Second Edition

Quality Resource Guide

Chairside CAD/CAM Dentistry

Author Acknowledgements

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The following commentary highlights fundamental and commonly accepted practices on the subject matter. The information is intended as a general overview and is for educational purposes only. This information does not constitute legal advice, which can only be provided by an attorney.

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The content of this Guide is subject to change as new scientific information becomes available.

Educational Objectives

Following this unit of instruction, the learner should be able to:

1. Understand the systems available for chairside CAD/CAM dentistry.
2. Describe clinical applications for chairside CAD/CAM systems in a dental office.
3. Compare and contrast the restorative materials available for chairside CAD/CAM restorations.
4. Understand published research on accuracy and clinical longevity of chairside CAD/CAM restorations.

Introduction

Computerized Dentistry and Digital Dentistry are terms generally used to describe the application of Computer Assisted Design, Computer Assisted Machining (CAD/CAM) to clinical dentistry. Several articles have described the process in considerable detail.[1-4] There are three interconnected processes included in the CAD/CAM workflow:[1]

1. Recording the geometry of the patient's intraoral condition to a computer program using an intraoral camera or intraoral scanner (IOS) to record a digital impression;

2. Creating a volumetric design of the restoration with the computer software program, and;

3. Producing the designed restoration with a machining device (a subtractive milling chamber that cuts or mills the final restoration from a preformed block of restorative material).

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Computerized dentistry systems for use in the dental office can arbitrarily be divided into two general categories:

1. Digital impression systems that focus on the first step of the CAD/CAM process (accurately recording the patient's intraoral condition). The digital file is transmitted to the dental laboratory for fabrication of the desired restoration. More information on Digital Impressions systems can be found in the MetLife Quality Resource Guide – Fasbinder DJ, *Digital Dental Impressions,* 2017.

2. Chairside CAD/CAM systems, which also rely on a digital impression, include the ability to design and mill the restoration employing all three steps of the CAD/CAM process in the dental office, usually during a single dental appointment. This affords a significant improvement in efficiency and convenience for the patient as there is no need for a temporary restoration or a second appointment to deliver the final restoration.

Chairside CAD/CAM Systems

The first chairside CAD/CAM systems were marketed as complete systems including the camera, computer, design software, and milling chamber. The CEREC system (*Dentsply Sirona*) was the first chairside CAD/CAM system marketed to dentistry more than 30 years ago.[5] The *CEREC OmniCam* consists of a portable unit or cart that contains the imaging camera, a monitor, and a computer that communicates with a dedicated milling chamber. Some clinicians may view the portable cart as another piece of equipment for which space must be found in the office. However, the portable unit offers an advantage in that the manufacturer has ensured the compatibility and performance of the software and hardware housed in the portable unit.

Many dental offices have computers in each operatory and some clinicians have questioned if the camera could be directly installed on their in-office computers rather than rolling a portable unit between operatories. The *E4D Dentist™* system (*D4D Technologies*) was introduced in 2007.[6] Their NEVO system features a portable camera connected to a laptop computer rather than encased in a rolling, portable unit. *Planmeca* invested in the company in 2013 and now markets *PlanScan CAD/CAM Restoration System*, driven by *E4D Technologies*. The *CS 3500 Intraoral Scanner (Carestream Dental)* also introduced a direct-USB connection camera that can be used with a laptop computer rather than being housed in a portable cart unit. Although purported to be a more streamlined set-up, the laptop computer still must be located adjacent to the operating field for direct access to the imaging camera on either an adjacent counter or a cart.

Another innovation for chairside CAD/CAM systems is the open architecture options offered for several digital impression systems. The *E4D Design Center* and E4D milling chamber became one of the first trusted connections with the *True Definition Scanner* (*3M*) in October 2012. This provided an opportunity for dentists using the *True Definition* digital impression system to also create restorations in-office. Data files recorded by the *True Definition Scanner* can be directly inputted into the *E4D Design Center* for in-office design of inlays, onlays, crowns, and veneers milled in the *E4D* milling unit. The *iTero Intraoral Scanner* (*Align Technology*) was similarly announced as being compatible with the *E4D* chairside design software and milling chamber in October 2013.

The *IOS FastDesign system* by IOS Technologies was founded in 2007 and acquired by Glidewell Laboratories in 2012. It includes the *FastDesign CAD software* and the *TS 150* in-office milling unit. It was announced in March 2013 that the TS-150 in-office milling machine became a trusted connection of the *True Definition Scanner* as well as integrated with the *TRIOS* digital impression solution (*3Shape*). In 2014 it was also integrated with the iTero IOS device. Digital files may be transmitted from all three IOS devices to the *IOS FastDesign* CAD software for fabrication of in-office inlays, onlays and crowns with a *TS-150* milling machine.

