

TARGIS™ SYSTEM

A B S T R A C T With recent advancements in adhesive technology, restorative materials have evolved to an enhanced level of aesthetics while enabling more conservative cavity preparations and promoting reinforcement of the remaining tooth structure. These restorations have included both anterior and posterior treatment modalities applied directly and indirectly. With a growing awareness on the part of many patients of the possible cosmetic treatment alternatives came the desire for aesthetic, metal-free, durable restorations. This presentation discusses the material properties and clinical protocol of a new material which combines a ceramic optimized polymer with a fiber-reinforced framework for durable, aesthetic anterior and posterior restorations.

Ceromer™/FRC Technology: The Future of Biofunctional Adhesive Aesthetic Dentistry

Newton Fahl, Jr., DDS, MS
Renzo C. Casellini, MDT

The introduction and adoption of heat-and-pressure-cured restorations (Concept®, Ivoclar Williams, Amherst, NY) and pressed ceramic restorations (IPS Empress®, Ivoclar Williams, Amherst, NY) has promoted an awareness of the functional and aesthetic limitations presented to the clinician by metal and metal-supported restorations. However, a metal-free veneering and framework system has been recently introduced (Targis™ System, Ivoclar Williams, Amherst, NY) which has the potential for replacing conventional ceramic-fused-to-metal restorations of single or multiple teeth. The framework has been under evaluation in single-unit applications since 1989 and in multiple-unit restorations since 1992, and has met the strength and aesthetic criteria for anterior and posterior restorations. It has demonstrated success as a result of its ease of fabrication, natural color, marginal integrity, and wear and fracture resistance of its component materials, Ceromers™ (CERamic Optimized polyMERS) and fiber-reinforced composites (FRC).

TARGIS™ CEROMER™

Ceromers are a specific combination of the latest in ceramic filler technology and advanced polymer chemistry which provide enhanced function and aesthetics.



1. Preoperative view of missing maxillary second premolar surrounded by minimally restored natural dentition.

They are composed of specially developed and conditioned homogeneous, three-dimensional fine particle ceramic fillers of submicrometer size which are densely packed (approximately 80% in weight) and embedded in an advanced organic matrix with optimum light and heat curing potential. Whereas some conventional composite resins contain only bifunctional molecules of Bis-GMA, Ceromer technology is considerably more complex, containing polyfunctional groups. Such configurations provide the potential for creating a higher level of cross linking and more double-bond conversion, which results

in the enhanced strength of the material. Adjusted optical properties permit the emulation of the natural dentition, facilitating a harmonious blend of the restoration with the remaining tooth structure. Due to their composition and structure, Ceromers combine the advantages of ceramics with those of state-of-the-art composite resin technology. The ceramic (inorganic) phase of the material imparts durable aesthetic quality, abrasion resistance, and high stability. The resin (organic) phase of the material determines enhanced polishability, effective bond with the luting resin, low degree of brittleness, and a reduced susceptibility

to fracturing, and ease of final adjustment and chairside repair. Ceromers are classified as a conservative type of restoration, as they reinforce the remaining tooth structure through adhesive luting with the new generation bonding agents and newest resin cements (Variolink® II, Ivoclar Vivadent, Amherst, NY).

