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Clinical Technique/Case Report

Conservative Anterior Partial Coverage CAD/CAM Restoration

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SUMMARY

Computer-aided design and manufacturing technology enables practitioners to create, in a single appointment, indirect restorations that are esthetic and functionally unique to the patient's situation. The popular effort to perform minimally invasive dentistry using digital techniques with chairside milling can lead dentists to novel individualized restorative treatment. This article demonstrates a conservative anterior partial coverage restoration, utilizing both digital technology and chairside ceramic characterization to achieve an optimal esthetic outcome while preserving healthy tooth structure.

INTRODUCTION

Single-appointment computer-aided design and manufacturing (CAD/CAM) dentistry has opened a new treatment option for restoring teeth with an indirect chairside approach. The effectiveness of digital scanners are shown to be at least as exacting and reliable as more traditional impression techniques.[1] Numerous studies have demonstrated long-term success with various CAD/CAM restorations, with most citing a success rate of approximately 90% at 10 years.[2-5]

Conventional treatment for moderately to severely broken-down anterior teeth having nonsurgical root canal therapy (NSRCT) typically includes direct resin composite buildup; resin composite core and full-coverage crown; prefabricated post, resin composite core, and full-coverage crown; and custom cast post/core and crown. Unless the access of the NSRCT was minimally prepared, very little tooth structure remains to support the core substructure and the subsequent crown. In addition, because the enamel thins as it approaches the cemento-enamel junction, cervical dentin is typically exposed, leaving minimal enamel bonding available. This is especially true with subgingival margins. This places all of the retentive stress on the post, core, and bond between the dentin and crown material. A lack of natural tooth structure weakens the tooth and increases the chance of the crown failure, making further treatment more difficult or invasive. In addition, the typical crown preparation margin is placed slightly subgingival to improve esthetics or in an effort to increase the ferrule effect.[6,7] In terms of bonding substrate, adhesive bonds to enamel are shown to be stronger and more durable than bonds to dentin.[8,9] Therefore, maximizing preparation surface area in enamel should increase restoration performance and longevity.

The trend in modern dental practice is toward a more conservative approach that preserves natural tooth structure while still providing long-lasting esthetic restorations.[10-13] By minimizing weakened tooth structure, removing existing restorative material, and keeping preparation depth in enamel, a greater amount of tooth can be preserved. With careful attention to tooth preparation, restoration design, and a quality custom stain, a very esthetic and strong partial coverage ceramic restoration can be delivered without sacrificing supportive structures. The purpose of this case report is to present an

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Figure 1. *Preoperative facial photograph showing fractured incisal edge and existing MIFL composite.*
Figure 2. *Large endodontic access with provisional restoration.*

Figure 3. *Anterior preparation, including finish line placed just below the height of contour.*
Figure 4. *Incisal view of the preparation. Notice that the lingual finish line was left at the previous access margin and the thick band of enamel 360 degrees around the preparation.*

alternative chairside CAD/CAM approach to traditional maxillary central incisor crown preparation utilizing a conservative esthetic preparation design.

CLINICAL TECHNIQUE REPORT

The patient presented with a provisionalized NSRCT retreat on #9 with a history of trauma, which led to the previous NSRCT, and multiple composite repairs (Figures 1 and 2). The patient was referred for an esthetic full-coverage restoration. During the evaluation, the patient explained he was not impressed with the previous composite restorations because they did not reproduce the fluorosis staining of the surrounding dentition. Options for treatment were discussed with the patient, including a composite buildup; core and crown; post (prefabricated or cast), core, and crown; and a partial veneer CAD/CAM all-ceramic restoration. The option of a CAD/CAM lithium disilicate partial veneer restoration was selected. Lithium disilicate has been increasingly used in thin veneer restorations due to impressive strength and esthetics.[10-14]

The advantages of this treatment option are numerous. With the large endodontic access, a traditional crown would be supported almost entirely by the post and core rather than natural tooth structure. A conventional crown preparation would sacrifice almost all of the remaining coronal tooth structure, further weakening the tooth.[15] Additionally, the patient was concerned about the possibility of receiving another potentially unesthetic composite restoration. Due to the amount of enamel remaining, the patient's preference for a less invasive treatment option, and the high esthetic demand, a conservative partial all-ceramic veneer restoration was selected. Enamel bonding is very predictable, while dentin bonding varies greatly based on type of bonding agent and type of tooth and between different patients.[12] In addition to these factors dentin

