Replacing a Traumatically Fractured Central Incisor

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The conventional approach for replacing a single missing tooth is to use a porcelain-fused-to-metal bridge, a fiber-reinforced composite framework with a porcelain veneer pontic, or a Maryland bridge. The increased acceptance of metal-free alternatives is a direct result of the esthetic concerns presented with metal-reinforced ceramic restorations. Problems such as the inability of light to pass through the substructure, the need for opaquers to mask the metal framework's dark color, and the subgingival placement of margins jeopardizes the overall biocompatibility of the restoration.[1-5]

CERAMIC SYSTEMS

Etched and bonded all-ceramic systems provide alternatives when esthetics are very important. A recently introduced glass-ceramic system (**IPS Empress® 2, Ivoclar Williams**) offers the strength necessary for the fabrication of anterior bridge restorations. (According to manufacturer's guidelines, inlay bridges are not an indication for the use of IPS Empress® 2.) The lithium disilicate framework prevents microcracks and contributes to the esthetic translucency of the material. The interlocking structure of the crystals elevates the toughness and flexural strength of the material to 340 MPa.[6]

The layering material, a sintered glass-ceramic, contains a fluorapatite crystalline microstructure that gives the material the optical characteristics of translucency, brightness, opalescence, and fluorescence. The following case presents a combination of full-coverage design, ovate pontic preparation, and box-form design to conservatively