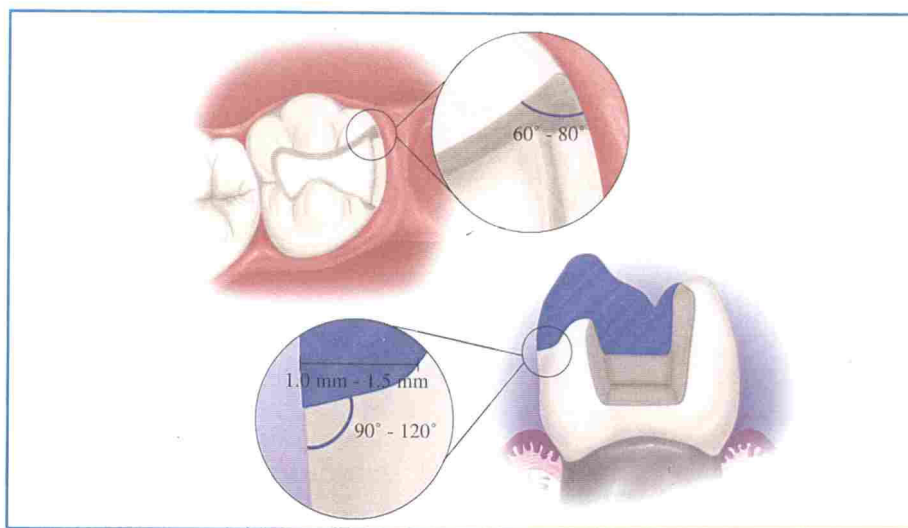
VECTRIS™ FRC MATERIAL

Fiber-reinforced composite technology has long been utilized in engineering and in the aeronautical and shipbuilding industries. In dentistry, the rationale for the utilization of FRC is to combine different materials to achieve superior properties and synergy effects. The FRC material comprises several layers of preimpregnated, homogeneous glass fiber wafers, in addition to uniaxially

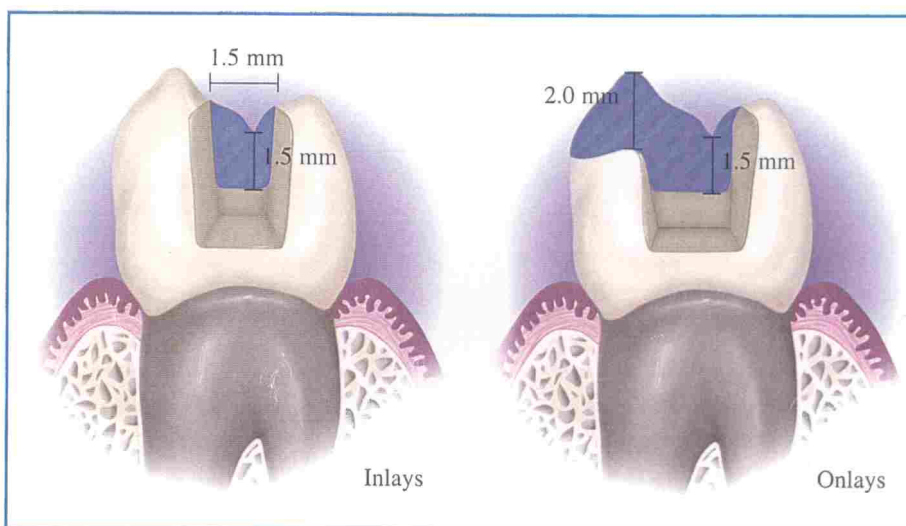
The composition and shading of Vectris is ideally coordinated with the natural dentition and the Targis veneering material.

oriented fiber bundles. These silanized glass fibers are reinforced during the fabrication process through the infusion of the same type of polymer matrix utilized in the fabrication of the Ceromer veneering material Targis. This advanced technology permits the design of metal-free, highly functional frameworks for anterior and posterior bridges, in addition to full-coverage crown restorations.

Vectris™ (Ivoclar Williams, Amherst, NY) is a light-cured, tooth-colored, translucent material built from FRC technology which serves as the framework for the Targis system. The composition and shading of Vectris is ideally coordinated with the natural dentition and the Targis veneering material. These features ensure lifelike aesthetic restorations which surpass their ceramometal counterparts. These new materials permit light to travel through the restora-



2. Preparation design for Targis™/Vectris™ inlay/onlay restorations. Proximal boxes should be prepared with 60°-80° cavosurface angles.



3. Preparation design for Targis™/Vectris™ inlay/onlay restorations. Inlay restorations require an isthmus width of 1.5 mm - 2.0 mm.

tion as a result of their translucency, enhancing their optical characteristics. Unlike metal, Vectris presents elasticity similar to dentin. This characteristic accounts for a positive effect on the distribution of stress within the material itself and the abutment teeth during mastication, as well as on its stability following cementation of the restoration.

Vectris comprises three different FRC components.

