CAD/CAM Veneers and Crowns

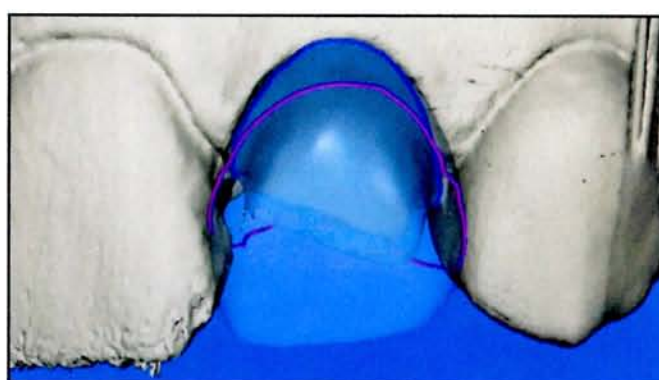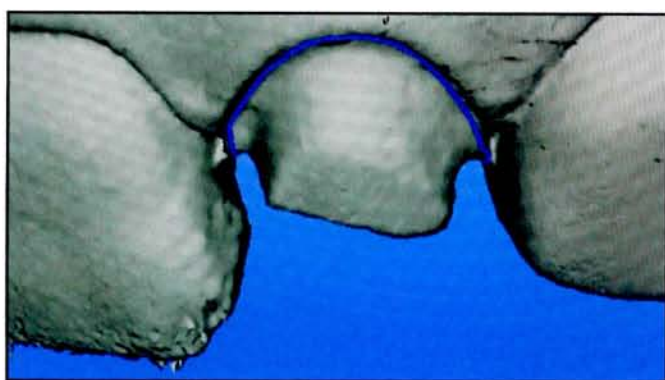**Nano-Crystalline Calcium Sulfate Site Preservation**

CAD/CAM Dentistry - Computerized Anterior Restorations Part 1: CAD/CAM Veneers and Crowns

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Abstract

Recently, an influx of computer technologies and CAD/CAM designs have been introduced to the restorative dentist. These technologies have helped streamline our fabrication protocols, reduced clinical chair-time and reduced laboratory costs. In addition, the accuracy of these techniques have equaled our conventional techniques with high level of precision. Using a combination CAD/CAM and robotics, the technology of final implant abutment fabrication and final CAD/CAM restoration is predictable for the clinician. The aim of this article is to demonstrate cases in which CAD/CAM technology was utilized for esthetic anterior restorations.

KEY WORDS: CAD/CAM, dental prosthetics, veneers, esthetics

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Figure 1: Case 1 fractured lateral incisor.

Figure 2: Close up of fractured lateral incisor from Case 1.

BACKGROUND

Over the past few years, an influx of computer technologies and CAD/CAM designs have been introduced to the restorative dentist.[1-3] These technologies have helped streamline our fabrication protocols, reduced clinical chair-time and reduced laboratory costs. In addition, the accuracy of these techniques have equaled our conventional techniques with high level of precision.[4-5] Using a combination CAD/CAM and robotics, the technology of final implant abutment fabrication and final CAD/CAM restoration is predictable for the clinician.[6-7] In addition, it has enhanced the education experience of our newly trained professionals. Anterior restorations can now be fabricated in a one-visit protocol.[8] The shade matching characteristics that were very difficult, and required many patient visits can be predictably performed, chair-side by the clinician. The use of in-office CAD/CAM digital acquisition units and scanners like Sirona/Cerec and E4D/D4D will be highlighted. The fabrication of crowns and veneers that are life-like in color and translucency as well excellent marginal integrity will be demonstrated. Computerized restorative dental restorations for our patients can be more efficient, more predictable and save chair time.

Figure 3: Ideal contour composite (ICC).