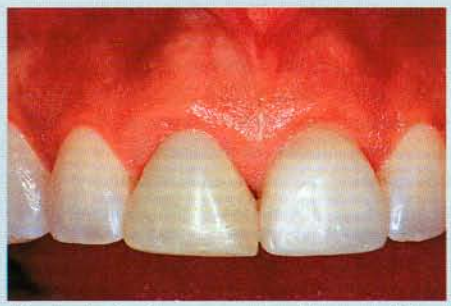

***Figure 1**—Patient presented with a provisional restoration on the right central incisor.*

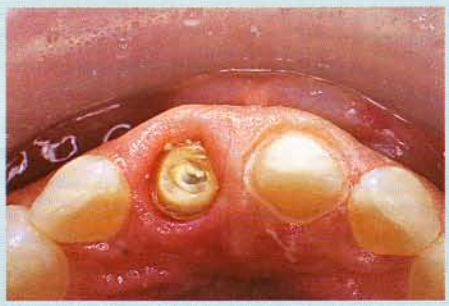

***Figure 2**—Central incisor fractured to the osseous crest.*

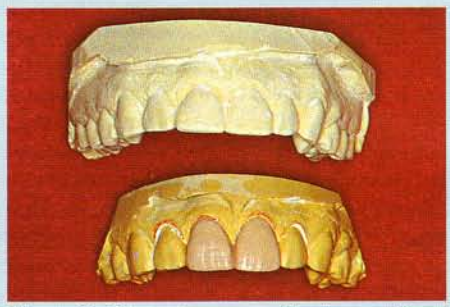

***Figure 3**—Diagnostic wax-up for the provisional restoration.*

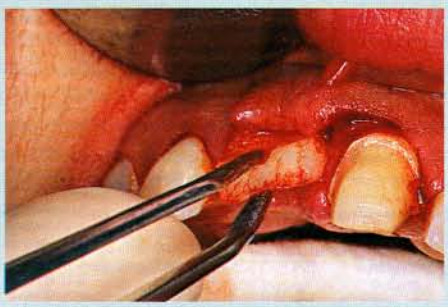

***Figure 4**—Subepithelial connective tissue graft being inserted into the modified pouch.*

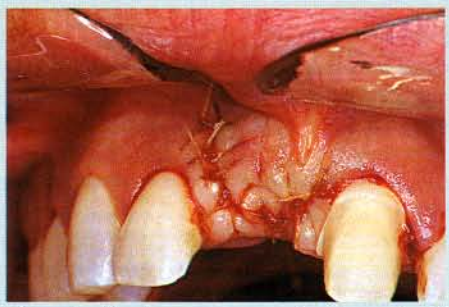

***Figure 5**—Flap suture over connective tissue using 5-0 chromic gut.*

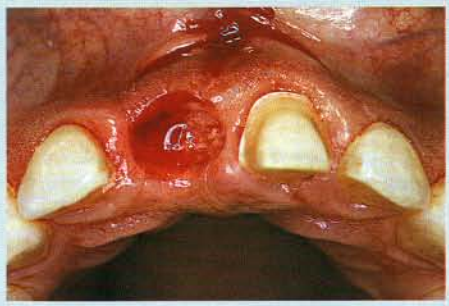

***Figure 6**—Maxillary facial frenectomy and ovate pontic site created.*

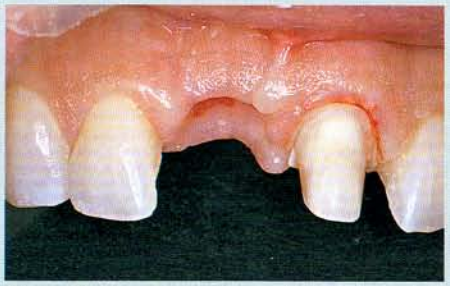

Figure 7—Complete healing and facial view of the preparation and ovate pontic site.

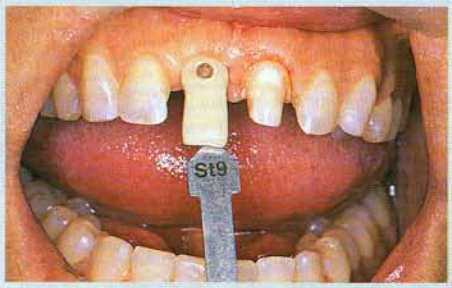

Figure 8—Preparation with stump shade guides.

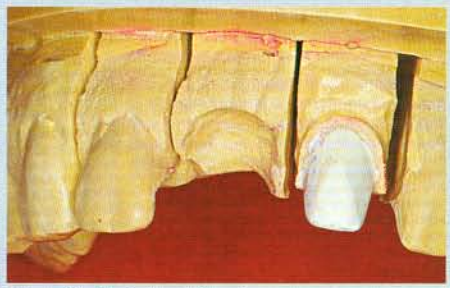

Figure 9—Facial model work.

Figure 10—Palatal model work.

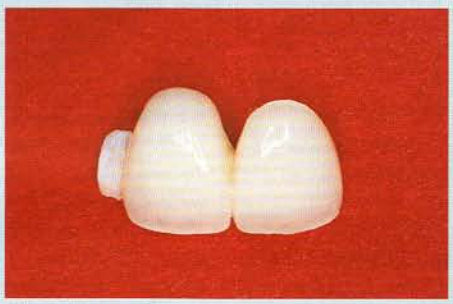

Figure 11—Final restoration; facial view.

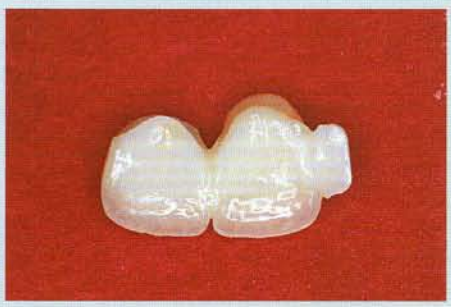

Figure 12—Final restoration; lingual view.

replace a traumatically fractured, endodontically treated, maxillary right central incisor. A conservative design was chosen because the abutment tooth was a previously untreated tooth with no clinical abnormalities. With the new material, we used cement adhesion for retention form on the distal untreated-tooth abutment. The box preparation on the abutment follows the manufacturer's dimensional parameters and material thickness desired for strength.[6]

Case Study

Patient History

A 24-year-old woman presented with a fractured, endodontically treated, right central incisor (Figure 1). The provisional restoration that was placed was considered esthetically unacceptable by the patient's parents, and the patient expressed dissatisfaction with the color of her teeth and the esthetics of her smile. The patient was a heavy smoker and moderate drinker, which limited the treatment modalities.

Clinical Examination

The examination revealed generalized gingivitis and moderate bleeding on probing with most depths measuring 2 mm. Lingual anterior tobacco stain was present. There was no soft- or hard-tissue pathosis, and a full complement of dentition (except for the third molars) was noted. No muscle or joint pathosis was observed, but excessive incisal wear was evident on both cuspids because of a nocturnal bruxing habit.

The patient's bite was solid, and there were no discrepancies between centric relation and centric occlusion. The full-mouth radiographic examination, combined with a comprehensive treatment plan, revealed a defective Class 1 amalgam on the maxillary right molar and a fractured maxillary central incisor below the bone margin (Figure 2). Smile analysis revealed generalized gingival excess and a deficient gingival height of contour on the central incisors. The ideal length-to-width ratio of the central incisors is 75% to 80% with the tooth being longer than wider. The length-to-width ratio of this patient's centrals was not 75%; they were too short and too wide.