- **Vectris Single**

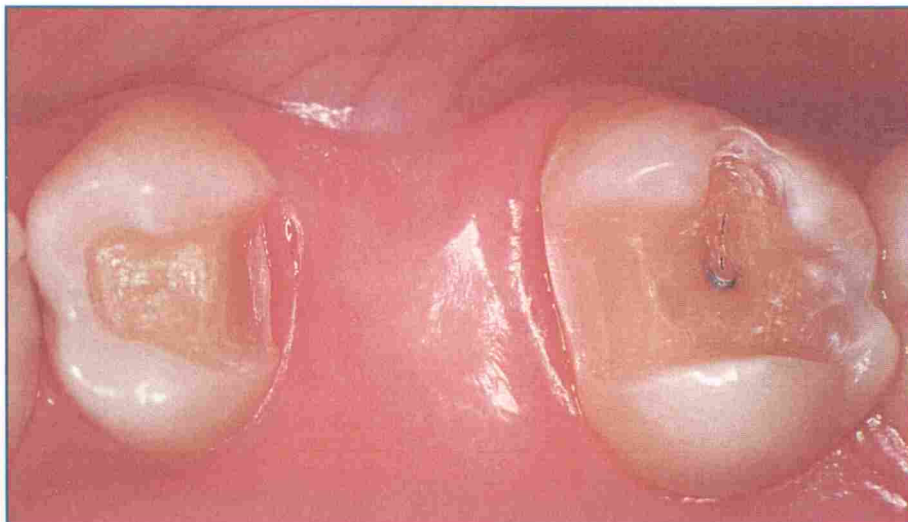
Copings for metal-free, single-unit full-coverage crowns and onlays are fabricated with this FRC.

- **Vectris Pontic**

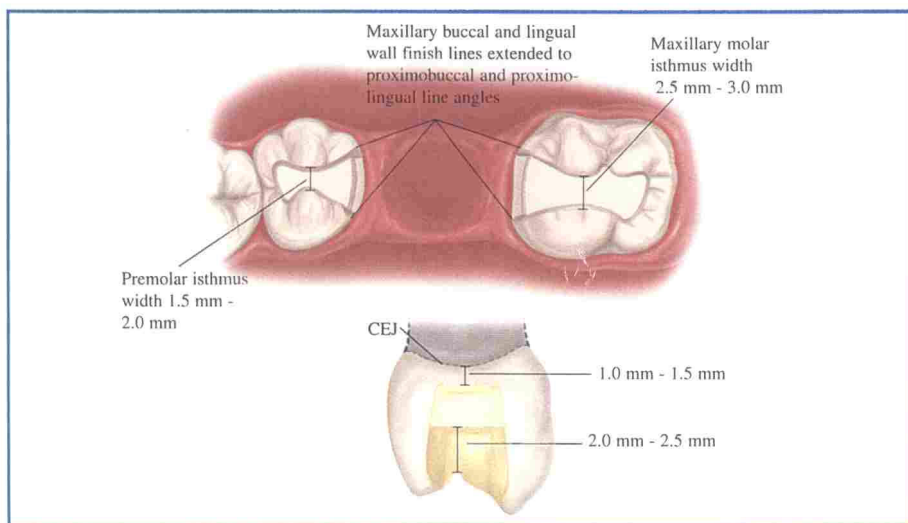
Multiple-unit bridge restorations require the Vectris Pontic for fabrication. The strength and stiffness of the pontic are imparted by the dense-packing of the glass fibers, which is achieved by a proprietary deep-drawing process (Vectris™ VS-1).

- **Vectris Frame**

This component has a structure similar to the Vectris Single and accounts for the final layer of the FRC for multiple-unit restorations.



4. View of the conservative inlay/onlay bridge preparation. Rounded internal line angles facilitate seating and stress distribution.



5. Preparation design for a Targis™/Vectris™ single pontic inlay bridge.

One clinical indication of primary concern is the inlay/onlay bridge utilizing reasonably sound teeth as abutments. The preparation design, shade selection, laboratory fabrication, and cementation procedures for such cases are presented.

CASE PRESENTATION

A 28-year-old female patient presented with a missing maxillary second premolar (Figure 1) which had been extracted at age 17 due to endodontic/periodontic involvement. The two abutment teeth contained small-to-medium Class I amalgam restorations, and the remaining tooth structure was sound. Implant therapy was discussed and declined due to the patient's unwillingness to undergo surgery and the postoperative circumstances involved. Conventional ceramo-metal bridgework and Maryland-type

One clinical indication of primary concern is the inlay/onlay bridge utilizing reasonably sound teeth as abutments.

restorations were also presented and compared to the Ceromer/FRC inlay bridge alternative. Due to its tooth preservation, strength, and aesthetic features, the Targis System inlay bridge was selected as the most suitable treatment modality.