CASE REPORT 1
CAD/CAM VENEER

A patient presents with her anterior left lateral incisor fractured due to a traumatic incident and one-half of the incisal edge remaining, radiograph evidence and peri-apical pathology was not evi-
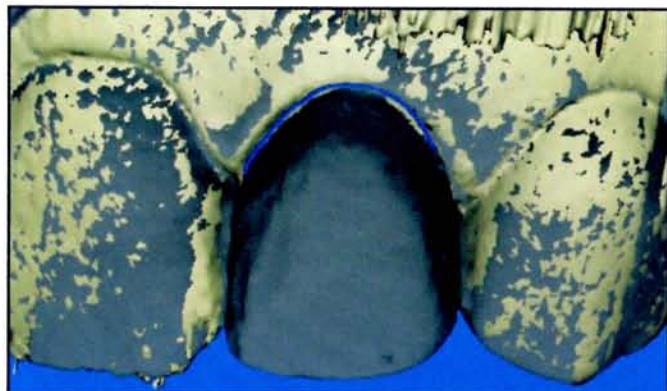
Figure 4: "Occlusion Window" used with a replicating mode in a facial view, that captures shape, incisal edge position, and texture created from the ICC
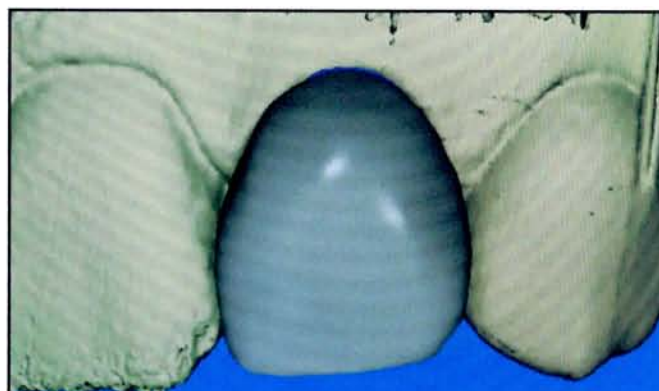

Figure 5: "Occlusion Window" used with a replicating mode in a facial view, that captures shape, incisal edge position, and texture created from the ICC.
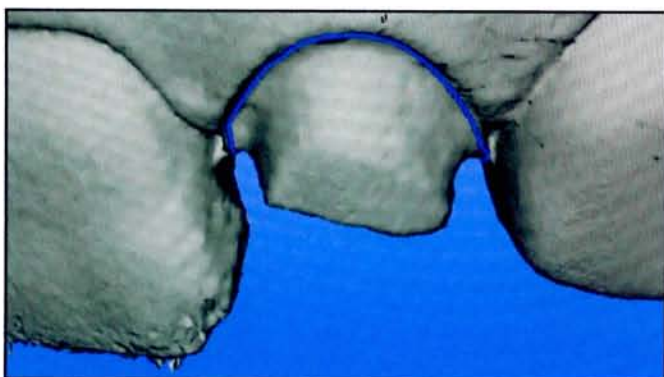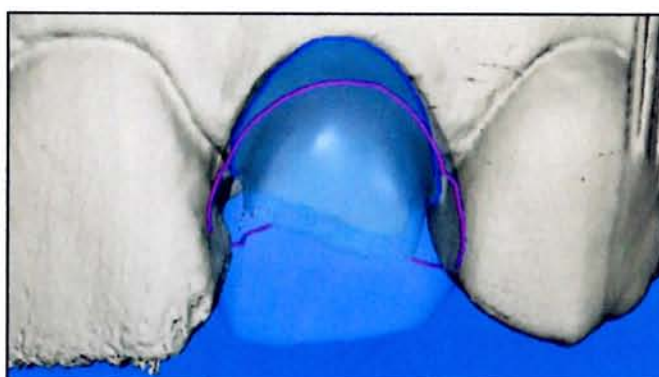

Figure 6: Preparation window.

