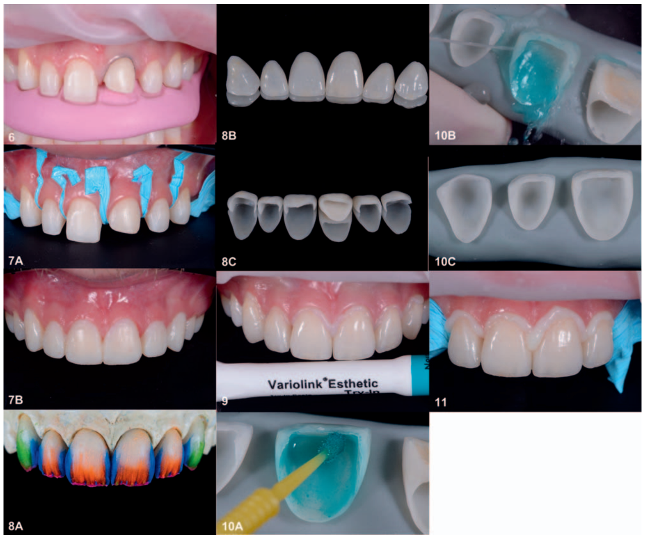

Figure 6. *Silicone index for teeth preparations based on diagnostic wax-up.*

Figure 7. *(A) The papillae were covered with Teflon strips to avoid gingival compression and maintain the space for dental hygiene. (B) Temporary restorations made with bis-acryl composite resin in shade A1 (Protemp-4/3M ESPE).*

Figure 8. *(A) Frontal view of lithium disilicate ceramic restorations (IPS e.max Press, Ivoclar Vivadent) and stratification of the buccal and incisal surfaces with fluorapatite ceramic (e.max Ceram, Ivoclar Vivadent). (B) Final view of ceramic restorations and (C) cervical view.*

Figure 9. *Selection of the neutral cement color with the try-in paste (Variolink Esthetic LC Try-In, Ivoclar Vivadent).*

Figure 10. *(A) Application of Monobond Etch & Prime (Ivoclar Vivadent) followed by (B) washing. (C) Appearance of the inner surface of ceramic restorations after surface treatment.*

Figure 11. *Application of the resin cement and adaptation to the prepared tooth.*

and allowed to act for another 40 seconds. The surfaces were then rinsed with water and dried with air jets (Figure 10A-C). Pumice and water prophylaxis was performed on the prepared teeth with a Robinson mini brush (ICBrush, Ultradent Products Inc, South Jordan, UT, USA) and then washed with water and dried with air jets. Teeth were then conditioned with 35% phosphoric acid (Ultra-Etch, Ultradent Products Inc) for 20 seconds, rinsed, air jet dried, and treated with an adhesive system (Excite F, Ivoclar Vivadent).

Neutral color Variolink Esthetic resin cement (Ivoclar Vivadent) was used for cementation of the ceramic veneers (Figure 11). The excess cement was removed with a brush,[33] followed by light curing for 40 seconds on each surface (Radii Plus, SDI Limited, 1200 mW/cm^2). Glycerin gel (Liquid Strip, Ivoclar Vivadent) was applied on the cervical (crown and

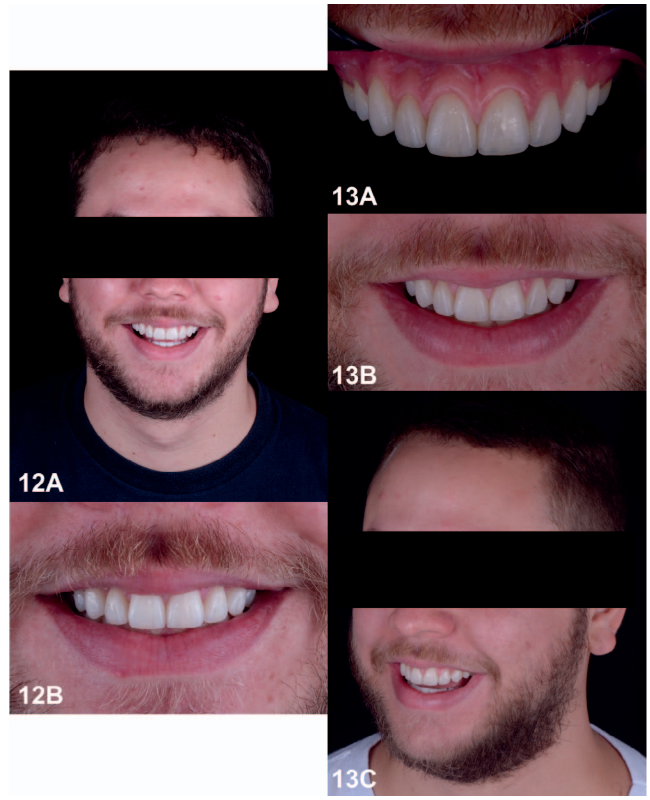

Figure 12. *(A) Facial appearance and (B) frontal view of the smile after cementation.*

