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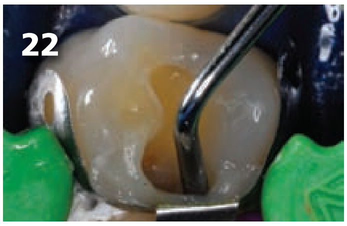

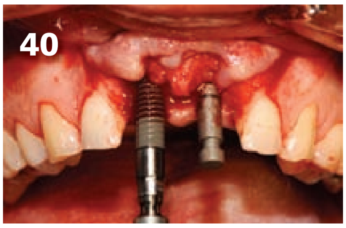

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Flowable composites: Aesthetics for tots and teens

Fred S. Margolis[1]

Introduction

Parents are concerned about aesthetics for their children. Aesthetic dentistry can provide a beautiful smile that parents and their children desire. Self image is very important for our young patients so that they can look good and feel good about themselves. We have all experienced that wonderful spontaneous patient smile when we have turned the "ugly duckling" into a "beautiful swan." We are fortunate to have dental materials and devices that provide us the opportunity to perform aesthetic dentistry. Some of the techniques and materials we have available for our young patients' smile creations include: porcelain veneers, microabrasion, bleaching, orthodontics (including clear braces and aligners), direct and indirect composite restorations, implants, and all-ceramic crowns.

This article will describe and illustrate various uses of flowable composites that aid in providing aesthetic restorations for children and teens. The advantages of the beauty and functionality will also be elicited.

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Table 1.
Indications for Flowable Composites

- Preventive resin restorations
- Bonding orthodontic brackets
- Minimally invasive Class I or II restorations
- Class II restorations as a base or liner under composite restorations
- Minimally invasive Class III restorations
- Class V restorations
- Splinting fractured and mobile teeth (post-trauma or periodontal involvement)
- Repairing small direct and indirect restorations
- Class VI restorations in nonstress bearing areas
- Fissure sealant

Indications for flowable composite in young patients

There are many indications for the use of flowable composites in young patients (Table 1). Some of of these are described in more detail:

Figure 1a. Permanent molar with incipient caries. (Courtesy of Giovanni Olivi)

Figure 1b. Preventive resin restoration. (Courtesy of Giovanni Olivi)

Preventive Resin Restorations

Simonsen[1] has recommended that, for the type 2 preventive resin restorations (PRR) in which the preparation involves both the enamel and dentin, a flowable composite could be utilized to replace the carious tooth structure after excavation of the incipient caries. In a recent article by Savage, et al[2] it was reported that flowable composite was the most widely used restorative material for the PRR among those pediatric dentists surveyed in this study. More than 30% of the pediatric dentists always use a flowable

Figure 2a. Permanent molar with caries adjacent to failed sealant. (Courtesy of Giovanni Olivi)

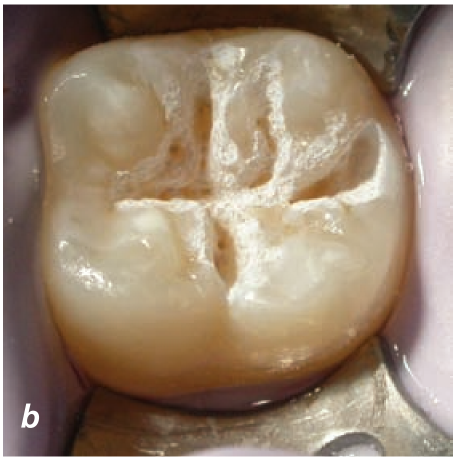

Figure 2b. Erbium laser preparation of molar for preventive resin restoration. (Courtesy of Giovanni Olivi)

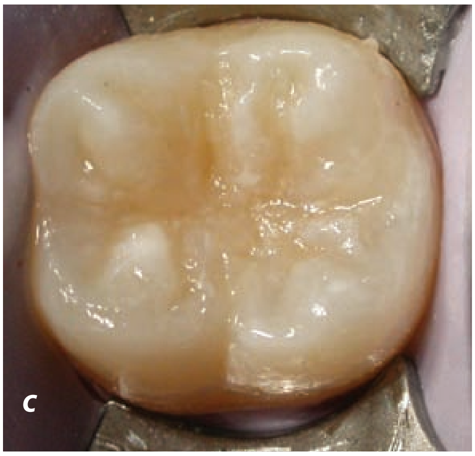

Figure 2c. Preventive resin restoration. (Courtesy of Giovanni Olivi)

Figure 3. Bonded orthodontic brackets.