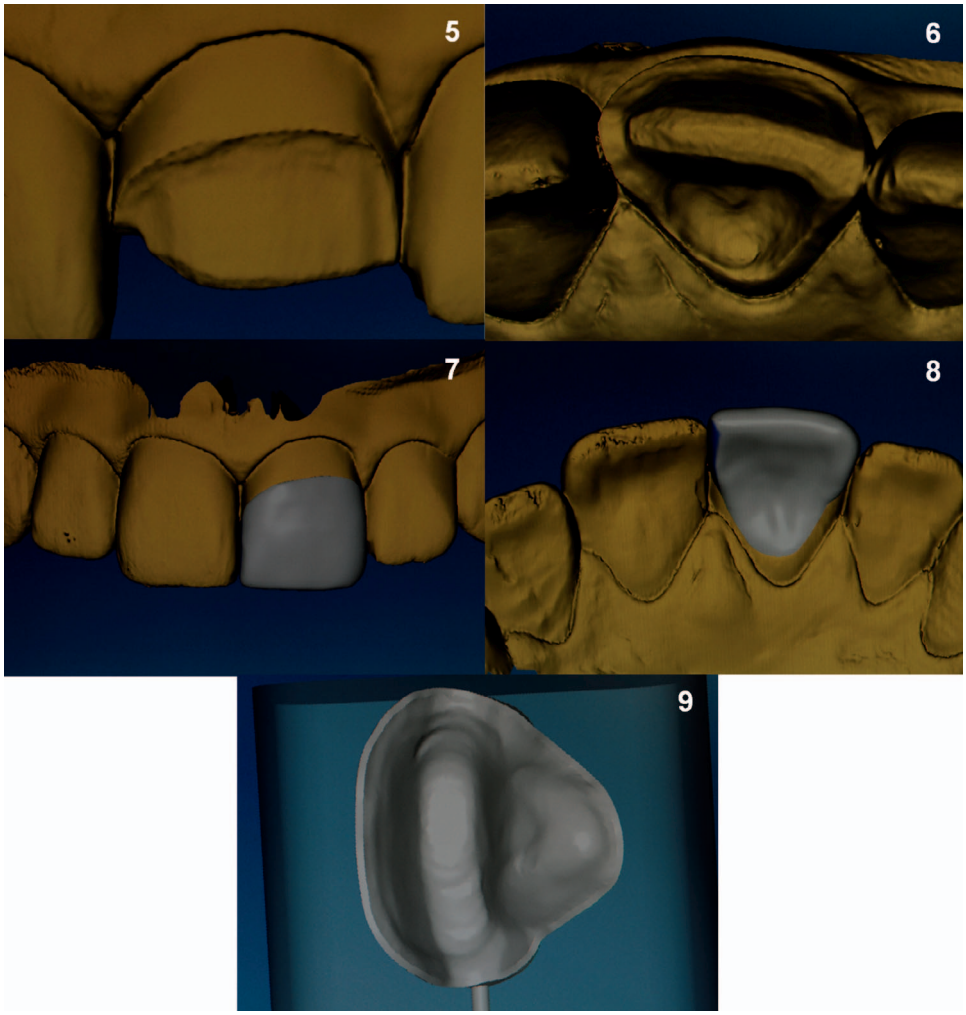

Figure 5. *Facial view of the preparation.*
Figure 6. *Incisal view of the preparation.*
Figure 7. *Image of the proposal.*
Figure 8. *Lingual of the proposal.*
Figure 9. *Intaglio of the proposed restoration. Notice the very small amount of overmill and the added 200-micron addition to the margins to protect the margin during the milling process.*

bonding has been shown to degrade over time.[16-18] Based on clinical findings, this option maintained the majority of circumferential enamel, allowing bonding of the most ideal substrate for long-term retention and success.

