Case Study

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Accelerate Restorative Artistry in the Anterior Sextant with Chairside CAD/CAM Technology

Normal Version

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A recent family vacation to India gave us the opportunity to visit the Taj Mahal. Over 375 years old, it is a testament to beauty and longevity. The monument is composed primarily of marble with inlaid precious stones. While in Agra, India, we had the opportunity to visit marble factories that still use the age-old technique of inlaying marble with precious stones to make everything from statues to floors. In marble inlay work, floral and geometric patterns are carved into the marble surface. Precious stones are then hand-milled with an emory board mounted on a manual, hand-operated rotary wet lathe. The milled precious stones are cemented into the prepared patterns. It is astonishing to watch the craftsmen hand-carve the patterns, hand-mill the stones, and cement them with diligent precision. As we toured the factories and learned of the technique, a dental epiphany of significant proportions occurred to me: computer aided design/computer aided machining (CAD/CAM) dentistry is modern-day dental architecture.

The technique used by 20,000 craftsmen during the 22-year construction of the Taj Mahal is identical to that of chairside CAD/CAM dentistry in 2006.[1] Dentists use high-speed drills and hand instruments to prepare a tooth for restoration, just as the artisan prepares the marble. Our modern-day dental lathe is the CAD/CAM milling chamber, which creates precision ceramic restorations for cementation. There are several CAD/CAM restoration systems available today that are lab-based, such as Lava (3M ESPE), Cercon (DeguDent), and Everest (KaVo), but only one is designed to fabricate restorations in the dental office at chairside, and that system is CEREC 3D (Sirona Dental Systems).

CEREC 3D has innovated the process[2] that makes this time-tested technique faster and easier with precision[3] and accuracy.[4] The system uses materials that are closest to enamel's physical properties,[5,6] yielding results of predictable longevity[7-10] for the restored teeth. The restored teeth exhibit natural beauty[11] with minimal risk of sensitivity[12] or side effects.

Case Presentation
A 25-year-old patient presented with large diastemas on the maxillary anterior teeth (Figures 1 and 2) and a clear desire to restore the area. An assessment was made as to the color, size, shape, and position of the teeth. The patient presented a class II skeletal position and did not want orthodontic treatment because of the need for orthognathic surgery. He had researched all treatment options available and concluded that the risks, recovery time, and potential complications associated with orthognathic surgery were far greater than the benefits. The patient also wanted the color striations removed and a final 1M1C shade for the maxillary anterior teeth. This would also require restorative treatment after orthognathic and orthodontic treatment. The desire to change the color, size, and shape without altering the positions of the maxillary anterior teeth was confirmed. The patient requested crowns and veneers to accomplish this after understanding the risks and benefits of this treatment option.

Figure 1 - Facial view of diastemas in the preoperative sextant.

Figure 2 - Incisal view shows excessive spacing between teeth Nos. 6 through 11.

Figure 3 - A diagnostic wax-up was fabricated to visualize and validate final form.

Figure 4 - A vacuform stent was made to facilitate intraoral try-in of composite mock-up teeth.

Figure 5 - Spot-etch was performed using Etch-Rite gel.

Figure 6 - Stent with flowable composite is tried-in.

The CEREC 3D software offers 3 design modes: Dental Database (with and without Antagonist), Replication, and Correlation.[13,14] Dental Database (with or without Antagonist) allows the clinician to design the tooth by selecting from the programmed tooth libraries. In the Dental Database Antagonist mode,[15] a bite registration can be used to aid in the automatic design process and generate appropriate occlusion. Replication mode allows the clinician to copy the contours of a contralateral tooth within the arch to aid in the design process. Correlation is the simplest of all design options and copies the contours to be restored from a preoperative tooth, diagnostic wax-up, or intraoral mock-up. The decision was made to restore the sextant in Correlation mode because an intraoral mock-up based on the diagnostic wax-up (Figure 3) would represent the final contours.

Creating the intraoral mock-up was simple. An ethyl vinyl acetate vacuform stent (Discus Dental) (Figure 4) was made from a copy cast of the preoperative diagnostic wax-up and tried in intraorally. Each of the teeth to be restored (Nos. 6 through 11) was spot-etched (Etch-Rite, Pulpdent) (Figure 5) and cured with bonding agent (OneStep, BISCO). The stent was filled with flowable composite (Esthet-X, Dentsply Caulk), seated passively, and light-cured through the stent (Figure 6). The contours were evaluated for incisal edge position, lip closure path, smile line, phonetics, occlusion, and patient approval of esthetics (Figures 7 and 8).

Figure 7- Intraoral mock-up, incisal view.

Figure 8 - Smile evaluation with mock-up.

Figure 9 - Powdered mock-up.

Figure 10 - Final preparations of central incisors with mock-ups on No. 7 and No. 10.

Figure 11 - Incisal view of final preparations with mock-ups on No. 7 and No. 10.

Figure 12 - Final powdered preparations.

The restoration sequence for individual teeth was based on the importance for midline and symmetry in closure of the diastemas. Emphasizing midline generation as the basis for symmetry in this case, teeth Nos. 8 and 9, with the composite mock-up, were powdered and a preoperative occlusion scan was taken from the incisal position (Figure 9). Both teeth Nos. 8 and 9 were prepared for full-crowns simultaneously (Figures 10 and 11), then powdered and imaged with the CEREC 3D infrared camera[16] from the incisal position.[17] The crowns were designed in Correlation mode and, once the patient and dentist were satisfied with the design, the milling process was started with Vita Mark II shade 1M1C all-ceramic material blocks for tooth No. 9, then No. 8.