Figure 4a. Class II preparation on a primary molar.

Figure 4b. Flowable composite placed.

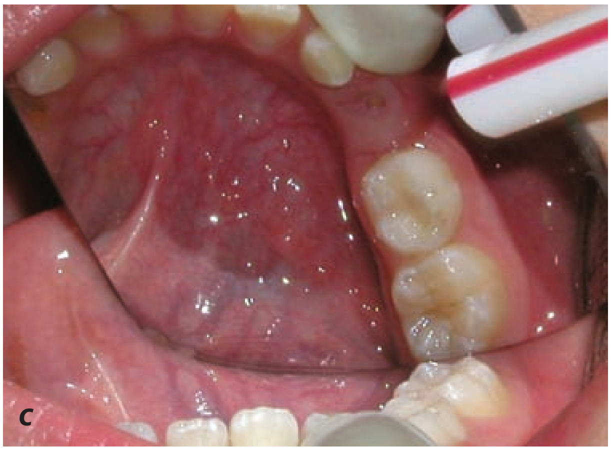

Figure 4c. Flowable composite restoration completed.

composite or a combination of flowable composite and "packable" composite/ flowable composite combination (Figures 1a and 1b).[2] The author has found flowable composite to also be useful when a sealant has failed and incipient caries has been detected at a recall visit (Figures 2a to 2c). The Venus Diamond Flow (Heraeus Kulzer) flowable composites offer low shrinkage and high flexural strength.

Bonding Orthodontic Brackets

Vicente and Bravo[3] evaluated the shear bond strength of several flowable composites after debonding of orthodontic brackets compared to a traditional orthodontic resin. The shear bond strength was measured with a universal testing machine and the adhesive remnant after debonding was quantified utilizing image analysis. The results showed that there were no significant differences between the shear bond strengths of the various groups evaluated. The orthodontic resin left significantly more adhesive on the tooth than the 3 flowable composites tested.[3] Ryou, et al[4] in a recent study concluded: "...flowable composites with no intermediate bonding resin could be conveniently applied for orthodontic bonding" (Figure 3).

Class II and V Restorations Utilizing Flowable Composite

Flowable composites are often utilized as a liner under composite restorations. The purpose is to seal the margin, which helps prevent postoperative sensitivity and secondary caries. Sadeghi and Lynch[5] investigated the effects of a layer of flowable composite and compomer on microleakage of composite restorations that extended apically to the cement-enamel junction. The results of the study showed that when flowable composites were used as a liner, both the packable and the nanofilled composite materials had significantly less microleakage than when flowable liners were not used. There was a significant reduction of the microleakage occurring under both types of composite materials at the gingival floors[5] (Figures 4a to 6b).

Illie and Hickel[6] investigated the mechanical properties of composites and concluded that flowable composites and compomers showed comparable results. Flowable composites only differed from microfilled composites in diametric tensile strength.

Some of the flowable composites the author uses routinely includes Venus Diamond Flow. The advantages to this particular flowable composite includes the increased strength (versus a sealant), low shrinkage stress, and high flexural strength. It also has the advantage of being an exact shade match with the Venus Diamond composite system. Other flowable composites that the author uses includes

Figure 5a. Class II preparations of bicuspid and molars.

Figure 5b. Flowable composite as a liner.

Figure 5c. Composite placed over flowable composite.

G-aenial Flo and Universal Flo (GC Corporation) and Beautifil Flow Plus (Shofu). The advantage to the later is the release of fluoride. Vertise Flow (Kerr) has the added benefit of being self-etching.