Figure 13. *(A) Final view of ceramic restorations and (B) smile after two years of follow-up; (C) lateral view of the facial appearance.*

veneers) and incisal (veneers) regions, and another curing cycle was performed. After polymerization, the excess cement was removed with a #12 scalpel blade. A protective splint was manufactured for the patient to prevent tooth wear during sleep. The occlusal splint has been used daily by the patient during these two years of follow-up. The veneers and the crown can be seen in Figures 12A,B and 13A-C, following cementation and after two years of follow-up, respectively.

DISCUSSION

The clinical success of ceramic restorations depends on an adequate adhesion between the dental substrate and the restorative material. This adhesion is composed of two interfaces: resin-cement and ceramic-cement.[34] Therefore, an appropriate surface treatment of the restoration is necessary. In the present clinical case, the restorations treated with self-etching ceramic primer showed color stability, ceramic and margin integrity, absence of cracks, fractures, discoloration, and debonding after the two-year follow-up. One previous clinical case also reported the application of MEP for the surface treatment of veneers and full crown of lithium disilicate–based ceramics. After the six-month follow-up period, the authors did not detect signs of failure, and the esthetic and functional characteristics of the restorations were considered excellent.[22]

MEP was developed for the treatment of the internal surface of silica-based ceramics for resin cementation.[16] The mechanism of action involves the conditioning of the ceramic by ammonium polyfluoride, causing the increase of roughness, contact area, and surface energy. The residues are removed by washing with water, and after drying, the silane methacrylate initiates the chemical reaction, leaving a thin layer of silane on the ceramic surface, which will react with the resinous monomers.[16,19]

Several *in vitro* studies have been developed to evaluate the effect of MEP on adhesion and mechanical properties of glass ceramics. Concerning topographic changes, studies found that the conditioning pattern generated by MEP is less evident, with lower values of surface roughness[10,17-21] and higher contact angle[21] compared with HF. The conditioning depth of the samples of glass and hybrid ceramics treated with MEP was lower than the samples treated with 5% and 10% HF for 20 and 60 seconds, and the concentration and application time of HF presented a linear relationship with the dissolution depth of the glass matrix.[20] Considering the current use of extremely thin ceramic restorations, such as in the present case, the use of less aggressive conditioning agents can benefit the mechanical properties and longevity of the pieces.[10,20]

MEP adhesion was evaluated by tensile bond strength or shear strength tests. The bond strength was similar to the treatment with HF and silane in most published articles.[15,17,22-29] Some studies performed the aging of the samples to simulate clinical degradation, especially at the adhesive interface, which is important to indicate the durability of adhesion between materials.[25] After aging, the tensile bond strength obtained with the self-conditioning primer was similar to HF and silane,[17,25,27-29] whereas the shear bond strength was higher in the samples treated with the conventional protocol.[10,21] In general, adhesion stability was negatively influenced by aging, regardless of the type of surface treatment.[10,17,25,27,28] The exception was the study by Prado and others,[21] in which the shear bond strength of the glass ceramic samples treated with MEP did not differ between before and after aging (storage in water for 70 days and thermocycling for 12,000 cycles), indicating a greater adhesion stability.

Scherer and others[19] tested fatigue resistance in lithium disilicate discs bonded to a dentin analogue using 5% HF and silane or MEP with and without aging and found higher values for HF. Although microstructural changes caused by HF are more aggressive, the micromechanical and chemical bonding with the resin cement appears to compensate and improve the strength of the samples. Despite these findings, the authors argue that MEP is a good option for surface treatment, given its ability to cause topographic changes in glass ceramics without the use of the highly toxic HF using a simple application method. Moreover, they point out that the resistance to fatigue achieved appears to be sufficient to withstand the masticatory loads, with an exception for high bite forces recorded during sleep bruxism.[19,35-37]

Despite the satisfactory clinical performance in the present clinical case and the favorable results of laboratory studies, many questions about MEP are still unanswered. Controlled and randomized clinical trials are essential to evaluate the longevity of adhesive restorations treated with this product. In addition, little has been investigated *in vitro* about the influence of MEP on the mechanical properties of glass ceramic, as well as the effect of different application protocols. Therefore, it is critical that more research be developed before MEP can be used in clinical practice with safety and predictable long-term performance.

CONCLUSION

The satisfactory clinical performance of ceramic restorations treated with MEP after two years of follow-up supports the promising results showed by laboratory studies. However, further research is needed to investigate the clinical performance and longevity of MEP and to fully recommend it as a safe and reliable alternative for the surface treatment of glass ceramic restorations.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the Federal University of Rio Grande do Norte (UFRN).

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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