Next, tooth No. 10 with the mock-up was powdered and a preoperative occlusion scan was taken. Tooth No. 10 was prepared for a full-crown, powdered, and imaged. Both the preoperative and preparation pictures were taken from the incisal position. The crown was designed in Correlation mode and the milling process was started.

As tooth No. 10 was milling, tooth No. 7 with the mock-up was powdered and an occlusion scan was taken. Tooth No. 7 was prepared for a full-crown, powdered, and imaged (Figure 12). The crown was again designed in Correlation mode and the milling process was started.

Then, as tooth No. 7 was milling, tooth No. 11 with the mock-up was powdered and a preoperative occlusion scan was taken from the facial position. Tooth No. 11 was prepared for a facial veneer without incisal extension onto the lingual surface, powdered, and imaged from the facial position (Figure 13). The veneer was designed in Correlation mode (Figure 14) because the preparation did not extend onto the lingual surface and the milling process was started.

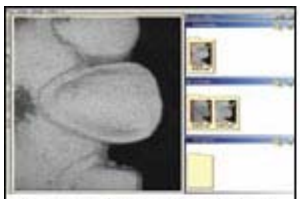

Figure 13 - Facial scan of veneer tooth No. 11.

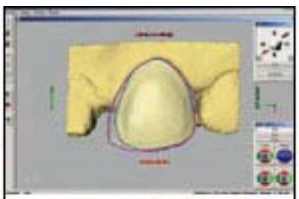

Figure 14 - Contour design veneer tooth No. 11.

Figure 15 - Glazed restorations after firing.

Figure 16 - Final cemented restorations.

Figure 17 - Final cemented restorations, occlusal view.

Figure 18 - Final smile line.

Finally, as tooth No. 11 was milling, tooth No. 6 with the mock-up was powdered and an occlusion scan was taken from the facial position. Tooth No. 6 was prepared for a facial veneer, powdered, and imaged from the facial position. The veneer for No. 6 was designed in Correlation mode and the milling process

was started.

Intraoral try-in was accomplished to verify marginal adaptation, shade, and final contours. The milled all-ceramic restorations were not stained, only glazed.[18] Glazing of the restorations was accomplished in 6 minutes using the Vita Akzent Stain and Glaze Kit (Vident) and a programmable porcelain furnace. The glazed restorations were cemented with Variolink II cement (Ivoclar Vivadent) (Figure 15).

Conclusion

The entire case was completed in a single visit; total treatment time was a little more than 5 hours, which averages to 55 minutes per restoration. The 55 minutes also takes into account diagnostic mock-up, teeth preparations, restoration design and milling, try-in followed by oven-glazing, and final cementation. It also includes taking all the clinical photographs featured in this article.

The time savings to the patient and dentist for single-visit dentistry are phenomenal. Because the teeth are not subjected to temporary restorations, there are significant added biological benefits to the patient. These benefits include better tissue management and lack of microleakage under temporary restorations, resulting in a decrease in dentinal hypersensitivity and endodontic complications. This is instant gratification at every level for the patient and dentist based on sound scientific principles and knowledge.

Chairside CAD/CAM dentistry is truly a renaissance in dental architecture. With this technology, we can help patients achieve their dental aspirations with predictable precision and accuracy in a single visit (Figures 16 through 18). The benefit to the patient and clinician: conservative dental treatment with biocompatible esthetic materials yielding beautiful results that can last a lifetime.[19]

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Product References
Product: CEREC 3D
Manufacturer: Sirona Dental Systems, LLC
Location: Charlotte, North Carolina
Phone: 800.659.5977
Web site: www.sirona.com

Product: Variolink II cement
Manufacturer: Ivoclar Vivadent
Location: Amherst, New York
Phone: 800.533.6825
Web site: www.ivoclarvivadent.us.com

Product: Akzent Stain and Glaze Kit
Manufacturer: Vident
Location: Brea, California
Phone: 800.828.3839
Web site: www.vident.com

Product: Ethyl Vinyl Acetate (EVA) clear fabrication sheets
Manufacturer: Discus Dental
Location: Culver City, California
Phone: 800.422.9448
Web site: www.discusdental.com

Product: Esthet-X Flow composite
Manufacturer: Dentsply Caulk
Location: Milford, Delaware
Phone: 800.532.2855
Web site: www.caulk.com

Product: OneStep bonding agent
Manufacturer: BISCO
Location: Schaumburg, Illinois
Phone: 800.247.3368
Web site: www.bisco.com

Product: Etch-Rite gel
Manufacturer: Pulpdent
Location: Watertown, Massachusetts
Phone: 800.343.4342
Web site: www.pulpdent.com

Product: Lava
Manufacturer: 3M ESPE
Location: St. Paul, Minnesota
Phone: 888.364.3577
Web site: www.3m.com

Product: Cercon
Manufacturer: DeguDent
Location: York, PA
Web site: www.degudent.com

Product: Everest
Manufacturer: KaVo
Location: Lake Zurich, Illinois
Phone: 800.323.8029
Web site: www.kavousa.com

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