Figure 7: Margination window.
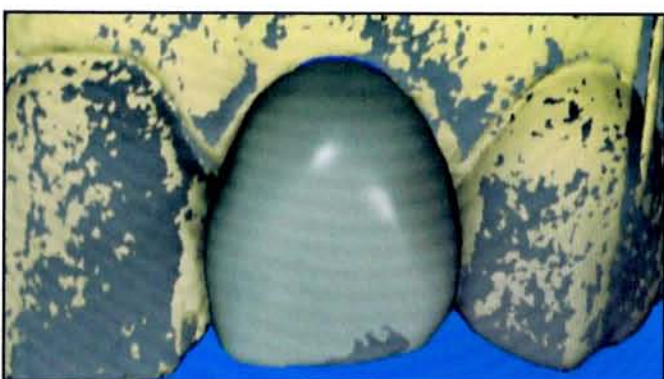
Figure 8: Restoration design window.

dent (Figures 1,2). After anesthesia was given, an Ideal Contour Composite, (ICC) was created intra-orally (Figure 3). It was scanned (6 views in total) with an intra-oral scanner (Cerec AC, Sirona dental systems, Charlotte, NC) in correlation mode. This is in the "Occlusion Window" and uses a replicating mode in a facial view, that captures shape, incisal edge position, and texture created from the ICC (Figures 4,5).

Preparation for porcelain veneer restoration was completed and the scan of the preparation (7 views in total) was captured in "Preparation Window" (Figure 6). In addi-

tion with the facial scan and preparation scan, an additional scan (6 views in total) was captured of a wax bite registration in MIP position (maximum inter-cuspal position) from an occlusal vantage point, "Antagonist Window".

The next window is called "Margination", where the clinician carefully chooses the margin of the restoration as well as the EDIT mode where we can see through the restoration (Figure 7). This can be viewed in 10-15 X magnification. The clinician chooses the correct margin circumferentially around the preparation. In this margination method the clinician marks the finish line of the preparation. This may be more accurate than the pindex method of die preparation, because there may be errors in pouring of the cast, ditching of the die, and it may be difficult to read. This will give increase precision of all restorations. After this is approved for accuracy, the design advances to the following window. The next window shows the path of insertion and reveals any undercuts in the preparation. If deficiencies in the preparation are evident, this would be the best time to re-prepare and make any corrections. If this is necessary, new scans of preparation must be made at this time. If the path of insertion is approved the program will continue to the design window.

During the restoration design window the computer software will give the clinician a design based on the correlation scanned ICC and the data base of lateral incisors installed in the software (Figure 8). It is up to the clinician to evaluate the proper position, incisal edge, line angles, occlusal clearance and length of the restoration. Several windows of this software help the clinician see the design in different vantage points as well as edit buttons

and parameters. The main parameters for the porcelain laminate veneer were set as follows:

Marginal Thickness:.. **70**
Occlusal offset:..**50**
Cement thickness: **30**
Minimal Occlusal thickness:...........................**750**

Although the learning curve on these design applications and design tools may take a few days to master, the results are worth the effort spent. Once the final design is approved and the slight changes have been made the following window will ask the clinician to choose the correct block size and type. In this patient treatment an Empress- Multi-Cad (Ivolclar-Vivadent, Amherst, NY) block was chosen.

CAD BLOCK SELECTION

The advantages of in-office fabrication include the clinican making the decisions to get the color, value and hue exactly they way he or she sees it. First, the dentin or background tooth shade must be matched. If this has a low value or dark (C4-D2 range) and needs to be lightened, then a more opacious block may be selected (ie. Vita Mach II, VITA Porcelain, VIDENT, Brea Ca.). If the dentin shade has good value (A3–B2 range) then a more translucent block may be chosen (ie. Vita-Tri-lux forte or Empress Cad multi-block). Secondly, the clinician must choose the best match of the adjacent tooth using a digital shade guide or a universal shade guide. When the final shade has been selected, then a correct block of the same shade must be selected taking into account for the dentin shade. Usually the final block chosen will be one shade lower value than the desired shade. This is because as the block gets milled, the amount of porcelain mate-

rial becomes thinner and therefore increases the value. For example, a dentin shade of A3, final desired shade A1, the correct block should be A2 (Vita-triflux, or Empress Multi-cad). If the Dentin shade is D3 and final shade is B1, then a Vita Mark II block final shade A1 would be the correct choice. These blocks are best for translucent and teeth in the Vita shade A-1 and B-1 ranges. They pick up colors from the adjacent teeth and are reflective in this nature and result in a very aesthetic restoration.