A more recent introduction by companies partnering to create an in-office solution is the P*rograMill One mill* by Ivoclar. It was introduced in 2017 and is a five-axis milling machine with an innovative milling process in which the workpiece rotates around the tool, ensuring that the tool never leaves the block, reportedly leading to shorter milling times. It is used in combination with the *TRIOS scanner* and design software by *3Shape* for chairside CAD/CAM restorations.

Maintenance requirements for in-office milling chambers vary between systems based on the manufacturer's recommendations. All are water-lubricated milling systems with self-contained, closed water systems that recycle the water during milling. The water chamber needs to be cleaned periodically. Lubricant is usually added to the water to reduce friction and control heat during the milling process. The milling diamonds wear and will require changing, with the frequency of change based on the size and type of materials milled. High strength porcelain systems are more detrimental to milling diamonds than resin based restorative materials. Manufacturers also generally suggest a yearly preventive maintenance routine. Several CEREC milling units now allow for the use of carbide burs to mill zirconia blocks in a dry subtractive process. There is a vacuum connected to the milling chamber to minimize the milling dust from zirconia. The vacuum and milling chamber has periodic cleaning required to ensure consistent results.

Several of the chairside CAD/CAM systems also have the capability of functioning as a digital impression system providing flexibility to the provider to fabricate an appropriate restoration based on the specific clinical requirements of the case. The *Sirona Connect* system, the *Planmeca Romexis Cloud Service* and the *CS Connect system* offer the opportunity to use chairside systems as purely digital impression techniques for cases the clinician desires to be fabricated in a dental laboratory. This offers a valuable tool for case fabrication by offering the full range of laboratory services in addition to the in-office options from the digital scanning.

Initial applications for chairside CAD/CAM systems were to produce single tooth restorations including inlays, onlays, veneers and crowns. Some of the systems have evolved to have the ability to fabricate short-span fixed partial dentures (FPDs), custom abutments, adhesively bonded fixed partial dentures (*Maryland Bridges*) and temporary restorations in the dental office. In addition, by also connecting as digital impression systems expanded services such as orthodontic clear aligners, bitesplints, surgical guides, and sleep apnea devices may be fabricated

As .stl files have become available for export from both digital impression systems and chairside CAD/CAM systems, 3D printing has become an alternative to subtractive milling for manufacturing of the CAD design. Although there are no current restorative materials available for 3D printing, clear orthodontic aligners, bitesplints, and implant surgical guides are readily 3D printed by a number of in-office printers.

One rapidly growing application for in-office digital technology is for dental implant therapy. There are two primary applications. The first is during the planning phase of implant treatment. Cone Beam Computer Tomography (CBCT) has become a preferred pre-operative 3D diagnostic tool for optimizing the surgical placement of the implant, and CAD/CAM designed surgical guides can be created to guide surgical implant placement. Several chairside CAD/CAM systems have the capability to export the .stl file from their software program and by using a second software program, merge it with the dicom file from the CBCT to provide a totally integrated prosthetic-influenced refinement for implant placement. Surgical guides can also be ordered from the digital planning system, to be created either at a dental laboratory or in-office milling chamber. The *CEREC OmniCam* integrates seamlessly with the *Galileos* CBCT through proprietary *Sirona Galaxis* software. The *PlanScan* and *Planmeca Romexis* also allow integration of files with several CBCT systems. In addition there are a number of third party software programs, such as *Blue Sky Plan* (*Blue Sky Bio*), *Invivo6* (*Anatomage*), and *Simplant* (D*entsply Sirona*), that can import dicom and .stl files from chairside CAD/CAM system for implant planning and surgical guide fabrication.

A second implant-specific application for CAD/CAM is the in-office design and fabrication of custom abutments and restorations for implants. The introduction of *Scan Posts* and *Scan Bodies* by *Sirona Dental* provides intraoral digital fixture level impressions that can be matched with overlaying soft tissue scans for the development and design of custom abutments for ten different implant systems using the *CEREC OmniCam*.

Chairside CAD/CAM Clinical Workflow

The clinical workflow to fabricate a chairside restoration with a CAD/CAM system is relatively similar for each system. Differences between systems are a function of the unique cameras, design software packages, and milling chambers used by each system. Once the tooth preparation has been completed, the margins are visualized for recording and the area is isolated from moisture. The tooth preparation and adjacent teeth are then scanned using the camera. A scan of the facial surfaces of the dentition in maximum intercuspation is used to align the scanned opposing arches or quadrants. The margin of the preparation is drawn on the virtual model to identify the limits of the restoration within the software program. The software program then calculates and proposes the initial design of the restoration on the virtual model. The software program also contains various evaluation tools and editing tools to refine the proposal based on the specific needs of the case and desires of the clinician. Refinements may include items such as the size and intensity of the proximal contacts, location and intensity of the occlusal contacts and restoration contour. The final restoration design is transmitted to the milling chamber where a manufactured block of the desired restorative material is milled to match the full contour design from the software program. Once the fit of the restoration has been verified on the tooth preparation, it is adhesively cemented with resin cement. Final contouring and polishing of the restoration is completed using a series of microfine diamonds and polishing instruments. More recent developments have improved the development of the occlusion on more complex cases through the use of functional articulation software tools similar to what can be done with a semi-adjustable articulator.