The effects of different light-curing units on the microleakage of flowable composite resins was studied by Yazici, et al.[7] They found that none of the Class V restorations restored with flowable composites exhibited marginal leakage of the enamel. Also, there was no significant difference exhibited between the flowable composites tested on the dentin margins.[7]

Splinting Fractured and Mobile Teeth and Orthodontic Retainers

Tabrizi, et al[8] found that flowable composites provided satisfactory shear bond strength comparable to a standard orthodontic resin and therefore may be used for direct bonding of lingual retainers.[8] Flowable composites may be used to splint mobile teeth utilizing orthodontic wire or nylon filament splints (Ribbond). Foek, et al[9] studied the adhesive properties of bonded orthodontic retainers to enamel, utilizing flowable composite, with both stainless steel wire versus fiber-reinforced composites. They found

Figure 6a. Class V preparation on bicuspid.

Figure 6b. Flowable composite restoration.

Figure 7. Splint bonded with a flowable composite.

Table 2. The Desirable Properties of Flowable Composite are the following:
• Flowable consistency and modeling (thixotropic) • Low shrinkage • Radiopaque • Shades corresponding to composites; color adaptative qualities • Polishability and long-lasting shine • Color stability

that the bond strengths between the fiber-reinforced composites and the orthodontic wire when used as retainers did not differ significantly (Figures 7 to 9).[9]

Repairing Small, Direct, and Indirect Restorations

One of the many advantageous properties of flowable composites is their ability to repair previously placed composite restorations. Papacchini, et al[10] evaluated the effect of various intermediate resin agents on composite-to-composite bond strengths. The flowable composites showed good interfacial quality to the adhesives. Also, the application of flowable composites resulted in statistically superior tensile strength (Figure 10).[10] The author used Venus Diamond Flow in this instance due to the studies indicating its excellent bond strength, low shrinkage stress, and shade matching quality.

Important properties of flowable composites

Flowable composites exhibit many characteristics that make them an excellent choice for indications like the ones highlighted above (Table 2). The following properties are important when treating young patients with this class of composite resin restorative material.

Radiopacity of Flowable Composites

One of the qualities of a flowable composite that is very favorable is that of being radiopaque. Venus Diamond Flow has been shown to be one of the most radiopaque flowables on the market today. Murchison, et al[11] in their study, stated the following: "The level of radiopacity of the tested flowable composites was variable; those with low radiodensity should be avoided in Class II restorations, where a clear determination of recurrent caries by the examining clinician could be compromised."[11] Sabbagh, et al[12] agreed

Figure 8a. Fractured permanent central incisor.

Figure 8b. Flowable composite bonded fractured segment to crown.

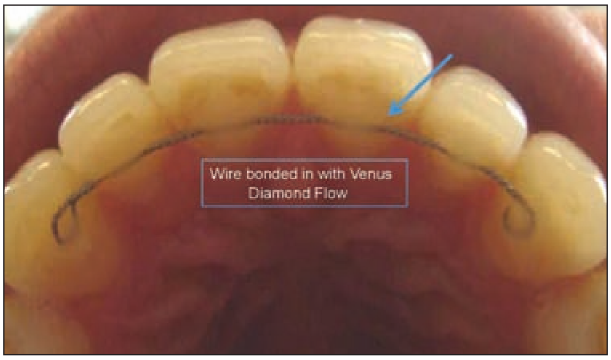

Figure 9. Orthodontic retainer bonded with flowable composite.

Figure 10. Occlusal restoration with Venus Bulk Flowable.

with a more recent study when they concluded that flowable composites used within intracoronal restorations, clinicians should use materials with high radiopacity (Figure 11).[12]

Polishing Flowable Composites

Polishablilty of the surface of the restoration is important for aesthetic and functional purposes. The surface should be able to have a smooth lustrous surface and be able to maintain this desired characteristic. Ozel, et al[13] studied the effect of one-step polishing systems on the surface roughness of various flowable composites. The one- or 2-step polishing systems are a good choice for the polishing of flowing composites.[13]

Conclusion

This article briefly described and demonstrated various indications for aesthetic restorations that can be used successfully for our child and adolescent patients. Modern aesthetic techniques and flowable composite resin materials, used properly for purposes such as those presented herein, will serve to broaden the scope of aesthetic dentistry delivered for children and teens.