CLINICAL PROCEDURE

Inlays/Onlays

Sharp internal edges and angles should be avoided. Rounded internal line angles facilitate seating of, and reduce stress concentration on, the restoration. Inlay/onlay preparation kits (Esthetic Inlay/Onlay Kit, Komet/Brasseler, Savannah, GA) are available which can facilitate completion of the preparations efficiently and accurately. Undercuts should also be avoided. Verifying the preparations with high magnification (e.g., loops, intraoral cameras, etc.) is useful in avoiding undercuts and misaligned paths of insertion.

INDICATIONS AND CONTRAINDICATIONS

The new Ceromer and FRC system when used in combination is primarily indicated for:

- Multiple-unit metal-free restorations limited to one pontic space (20 mm span) between abutments.
- Single-unit metal-free full-coverage restorations.
- Metal-free implant superstructures.
- Selected onlays.

The Ceromer material (Targis) is used independently for:

- Jacket crowns.
- Telescopic crowns.
- Inlays and onlays.

Or, it can be bonded to metal substructures using Targis Link™ (Ivoclar Williams, Amherst, NY) for:

- Metal-reinforced single or multiple unit restorations.
- Metal-reinforced implant superstructures.

When an adhesively bonded technique is utilized, field isolation is mandatory. The new Ceromer/FRC combination is contraindicated when subgingival preparation margins prohibit adequate isolation.

Proximal boxes should be prepared with 60°-80° cavosurface angles to optimize acid-etching. Ideally, a deep chamfer or shoulder preparation of 1 mm-1.5 mm at a 90°-120° angle should be performed. Beveled shoulders and feathered edges should be avoided.

The minimum reduction depth in the fissure area must be 1.5 mm for both inlays and onlays. The same dimension is required for the isthmus-pulpal wall depth.

Inlay/Onlay Bridge Preparation Guidelines

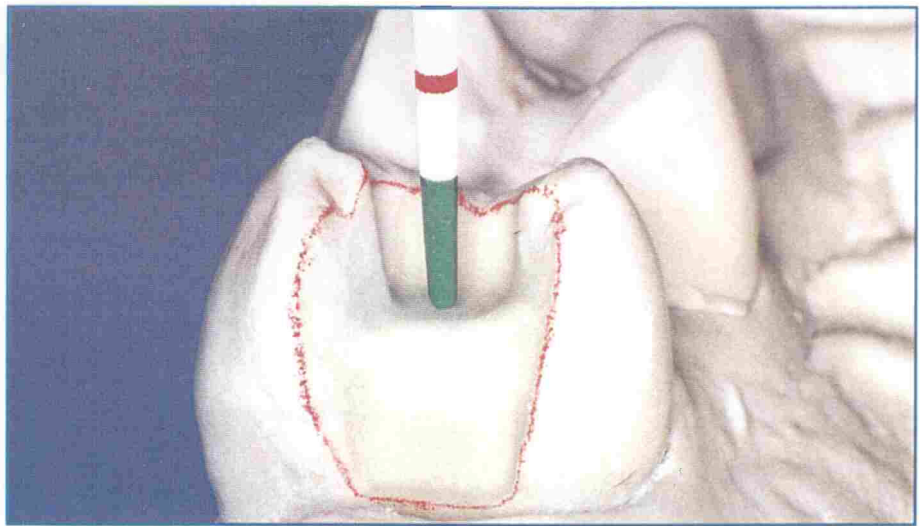
The preparation design for the Targis/Vectris inlay/onlay bridge is similar to the design for inlays and onlays, with a few modifications (Figures 2 through 5). Due to the thickness of the Vectris pontic and frame material combined, additional space must be created in order to achieve the optimal aesthetics and

The occlusocervical reduction of the proximal boxes should be maximized in order to enhance the stability of the bridge restoration ...