Diagnosis and Treatment Plan

The initial treatment plan consisted of a prophylaxis to ensure and promote gingival health. I proposed an orthodontic eruption of the remaining root structure to occlusally force the epithelium and bone before root extraction. The cosmetic appearance of the ridge would have been greatly enhanced if this procedure was used, but the patient refused to wear any orthodontic appliances, so the proposal was dismissed.

Implant therapy was suggested, but because of the length of time required for osseointegration and the patient's smoking habit, this treatment was contraindicated. A proposal of six ceramic anterior restorations to help restore the patient to a more favorable occlusal guidance and to lengthen the anterior segment was also rejected. Because of the patient's age and the psychological trauma from the fracture, the patient wanted the least invasive preparation available.

The definitive plan involved placing a metal-free lithium disilicate glass-ceramic slot-box-designed bridge. The unique design was used because of its conservative untreated-tooth adhesion techniques. The bridge would have been retentive because of adhesive cements, not because of mechanical retention.[7,8] Complete records were taken including a face-bow transfer record (**Universal Transfer Bow, Stratos™ 200, Ivoclar Williams**), 35-mm slides, and preliminary models. The laboratory was instructed to wax-up the models for provisionalization and prepare them so the dentist had a guide for preparation design (Figure 3).

Preparation

After the patient was anesthetized, the provisional restoration on the right central incisor was removed. Preparation guidelines must be followed to ensure predictable function and esthetics. Reduction of 1.5 mm of the axial wall and 2 mm of incisal length was accomplished on the left central incisor. A 360° butt joint margin that followed the gingival crest was created with a **No. 893-012 bur (Diatech Dental)** at approximately 1.5-mm depth. The maximum pontic space of 11 mm was measured, and the bridge connector dimension of 4 mm

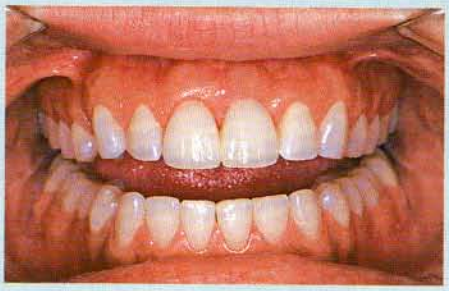

Figure 13—Frontal view; magnification 1:2.

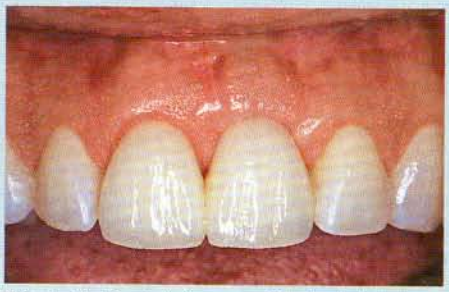

Figure 14—Frontal view; magnification 1:1.

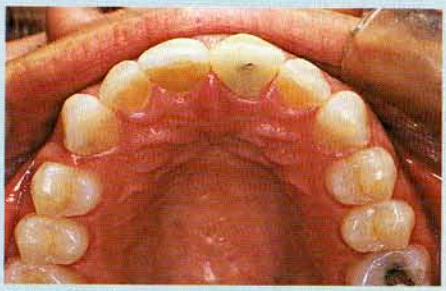

Figure 15—Preoperative; maxillary occlusal view.

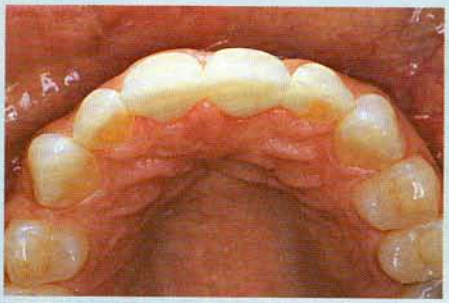

Figure 16—Postoperative; maxillary occlusal view.

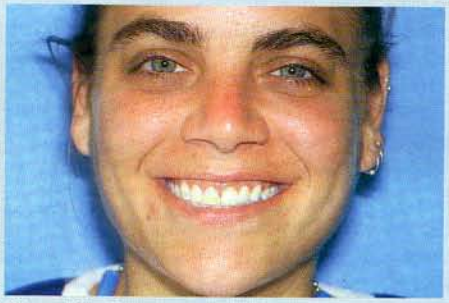

Figure 17—Preoperative; full frontal view.