Disclosure: Dr. Margolis receives honoraria and products from Biolase Technologies, Inc.

Flowable Composites: Aesthetics for Tots and Teens, by Fred S. Margolis, DDS: Dentistry Today, Vol. 30, No. 4, 04/11, pp 132-137.

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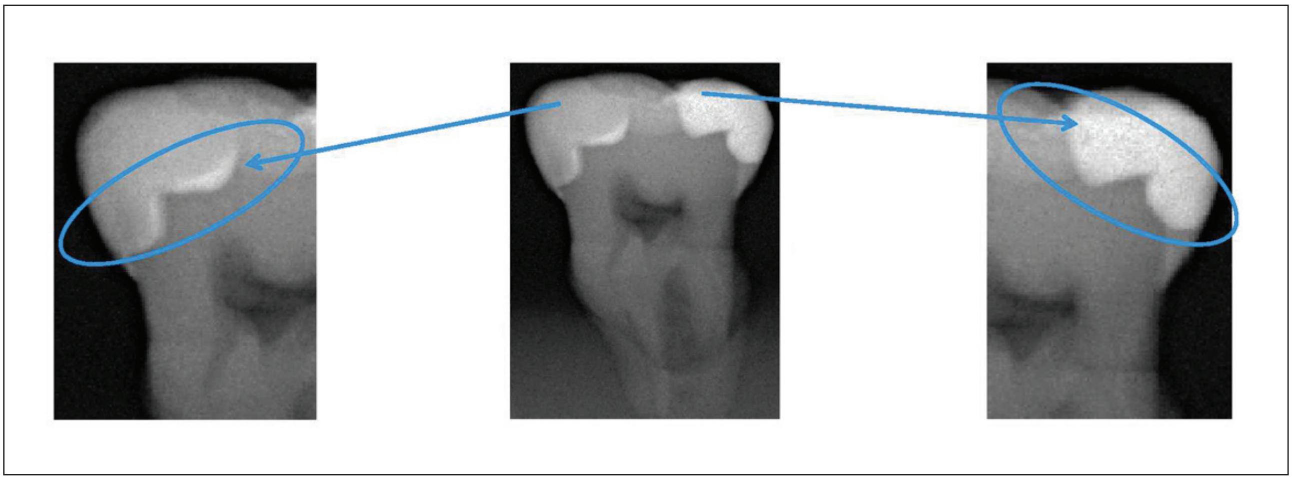

Figure 11. Radiopacity of a flowable composite material.

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Surface treatments for tooth-colored restorations: Part 2

Douglas A. Terry,[1] Markus B. Blatz[2]

Adhesive and restorative success for any indirect restoration begins and ends at the restorative-tooth interface. The bonded restorative complex includes the outer layers of the substrate, the adhesive layer, and the restorative material. Any biomaterial when properly joined to the tooth substrate is able to provide an improved marginal seal while reducing marginal contraction gaps, microleakage, nanoleakage, marginal staining, and secondary caries.[1] Also resulting from the adhesion between tooth and biomaterial is restoration retention and a reduction of stress at the tooth-restorative interface. Biomechanically, this bond reinforces tooth structure and biologically preserves tissues, seals dentin tubules, and provides long-term functional success.[2-4] In part 1 of this article, a discussion of adhesion at the restorative interface was provided to the clinician and technician to encourage more predictable methods for achieving an optimal bonded tooth-colored restoration. As part 1 described a standard surface treatment and adhesive cementation protocol for laboratory-processed composite resin restorations, this segment of the discussion will describe the surface treatment protocols for different ceramic microstructures with various clinical adhesive cementation applications.

Figure 1: The patient presented with no posterior disclusion or anterior guidance after orthodontic treatment. A prepless veneer was placed (tooth No 6) to establish the proper function and to improve the aesthetics.