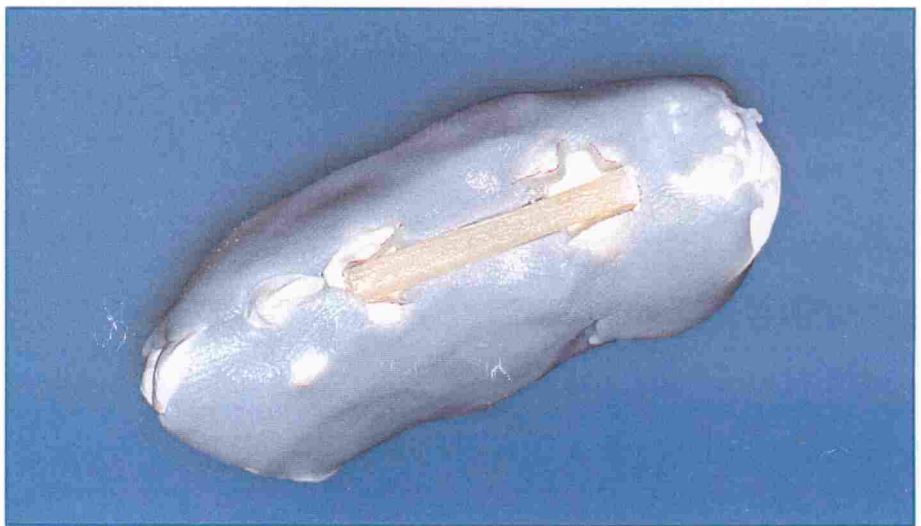
strength intracoronally at the fissure area. Premolars require an isthmus width of 1.5 mm-2.0 mm, and molars an isthmus width of 2.5 mm-3.0 mm.

The space between the pulpal wall of the cavity and the deepest pit or fissure should be 2.0 mm-2.5 mm to allow sufficient room for both the Vectris substructure and the Targis veneering material. This depth can best be assessed by filling the occlusal portion of the cavity with an inlay/onlay temporary material (Fermit™, Ivoclar Vivadent, Amherst, NY) and polymerizing it while the patient articulates in maximum intercuspation. The inlay mock-up can be easily removed, its thickness appraised with a caliper, and any further preparation completed, if required. A periodontal probe is another practical adjunct in determining the occlusal preparation depth (Figure 6).

The occlusocervical reduction of the proximal boxes should be maximized in order to enhance the stability of the bridge



6. There should be sufficient space (2.0 mm to 2.5 mm) between the pulpal wall and the fissure to accommodate the Vectris framework and the Targis veneering material.



7. The first step in the laboratory fabrication of the framework is the placement of Vectris Pontic Fibers into the silicone key to span the entire length of the bridge.

restoration by decreasing the rotational movements induced by occlusal stress generated in the pontic area. Generally, the proximocervical finish line of the preparation should be kept 1.0 mm-1.5 mm from the cemento-enamel junction (CEJ).

Shade Selection

A shade guide (Chromascop®, Ivoclar Williams, Amherst, NY) is employed to select the shade of the cervical, middle, and occlusal thirds. Variations in translucency and opacity, as well as hypocalcification, craze lines, and degree of pit and fissure pigmentation should be observed and charted in a schematic drawing to be

included in the laboratory prescription. Slides or photographs of the prepared teeth, as well as of sound teeth exhibiting a natural occlusal morphology, if present, will greatly assist the laboratory in the fabrication of the restorations. A preparation die shade guide should be utilized to select the shade of the prepared dentin surface.

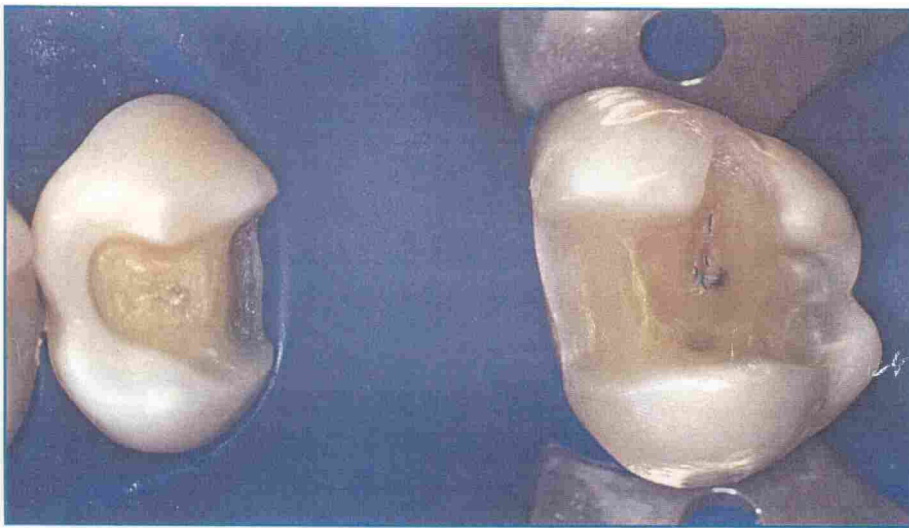
LABORATORY FABRICATION

Fabrication of the Vectris™ Framework

The beam-like pontic is waxed-up between the two abutments on the



8. The Vectris Frame produces an enhanced, durable bond between abutment teeth and pontic. Note the natural aesthetics which have been achieved.