Figure 18—Postoperative; full frontal view.

occlusogingivally and 4 mm buccolingually was reconfirmed; this case fell into the acceptable parameters.

The distal box on the lateral incisor had to have opposing vertical axial walls of box form and grooves to successfully retain the bridge, and it also had to follow the 4 mm × 4 mm bridge connector rule—a total of 16 square millimeters was needed for adequate strength in the connector. A stump shade was selected for the central incisors, and pictures with several shade tabs were taken to assist the laboratory technician in creating a restoration that matched the existing dentition. A vinyl polysiloxane material was used to take the triple tray bite impression. Slides and impressions were forwarded to the laboratory to ensure sufficient reduction had been attained and to allow the technician to evaulate the shade we would be matching.

A provisional restoration was made from the diagnostic wax-up, and an impression material (**Sil-Tech®, Ivoclar Williams**) was used to fabricate a mold on the model. The preparation was lubricated with glycerin, and **Luxatemp® in an Al shade (Zenith Dental/DMD)** was injected into the mold and placed on the preparation for 2 minutes. The mold was removed from the prepared teeth and allowed to bench-cure for an additional 3 minutes. It was then seated and trimmed. Final polishing was completed and the provisional was cemented with unfilled resin (**OptiBond™, Kerr® Corporation**) bonded on the facial of the central incisor.

Surgery

Because of multiple fractures, tooth No. 8 was extracted by sectioning, which involved sacrificing osseous support on the facial aspect. We waited 6 weeks so the site could heal before we started augmentation. A connective tissue graft was harvested from the palate and inserted on the facial and incisal portion of the edentulous ridge area of tooth No. 8 (Figure 4). Subsequently, a maxillary facial frenectomy and internal beveled gingivectomy on tooth No. 9 were performed (Figure 5). In addition, an ovate pontic site was created using the provisional restoration to aid in pontic site development (Figures 6 and 7).

Impressions and Laboratory Communication

After the patient was completely healed, anesthetic was administered and the provisional bridge was removed. The shade of the preparation was taken using a preparation shade guide (**st 9 stump shade guide, Ivoclar North America**) (Figure 8). The final shade of the bridge was obtained by taking photographs with **Chromoscop® (Ivoclar North America)** shade tabs held next to the natural dentition from various angles.

An epinephrine-impregnated zero cord was placed intersulcularly on the central incisor. A full-arch impression was obtained using a vinyl polysiloxane light-syringable and heavy tray material. An opposing bite registration was obtained using a thixotropic vinyl polysiloxane bite registration material (**Blu-Mousse®, Parkell®**) both with and without an interpupillary recording stick. A facebow transfer was recorded, and models of provisional restorations (Figures 9 and 10) were sent to the laboratory with a prescription detailing the patient's length, width, and color requirements, as well as all photographs.[9]

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Cementation

The case was returned from the laboratory and tried on both soft-tissue and die-trimmed models to verify accurate marginal fit and overall esthetics. The patient was anesthetized, the provisional restorations were removed, and the tissue was inspected. The accurate marginal integrity of the provisional and its shape and high-surface polish promoted improved tissue health and maintenance of the soft-tissue architecture of the pontic site.

The teeth were pumiced and

the restoration was tried in using a try-in paste (**Variolink® II try-in paste, Ivoclar Vivadent**) before it was evaluated for marginal integrity, esthetics, and tissue adaptability around the ovate pontic receptor site. The patient approved the esthetic appearance of the restoration (Figures 11 and 12). The restoration was then cleaned internally with phosphoric acid, silanated for 1 minute, and air-dried.

A rubber dam was placed to isolate the maxillary dentition from canine to canine. **Consepsis® (Ultradent Products, Inc.)** was scrubbed on the preparation, rinsed, acid-etched for 15 seconds, and rinsed again. The preparations were redampened with an antibacterial solution (**Tubulicid Red, Global Dental Products**) and blotted dry. A hydrophilic primer agent was applied on the tooth until a shiny coat appeared when the tooth was lightly air-dried. A dual-cured unfilled resin was placed on the internal aspect of the bridge and the surface of the tooth preparations. A light-polymerized resin luting cement (**Variolink® II dual-curing system, Ivoclar Vivadent**) was lightly coated on the entire internal surface of the restoration and the wing.