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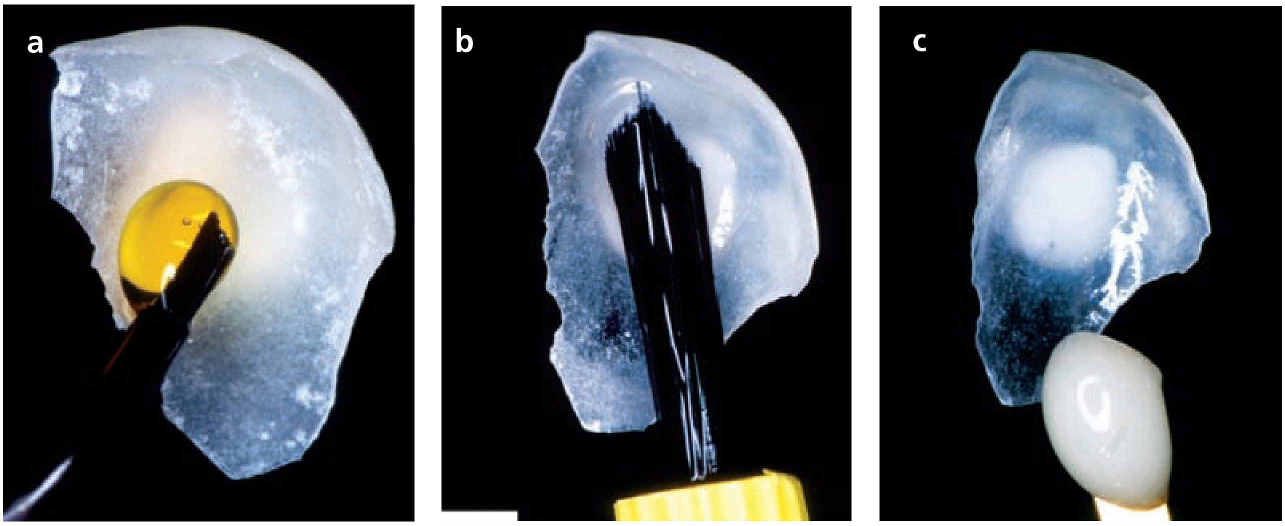

Figure 2: The internal surface of the silica-based ceramics (Willi Geller Creation, Creation International) was etched with a 9% buffered hydrofluoric acid (Porcelain Etch, Ultradent Products) for 2 minutes, rinsed, and air-dried (2a). An application of silane (Porcelain Bond Activator mixed with Clearfil SE Bond Primer, Kuraray) was applied. Some manufacturers add a silane coupler to their bonding system that is mixed with the other components (eg, bonding agent/primer) during ceramic adhesion (2b). A clear translucent light-cure resin cement (Illusion, BISCO) was applied to the internal surface of the veneer (2c).