9. Rubber dam isolation should not interfere with the passive seating of the restoration. All margins should be clearly visible.

model. A silicone key is then modeled around the beam and the wax is removed. The Vectris Pontic is placed on the occlusal opening of the silicone key, according to each specific circumstance and bite relation (Figure 7). The process of combining vacuum, pressure, and light in the state-of-the-art, proprietary deep drawing system (Vectris™ VS-1, Ivoclar Williams, Amherst, NY) produces a highly accurate, bubble-free framework. Next, the Vectris Frame is applied, producing an enhanced, durable bond between abutment teeth and the pontic. Adaptation of the fiber-reinforced frame and

curing is achieved with the proprietary framework former (Vectris VS-1). The framework can be trimmed as required to achieve sufficient space for the aesthetic cervical area.

Fabrication of the Targis Overlay

The translucent Targis Base is applied to the Vectris framework to establish a sound chemical bond. The bridge is then built up, layer by layer, using the ready-to-use materials with matching consistencies. Each layer is set with the initial curing light (Targis™ Quick, Ivoclar Williams, Amherst, NY). Individual shading and internal and external

staining impart the natural characteristics, features, and aesthetics (Figure 8). In order to achieve optimum light and heat polymerization of the Ceromer, the specially designed polymerization unit (Targis™ Power, Ivoclar Williams, Amherst, NY) is utilized in the final phase.

CEMENTATION

Following removal of the temporary filling material (Fermit), the preparations are inspected for debris, and a cotton pellet moistened with 2% chlorhexidine rubbed on the enamel and dentin surfaces for 30 seconds. The accuracy of fit is verified, after which the appropriate luting resin cement shade is determined utilizing try-in pastes (Variolink II Try-In Pastes). A natural color blend between tooth structure and restoration should be perceived.

Special consideration must be given to the case of an inlay/onlay bridge.

The sandblasted internal surfaces of the restoration are cleaned and acidified with phosphoric acid, and treated with a silane coupling agent (Monobond-S™, Ivoclar Vivadent, Amherst, NY). A rubber dam is placed and should not interfere with passive seating of the restoration (Figure 9). Special consideration must be given to the case of an inlay/onlay bridge, where the rubber dam must be placed in such manner that it will not exert a spring motion under the pontic, interfering with and possibly causing a dislodgment of the bridge during cementation.

The enamel and dentin surfaces of the preparation can be lightly sandblasted with 50 μm aluminum oxide (Microetcher II, Danville Engineering, San Ramon, CA) to enhance adhesion, thoroughly cleansed, and dried. The enamel and dentin are then etched for 15-20 seconds with a phosphoric acid gel

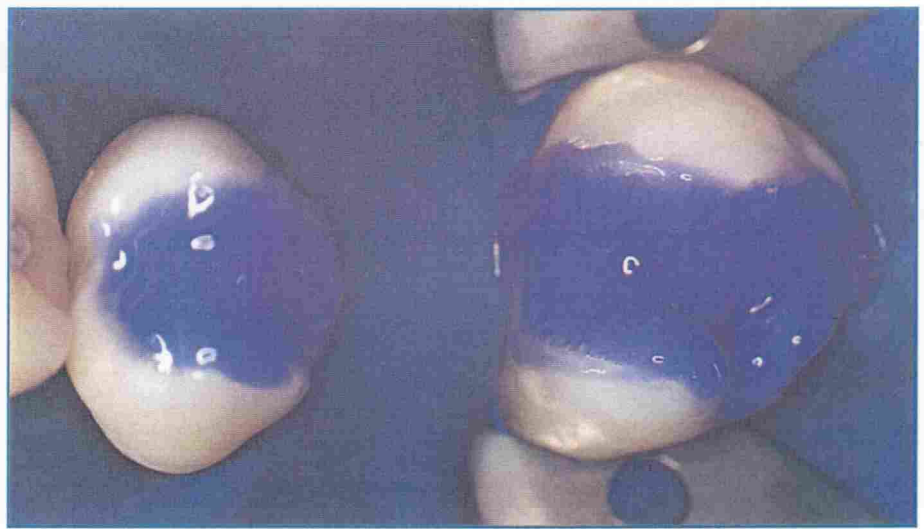
(Enamel Prep GS, Ivoclar Vivadent, Amherst, NY) and washed with a water spray for 10 seconds (Figure 10). A dentin-enamel adhesive system (Syntac®, Ivoclar Vivadent, Amherst, NY) is applied to the preparation and restoration according to manufacturer's instructions (Figure 11). A dual-cured resin cement (Variolink II) keyed to the shade of the try-in paste is selected and dispensed according to the manufacturer's instructions. It is applied either into the cavity preparation (inlays), or onto the inner aspect of the onlays.