The bridge was seated onto the prepared tooth, and excess cement was removed using nylon brushes and rubber tips. The restoration was spot-tacked into place by simultaneously using a 2-mm light tip over an argon laser tip. Waxed floss was drawn through the contacts to remove excess cement, and a bridge threader removed excess resin under the connectors before the resin cement was completely polymerized. **DeOx® (Ultradent Products, Inc.)** was applied to all margins to prevent an oxygen-inhibiting layer of resin cement from forming, and then final polymerization was accomplished with an argon laser.

Finishing

Excess cement was removed with scalers and scalpel blades (**No. 12 Bard Parker, Becton Dickinson and Company**), and interproximal margins were finished and polished with finishing strips (**Epitex™ strips, GC America**). The rubber dam was removed and the occlusion was evaluated to ensure proper anterior guidance had been attained. The patient was instructed to return in 1 week for an evaluation of cementation removal, tissue health, and color. She also returned to the periodontist for a slight recontouring of the tissue in the buccal view.

Conclusion

Patients deserve conservative and functional restorations that look natural. The new IPS Empress® 2 metal-free restorative material offers esthetic rehabilitation that had not been previously available. The IPS Empress® 2 restoration exceeded my patient's expectations (Figures 13 through 18), and her apprehension about treatment was alleviated.

To benefit from an all-ceramic restorative, the functional aspects of the restoration should be the primary concern before esthetics are considered. To maximize the functional and esthetic benefits for the patient, dentists must understand the importance of occlusion for any restoration. In addition, understanding soft-tissue adaptation in the pontic site also will ultimately enhance esthetic results.

Acknowledgments

The author would like to thank Tres Reeves, DDS, for performing the periodontal ovate pontic surgery presented in this article. The author would also like to thank Matt Roberts at CMR Dental Labs of Idaho Falls, Idaho, for his work on the restorations presented, and for his guidance, knowledge, and support. ■

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9. Trinkner TF, Roberts M: Laboratory communication. Communication guidelines for achieving aesthetic success. *Signature* 5(3):18-21, 1998.

Product References

Product: No. 12 Bard Parker
Manufacturer: Becton Dickinson and Company
Address: 1 Becton Drive, Franklin Lakes, NJ 07417
Phone: 201.847.6800
Fax: 201.847.6475

Product: No. 893-012 bur
Manufacturer: Diatech Dental
Address: 24 Market Street, Suite 210, Charleston, SC 29401
Phone: 800.222.1851
Fax: 803.853.6987

Product: Blu-Mousse®
Manufacturer: Parkell®
Address: 155 Schmitt Boulevard, Farmingdale, NY 11735
Phone: 800.243.7446
Fax: 516.249.1242

Product: Consepsis® DeOx®
Manufacturer: Ultradent Products, Inc.
Address: 505 West 10200 South, South Jordan, UT 84095
Phone: 800.552.5512
Fax: 801.572.0600

Product: Chromoscop® shade guide st 9 stump shade guide
Manufacturer: Ivoclar North America
Address: 175 Pineview Drive, Amherst, NY 14228
Phone: 800.533.6825
Fax: 716.691.2285

Product: Epitex™ strips
Manufacturer: GC America, Inc.
Address: 3737 West 127th Street, Alsip, IL 60803
Phone: 800.323.7063
Fax: 708.371.5103

Product: IPS Empress® 2, Sil-Tech®, Stratos™ 200 Universal Transfer Bow
Manufacturer: Ivoclar Williams
Address: 175 Pineview Drive, Amherst, NY 14228
Phone: 800.533.6825
Fax: 716.691.2285

Product: Luxatemp® shade A1
Manufacturer: Zenith Dental/DMG
Address: 242 South Dean Street, Englewood, NJ 07631
Phone: 800.662.6383
Fax: 201.894.0213

Product: OptiBond™
Manufacturer: Kerr® Corporation
Address: 1717 West Collins Avenue, Orange, CA 92867
Phone: 800.537.7123
Fax: 800.537.7345

Product: Tubulicid Red
Manufacturer: Global Dental Products
Address: P.O. Box 537, North Bellmore, NY 11710
Phone: 516.221.8844
Fax: 516.785.7885

Product: Variolink® II dual-curing system, Variolink® II try-in paste
Manufacturer: Ivoclar Vivadent
Address: 175 Pineview Drive, Amherst, NY 14228
Phone: 800.533.6825
Fax: 716.691.2285