Accuracy of Chairside CAD/CAM Systems

There is over 25 years of laboratory and clinical research confirming the accuracy of *CEREC* chairside CAD/CAM restorations.[7,8] A recent systematic review of CAD/CAM restoration margin fit reviewed over 230 studies published between January 2000 and October 2012 reported on 26 different CAD/CAM systems.[9] The only chairside CAD/CAM system included in the review was the *CEREC* system. Eleven studies (combined) reported an average margin gap of 76.9μm for *CEREC* inlays and onlays. Nine studies (combined) showed an average margin gap of 65.3μm for CEREC crowns. All the studies used either *CEREC 2*, *CEREC 3* or *CEREC 3D* systems (precursors to the current *CEREC BlueCam* and *OmniCam* systems). One *in vitro* study measured the fit of CEREC crowns compared to those fabricated using a variety of laboratory techniques.[10] There was no significant difference in crown margin fit between the *CEREC* chairside CAD/CAM and laboratory fabricated techniques. *CEREC* crowns had a mean margin gap of 65.5 ± 24.7μm (ceramic) and 66.0 ± 14.1μm (composite).

The *PlanScan* system has been recently introduced for chairside CAD/CAM restorations and has limited published research on margin fit and internal adaptation. One study measured the marginal fit of *E4D* fabricated crowns on typodont preparations completed by 62 different clinicians.[11] Each of the crown preparations was judged as good, fair, or poor using both a replica technique and visual examination looking at common criteria for ceramic restorations. The quality of the preparation significantly influenced the accuracy of the margin fit ($p<0.05$). Ideal preparations had mean margin gaps of 38.5μm, fair preparations had mean margin gaps of 58.3µm, and poor preparations had mean margin gaps of 90.1µm. A second *in vitro* study measured the margin fit and internal adaptation of E4D fabricated IPS e.max CAD crowns.[12] (Mean margin gaps varied from 79.32 ± 63.18 µm for buccal margins and 50.39 ± 35.98 µm for lingual margins.

Chairside Restorative Materials

Chairside CAD/CAM restorations are monolithic. This means that the entire restoration is composed of a single material rather than a bilayer restoration consisting of a coping and veneer layer. Monolithic restorations have several unique features. Dental manufacturers produce the monolithic materials resulting in a dense, homogenous material without porosity or voids, which maximizes the material's physical properties. The restorative materials are delivered in a solid block form on a milling mandrel specific to the chairside CAD/CAM milling chamber. Current milling systems utilize a subtractive wet-grinding process to shape or mill the desired restoration contour from the preformed blocks based on the volumetric design created with the software program. These materials can be efficiently milled in a time period suitable for delivery at the same appointment the tooth is prepared and imaged, and the restoration is designed. Chairside milling time is usually less than 15 minutes, with many restorations being milled in less than 10 minutes. Times in excess of 20 minutes are usually considered "extended" milling times. Post-milling handling time is a key consideration for the financial investment required for some of the restorative block materials as a porcelain oven may be required to fire the milled restoration prior to delivery.

There are a number of categories of restorative materials available for chairside CAD/CAM restorations.[13,14] A number of manufacturers market materials specific for the various systems (**Table 1**). Each of these categories of materials offer unique features designed for their specific clinical applications. The chairside CAD/CAM system represents the process by which these materials are fabricated into a restoration, while the clinical outcome of the restoration

Table 1 - Block availability for each chairside CAD/CAM milling system

Material	Brand	*CEREC*	*PlanScan*	*Carestream*
Adhesive Ceramic leucite-reinforced	*IPS Empress CAD (Ivoclar)*	X	X	
Adhesive Ceramic feldspathic	*Vita Mark II (Vident)* *Sirona Blocs (Sirona)*	X X		X
High Strength Ceramic lithium disilicate zirconia-lithium silicate lithium silicate	*IPS e.max CAD (Ivoclar)* *Celtra Duo (Dentsply)* *Obsidian (Glidewell)*	X X	X	
Hybrid Ceramic nano-ceramic hybrid ceramic	*Lava Ultimate (3M ESPE)* *Cerasmart (GC America)* *Enamic (Vident)*	X X X	X	X
Composite	*Paradigm MZ100 (3M ESPE)*	X		
Zirconia	*CEREC Zirconia (Dentsply Sirona)* *Katana (Noritake)*	X X		
Temporary Acrylic PMMA Microfilled	*TelioCAD (Ivoclar)* *Vita CAD-Temp (Vident)*	X X	X	