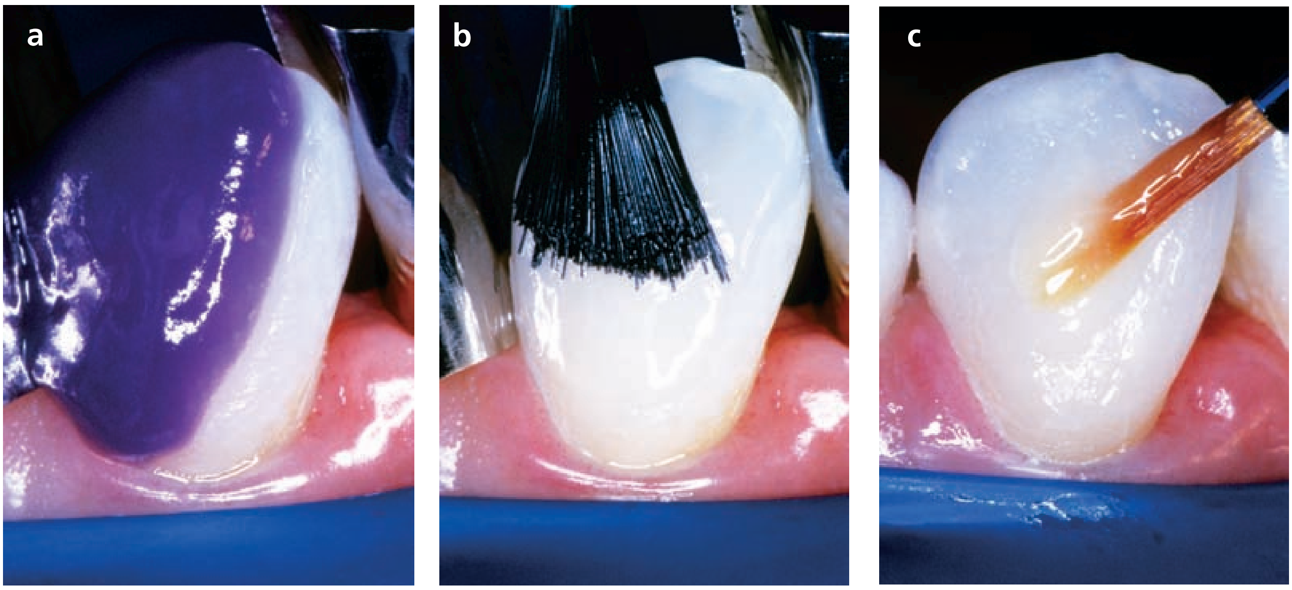

Figure 3: Once the disinfectant step was completed, the enamel was etched using a 37.5% phosphoric acid (Gel Etchant, Kerr). The gel was placed several mm beyond the anticipated restorative margin (3a). An adhesive agent (Optibond Solo Plus, Kerr) was applied to the etched enamel, air-thinned, and light-cured for 40 seconds (3b). The veneer was positioned into place and the excess resin cement was removed using the "wetbrush" technique and was light-cured for 40 seconds. It is important to leave a residual amount of resin cement at the interface to compensate for polymerization shrinkage (3c).

Surface treatment of all-ceramic restorations for adhesive resin cementation

Adhesive cementation typically involves surface treatment of the restoration and the tooth structures, application of primers and adhesives and the use of composite resin luting agents. Different ceramic surface treatments have been introduced to pretreat the intaglio ceramic surface and improve the bond at the ceramic-resin interface.[5-9] The adhesion between ceramic material and composite resins is the result of a physicochemical interaction at the ceramic-resin interface involving 2 simultaneous mechanisms – chemical bonding and micromechanical interlocking.[10] Because of the different chemical structure between silica-based and high-strength ceramics different surface treatments are required.

Figure 4: Function and aesthetics were improved using a noninvasive preparation-less procedure.

Figure 5: Preoperative facial view of existing ceramo-metal restorations with open margins, recurrent caries,and inadequate epithelial attachment. Patient presents with sensitivity and requests an aesthetic improvement. Treatment required connective tissue grafting and replacement of the existing crowns with zirconium restorations and a Class V composite restoration on the second premolar.

Silica-based ceramic restorations

Silica-based ceramic restorations, because of their optical and aesthetic properties, are used to a great extent for porcelain laminate veneers, inlays and onlays, and full-coverage crown restorations. This brittle restorative material derives its strength from the adhesive bond of the definitive restoration and the supporting tooth structure.[11,12] Proper surface treatment of the ceramic surface prior to cementation is therefore rudimentary for their long-term clinical success.[12,13] Bonding to silica-based ceramics is usually obtained by the 2 aforementioned simultaneous mechanisms.[14-25] The hydrofluoric acid (HF) attacks the glassy phase of the ceramic material,dissolving the surface and exposing the silicate crystals in the matrix, while the silane coupling agents provide a chemical covalent bonding between the silica in the ceramic matrix[20-22] and copolymerizes with the methacrylate groups through siloxane bonds.[26,27] The authors' recommend acid-etching with 4% to 9.8% HF to create surface roughness and the application time depends on the crystalline content of the specific ceramic substrate. A higher crystalline content requires less acid etching time and concentration. A silane coupling agent is then applied to the etched ceramic surface. It is important not to place an excess or thick layer of silane because additional layers of hydrolyzed silane will not bond to the porcelain surface and can result in a less than optimal porcelain bond[28,29] (Figures 1 to 4).