The restoration is then seated and held in position with an instrument to facilitate removal of excess resin cement. The restoration is then spot tacked in position, and floss is utilized interproximally to remove excess resin completely (Figure 12). Glycerin gel is applied over and along the restoration cavosurface margins to promote thorough polymerization of the cement's oxygen-inhibiting layer. The final photopolymerization is achieved by exposing each aspect of the restoration to a halogen curing unit for the appropriate amount of time recommended by the manufacturer.

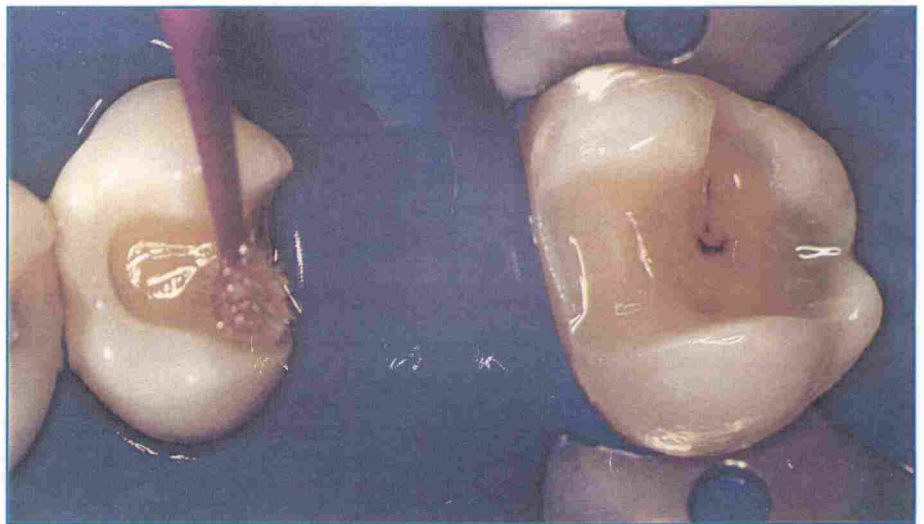
Finishing and occlusal adjustments are accomplished with 12-fluted carbide burs (7901 and 7604, SS White, Lakewood, NJ). For refinement of embrasure forms, finishing discs (Sof-Lex® 3M Dental Products, St. Paul, MN) can be utilized. Any excess interproximal resin cement can be removed with interproximal carvers and/or a #12 scalpel blade. Rubber polishing instruments (PolitiP™ Finishers and Polishers, Ivoclar Vivadent, Amherst, NY) should be utilized to further refine and polish the restoration. Final shade evaluation should be performed at least 24 hours postplacement to permit rehydration of the tooth structure (Figure 13).

DISCUSSION

Presently, several treatment modalities are available for the prosthetic replacement of a single missing tooth, such as the inlay/onlay bridge case presented here. An implant-supported single crown restoration may also be a viable alternative, provided there exists sufficient bone quantity and quality at the implant site.



10. A total etch technique is performed in preparation for bonding of the bridge. The enamel and dentin are etched for 15-20 seconds.