Once the correct cad block is chosen, it is placed in the milling machine (MC XL, Sirona Systems). The total milling time for this restoration was 8.5 minutes. After the milling process has been completed the restoration is tried in with water for marginal integrity, occlusion, inter-proximal contacts. Any adjustments that are necessary are made, intra-orally with high-speed rotary instrument (Brasseler #8862-012 (red stripe) Brasseler, USA) with high water volume. Depending on the patients' natural enamel on the adjacent teeth, it may be necessary to add the following contour changes:

● **Line Angles, distal and mesial**
● **Mamelons**
● **Incisal line angles and characteristics**
● **Differentiations in texture**
● **Third dimensional shaping**
● **Cervical thinning**
● **Horizontal lines on facial/incisal areas**

After all the contouring and shaping is completed, the final try-in with water is confirmed with digital photography. This will allow the clinician a true representation of the contours as the light is reflected off of the facial, mesial and distal surfaces. If this is acceptable then the glazing and staining phase may begin.

STAIN AND GLAZE

Each manufacturer has a specific stain and glaze kit. It is highly recommended to follow the specifications of the manufactures steps in staining and glazing. It may be a good idea to test the porcelain oven settings to make sure they are increasing and decreasing at the proper time and temperature as specified. In this patient treatment we used the Empress Multi-Cad block, so the stain and glaze with the Ivoclar Empress simple staining kit was used. Colors used in this restoration are applied as follows:

● **Universal Glaze: thin layer, 2- 3 times with ultra-thin brush**
● **A-1 shade: thin area at cervical, to add slight pigment**
● **Blue shade: thin spots on the lingual surface of the incisal edge area**
● **White Shade: thin layer over the mid portion of restoration to match adjacent central incisor.**

Note: If the color is not correct when held next to adjacent natural teeth. Rinse with distilled water and re-apply all steps until the match is acceptable. Digital shade guides and digital photography will help evaluate color.

Once the color and stain is acceptable it is placed on the wafer shelf of the porcelain oven (VITA Vacumat, 40T, Vident, Brea CA.) and glazing cycle will begin. This restoration glazing cycle was 12 minutes. Once the glazing has been completed the restoration is allowed to cool to room temperature, and the it is etched with 25% hydrofluoric acid porcelain etch (LabETCH, PULPDENT Corporation, Watertown, MA) for 5 minutes.

At this time the restoration is ready for cementation.

The following steps were used for cementation:

1. **The prepared tooth is etched with 20% phosphoric acid for 15 seconds.**
2. **Dentin bond solution (Ivoclar, Excite-pen) is placed for 20 seconds, air dried, and cured 20 sec.**
3. **Opti-bond Solo-plus 1, thin layer 20 seconds, air dried, cured 15 sec.**
4. **Opti-bond 2 FL, thin layer on the internal surface of veneer (not cured)**
5. **Flowable composite, shade B1 (Luxa-Flow, Zenith-DMG, Englewood, NJ) flowed onto preparation and internal surface of veneer.**
6. **Veneer is placed in proper position, excess is wiped with small brush, cervical, lingual and inter-proximal.**
7. **Tack cure on cervical area with 3 mm light tip (Practicon, Greenville, NC)**
8. **Inter-proximal serrated blades are placed on the mesial first, cured, then on the distal area.**
9. **Cleaning with small scaler on the lingual, and cured**
10. **Full cure the entire restoration**
11. **Trim off excess with rotary instrument H-132-008, (red band) carbide (Brasseler, USA)**
12. **Polish with high speed, gray and yellow band porcelain polishing bur (# 136c Mini, Shofu, San Marco, California, USA)**

    2 weeks post insertion is shown in Figure 9.