The patient was anesthetized (Septocaine [Articaine HCL 4%], Septodont, Lancaster, PA, USA), and the anterior dentition was isolated (Optragate, Ivoclar Vivadent, Amherst, NY, USA; Isodry, Isolite Systems, Santa Barbara, CA, USA). The provisional restoration, cotton pellet, and original composite restoration were then removed. The self-etch resin adhesive was applied (Clearfil SE Protect, Kuraray, New York, NY, USA), and a universal nanofilled resin composite (Premise, Kerr, Orange, CA, USA) was placed in 2 mm incremental layers to complete the core substructure.[19,20] The facial surface was prepared using 0.5 mm veneer reduction burs (0.5 mm depth cutter diamond, Neodiamond Microcopy, Kennesaw, GA, USA). The remaining tooth was then prepared with a minimal preparation using rotary diamond cutting instruments (coarse and fine diamonds, round-end taper and flat-end taper, Neodiamond Microcopy) (Figures 3 and 4), and the digital impression was captured (CEREC Bluecam, Sirona, Charlotte, NC, USA) (Figures 5 through 9). The cervical lingual margin of the endodontic access was used as the finish line for the restoration, and proximal contacts, with the cingulum, were maintained to the greatest extent possible. This design allows for conservative preparation to retain enamel and create a light chamfer finish line.[11] Milling a light chamfer can be problematic and result in chipping if the margin is too thin. In order to prevent this, the restoration margin thickness parameters were changed from the 50 micron manufacturer recommendation to 200 microns. This change created a small amount of overlap at the margins to allow for sufficient bulk. This excess, which was trimmed and polished prior to crystallization, allows the mill to create an accurate fitting restoration without risk

Figure 10. *Delivered #9, custom stained and bonded in place.*
Figure 11. *Final smile after delivery.*

of chipping the margin. The incisal region of the preparation was minimally flattened to accommodate the size of the milling bur, reducing the possibility of overmill.

The restoration was milled (CEREC MC XL, Sirona) out of an A1-HT-12 (high-translucency) lithium disilicate block (IPS e.max CAD, Ivoclar Vivadent). While still in its lithium metasilicate state, the restoration was tried in and adjusted accordingly using light pressure with a finishing flame diamond and copious water. The margins were repolished using an extraoral finishing and polishing system (Dialite LD, Brasseler USA, Savannah, GA, USA). The restoration was then prepared for crystallization, and a custom stain and glaze (IPS Empress Universal Shade/Stains, Ivoclar Vivadent) were applied to re-create the white characterization and striations. After crystallization, the restoration's fit was verified, and the esthetics were approved by the patient. The conservative 2/3 partial veneer CAD/CAM crown was bonded using a yellow dual cure resin cement (Variolink II, Ivoclar Vivadent) (Figures 10 and 11). Completion of the restoration included excess cement removal, occlusion adjustment, and marginal repolishing (Dialite HP, Brasseler USA).

DISCUSSION

The CAD/CAM partial coverage restoration presented here maximized the conservation of enamel and coronal tooth structure while providing full support and incisal coverage after endodontic retreatment. The patient's esthetic expectations were met while maximizing sound tooth structure.

Understanding how CAD/CAM technology can be applied allows for modern restorative treatment options to be more conservative than some traditional approaches. The ability to fabricate strong custom-stained lithium disilicate restorations chairside provides the clinician with an efficient and versatile procedure, eliminating the need for a return visit for most patients.

The author selected the 200 micron change due to personal experience and preference. It is possible that this is overly cautious and that a smaller margin thickness parameter may be satisfactory. This is one of the advantages of a CAD/CAM system; namely, it allows the practitioner to adjust restoration parameters to personal preferences.

As CAD/CAM technology becomes increasingly integrated into restorative dental practice, the ability of the practitioner to create and control the fabrication of unique indirect restorations will expand.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the Marine Corps Recruit Depot Parris Island, Branch Dental Clinic.

Navy Disclosure

The opinions or assertions contained in this article are the private ones of the author and are not to be construed as official or reflecting the views of the Department of the Navy.

Conflict of Interest

The author of this manuscript certifies that he has 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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