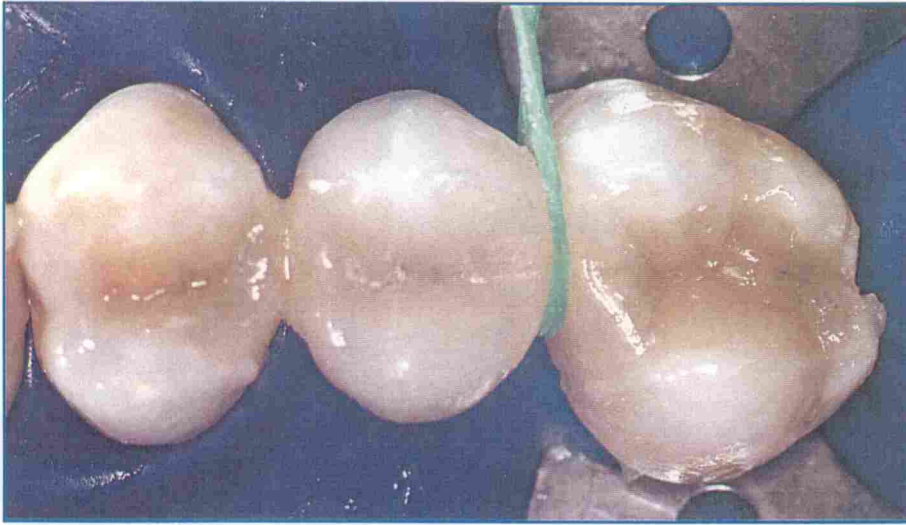
11. A dentin-enamel adhesive (Syntac, Ivoclar Vivadent, Amherst, NY) is applied to the preparation according to the manufacturer's instructions.

In such cases, additional bone and connective tissue grafting may be necessary to achieve optimal aesthetics and physiological contours.

A conventional ceramometal bridge is an alternate treatment option which can be similarly indicated. However, this procedure involves aggressive reduction of sound tooth structure which, in the specific clinical case presented, would have been unfavorable considering the soundness of the abutment teeth. A ceramometal Maryland-type bridge, or even a ceramometal inlay bridge, could also be considered as high-strength, conservative therapeutic procedures. However, these

alternatives often lack the superior aesthetics exhibited by metal-free restorations, while simultaneously presenting the potential for adhesive failures.

FRC technology permitted an aggregation of high strength and exceptional aesthetics in the conservative rehabilitation of the missing maxillary second premolar. Class I amalgam restorations were expanded into Class II inlay preparations, thereby limiting tooth reduction. The fabricated Ceromer/FRC inlay/onlay bridge demonstrated an excellent accuracy of marginal fit and optimal handling characteristics, which were evident during the final placement of



12. The restoration is spot tacked in position, and floss is utilized interproximally to remove excess resin.



13. View of the finished restoration one week postoperatively. Note excellent form and color integration.

the restoration. An expanded range of shade availability, including new incisal shades, facilitated a harmonious optical blend between the restoration and the adjacent natural dentition. Adhesive cementation, which is associated with the low degree of brittleness of the FRC and Ceromer materials, contributed to a complete reinforcement of, as well as a dynamic stress distribution along, the tooth-restoration complex. These characteristics, in addition to the ease of final adjustment and excellent polishability, determined the indication of the Targis System for the restoration of this case.

CONCLUSION

The new Ceromer and FRC technology is now available for the replacement of a single tooth or multiple teeth. This combination results in a product system with an aesthetic, translucent, tooth-colored framework/veneering material which rivals the strength of conventional ceramometal restorations. A close, stress-free fit is ensured as a result of the vacuum pressure framework form technology which demonstrates a strong light-cured integrity. The laboratory and clinical protocols are operator-friendly, optimizing the efficiency and cost of the restorations. Whereas the Targis/Vectris system has

definite indications, it presents the clinician with an advanced restorative alternative with the potential to be aesthetically and functionally utilized in expanded, scientifically sound cases. The final result is complete satisfaction with the definitive restoration for the patient, dentist, and dental technician.

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Newton Fahl, Jr., DDS, MS, maintains a private practice, emphasizing Restorative and Aesthetic Dentistry in Curitiba, Brazil. Dr. Fahl is a founding member and Vice President of the Brazilian Society for Aesthetic Dentistry, and lectures and conducts continuing education seminars on Aesthetic Dentistry in Brazil and internationally.



Renzo C. Casellini, MDT, is owner of Swiss Quality Dental Ceramics, Inc. and Dental Implant Studio, where he has specialized in the fabrication of aesthetic restorations for more than 23 years.