CASE REPORT 2
CAD/CAM CROWN

Anterior central incisor fractured distal edge (Figure 10). Full crown preparation, margination and design (Figures 11,12). 2 Weeks post insertion (Figure 13).

DISCUSSION

In a one-visit protocol many anterior restorations on teeth and implants can be completed predictably with patient chair time reduced by up to 50% and laboratory costs reduced as much as 70%. Although there is a cost for the monthly payment of the intra-oral scanner and Cam milling machine, there is no limit to the amount of restorations that can be fabricated within that one month period. The cost of supplies, lab time, casts, mounting, pick-ups and deliveries, and re-makes due to color and fit, may be more costly than one monthly payment. The time and effort by all parties involved makes the anterior tooth one of the most difficult to match. Shade taking and shade selection has been difficult to reproduce using conventional laboratories, especially when one anterior tooth is involved. Too often this requires many visits and many anxious moments of the patients and clinician to see if it will look pleasing and natural. It is definitely an art form within itself and needs personal and custom education to become predictable. Although these technologies have been perfected over the past 5 years, the true reason for the highly aesthetic restoration has to do with the new block choices that allow for translucency, fluorescence, gradient color, and life- like hues and values. A list of the blocks most commonly used by the author is listed in Table 1. To ensure long-lasting restorations, a

Figure 9: Case 1 two weeks post insertion of final restoration.

Figure 10: Case 2 fractured central incisor.
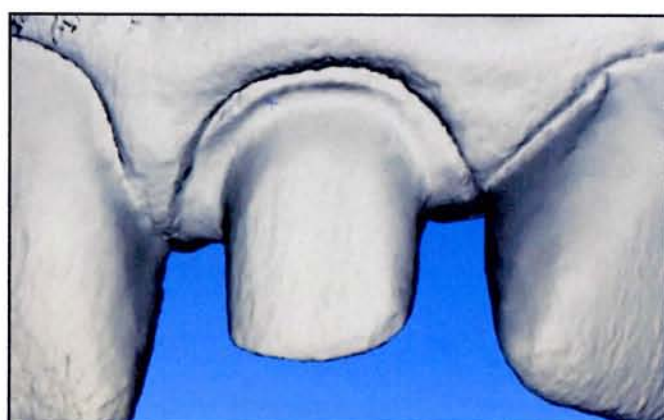

Figure 11: Case 2 full crown preparation.

Figure 12: Case 2 margination window.

Figure 13: Case 2 two weeks post insertion of final restoration.

Table 1: Blocks Most Often Used in CAD/CAM Dentistry

Ivoclar Vivadent	VITA Vident
Empress CAD Multi - inlays, crowns	**Vita Real Life CAD - ant. crowns, veneers**
Empress CAD LT, HT - crowns, veneers	**Vita TriLux Forte - ant. post, crowns**
E-max CAD - post. crowns, implant crowns	**Vita Mark ii CAD - post. Crowns, implant crowns**

final analysis of the occlusion will be evaluated so that on all excursive movements there are no excessive forces on the porcelain veneer. In right and left working movement it is assured that the lower left canine does not come in contact with the lateral incisor restoration.

AUTHOR COMMENTARY

It takes approximately 12 individuals and 18 steps to fabricate a single unit ceramo-metal restoration. The hours spent by the laboratory, staff members and clinicians needs to be re-evaluated. CAD/CAM technology is available to predictably fabricate anterior restorations. The business model for single unit restorations has now been challenged with this technology. The question is not which scanner the clinician should purchase, but rather when this purchase will take place. In addition, when will all clinicians embrace of this technology and how long will it take to become the standard of care? It is the author's position that sooner rather than later may be beneficial for our patients and our profession. ●

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