High strength ceramic restorations

High strength non silica-based ceramic restorations such as zirconia and alumina have increased in utilization by the clinician and technician because of the material's strength, multitude of clinical indications and applications, and its cost effectiveness compared to precious metals.[30] Of course, when preparation designs are retentive, non adhesive cements (ie, glass ionomer cements) or moderately adhesive cements (ie, self-adhesive resin cements) can be used successfully to retain these non silica-based restorations. However,when the retention/resistance form is compromised, adhesive cementation with surface treatment of the ceramic material can improve the durability and reliability of the bond for non silica-based restorations.[30] The excellent optical properties of high-strength ceramic materials are especially advantageous for indirect resin-bonded restorations such as resin-bonded fixed partial dentures. These types of restorations, however, rely on stable and long-term durable resin bonds.

Although the surface treatment for the tooth substrate remains the same (ie, self-etch or total etch), the surface treatment procedures known for silica-based ceramics cannot be utilized for high strength ceramic materials (ie, alumina, zirconia). Traditional bonding procedures (ie, acid etching and silane application) for silica-based ceramics cannot provide long-term durable bonds to the silica-free,acid resistant, high-strength ceramic materials.

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Figure 6: The internal surface of the high strength ceramic crown (Lava, 3M ESPE) was microetched using a silica coating, CoJet-Sand (Rocatec/CoJet System, 3M ESPE) (6a). A silane coupling agent (ESPE Sil) was applied onto the internal surface of the restoration (6b). Application of a methacrylate based self-etch cement (G-Cem, GC America) onto the internal aspects of the porcelain crown for final cementation (6c).

Conventional acid etchants do not sufficiently roughen the dense surface[31] of these materials and the chemical reaction from silanization of these non silica-based ceramics is not possible. However, silane application can provide increased wettability.[16-27,31,32] Silica/silane coating or application of a phosphate-monomer-containing ceramic priming agent after airborne particle abrasion increases the shear bond strength between zirconium-oxide ceramic and a resin luting agent.[33,34] In addition, several in vitro studies have indicated that air-particle abrasion and a phosphate-modified resin luting agent have the potential to provide long-term durable resin bonds.[35] Another long-term in vitro study found that silica coating and silanization increases resin bond strength to zirconia (Lava, 3M ESPE) with different resin cements.[36,37] While silica/silane coating failed to provide durable bonds to densely-sintered aluminum-oxide ceramics, it was successfully implemented for zirconia ceramics.[38,39] In an in vitro investigation on the fracture strength and marginal leakage of densely-sintered alumina crowns after aging in an artificial chewing simulator, fracture strengths were well above natural chewing forces for all cementation methods. However, adhesive bonding with a composite resin luting agent and ceramic primer containing adhesive phosphate monomers after air-particle abrasion of the crown intaglio surface significantly increased fracture strength and decreased marginal leakage as compared to conventional cementation methods. The current evidence supports the use of modified priming and/or resin composite luting agents containing special adhesive monomers (eg, MDP Kuraray) that provide chemical bonds to metal oxides and, therefore, long-term durable resin bonds to high-strength ceramic materials.[33-35,38,40-49] Airborne-particle abrasion and an MDP-containing priming agent (Porcelain Bond Activator mixed with Clearfil SE Bond Primer, Kuraray) followed by

Figure 7: Postoperative facial view of the final restorations. Notice the soft tissue biocompatibility at the restorative interface.

Figure 8: Patient presents with a fractured all-ceramic crown on the maxillary right first molar after endodontic treatment. Treatment involved replacement of existing crown with all-ceramic restoration fabricated with a zirconium internal substructure and Vita surface ceramics (VITA VM9, Vident).