is primarily determined by the choice of the restorative material. Esthetic ceramic materials contain a glass component and have very good translucency and moderate flexural strength. *Vita Mark II* (*Vident*) and *CEREC Blocs* (*Sirona Dental Systems*) are feldspathic glass ceramics. Both materials are fine-grained, homogeneous feldspathic porcelain with an average particle size of 4 microns. The small particle size allows for a high gloss finish and minimizes abrasive wear of the opposing dentition.[15] *IPS EmpressCAD* (*Ivoclar*) is a 35% to 45% leucite-reinforced glass-ceramic similar to *IPS Empress 1* but with a finer particle size of 1 – 5 microns. The presence of the glass component in these materials permits them to be etched with hydrofluoric acid, treated with a silane coupler, and adhesively bonded to the tooth using resin cement. Adhesive bonding of these materials is critical to their long-term success, as they do not have sufficient strength to permit conventional cementation with either resin modified glass ionomer or traditional glass ionomer cements. The adhesive bonding not only provides retention for the restoration, it also contributes to the clinical strength of the restoration to resist fracture.

IPS e.max CAD (*Ivoclar*) [lithium disilicate] has substantially greater flexural strength and fracture toughness compared to esthetic ceramic materials.[16,17] These blocks are partially crystallized in a "soft" state, allowing the block to be easily milled without excessive diamond bur wear or damage to the material. After the lithium disilicate restoration is milled, it must undergo a two-stage firing process in a porcelain oven under vacuum to complete the crystallization of the lithium disilicate. This creates a glass ceramic with a fine grain size of approximately 1.5μm, with 70% crystal volume incorporated in a glass matrix. A recently introduced zirconia-reinforced, lithium silicate material (*Celtra Duo* [*Dentsply Sirona*]) comes as a fully-crystallized block that purportedly allows the option to either polish the material after milling resulting in a flexural strength of 210 MPa, or glazing in a porcelain oven resulting in a flexural strength of 370 MPa.[15]

Recently introduced resilient ceramic materials are designed to offer the benefits of easy handling similar to composite materials, but with the strength and surface finish of ceramics without the brittleness. *Lava Ultimate* (*3M*) is a nano-ceramic containing silica particles of 20 nm, zirconia particles of 4-11 nm, and agglomerated nano-sized particles of silica and zirconia all embedded in a highly cross-linked polymer matrix, with approximately an 80% ceramic load. *Vita Enamic* (*Vident*) is a hybrid ceramic comprised of a dual-network structure where ceramic and polymer are merged together. The manufacturer claims this material incorporates the benefits of ceramic and composite materials in one product, offering both strength and elasticity. It is advocated for based on its crack prevention capability. *Cerasmart* (*GC America*) is a flexible nano-ceramic matrix with a homogenous distribution of nano-ceramic filler. The manufacturer claims it is a high strength (210 MPa) and force absorbing material for both natural teeth and implant applications.

Two types of composite resin blocks are available for use in chairside CAD/CAM applications. One type is designed for final restorations and the other is used for long-term temporary restorations. *Paradigm MZ100* (*3M/ESPE*) is a composite block based on the Z100 composite chemistry and relies on a proprietary processing technique to maximize the degree of cross-linking.[16] *Paradigm MZ100* has zirconia-silica filler particles and is 85% filled by weight with an average particle size of 0.6μm. It is radiopaque and recommended for definitive composite restoration applications. CAD/CAM temporary blocks are available for chairside fabrication of long-term temporary crowns and FPDs. The CAD/CAM process avoids the air-inhibited layer present on conventional self-cure or VLC acrylics as well as polymerization shrinkage. *Vita CAD-Temp blocks* (*Vident*) is a highly crosslinked, microfilled polymer available in extended block sizes, including 40 mm and 55 mm lengths, to accommodate multiple unit FPDs. *Telio CAD* (*Ivoclar*) is a millable cross-linked polymethyl methacrylate block that is part of the *Telio System* (a self-curing composite, desensitizer, and cement). It is also available in 40 mm and 55 mm size blocks.

The newest category of materials available for in-office use is full contour zirconia. The change that has made it available is not actually part of the CAD/CAM process, but rather an innovation in the porcelain oven and the reduced time required for sintering the zirconia after it is milled. Conventional zirconia sintering times approach 6 to 8 hours in a dental laboratory. The *SpeedFire Oven* (*Dentsply Sirona*) can sinter single unit zirconia crowns in under 20 minutes moving it into a single appointment procedure. There are no oven settings to modify since the *SpeedFire oven* is integrated into the *CEREC* software program. The *CEREC* software program uses the final restoration design to calculate the correct oven settings for sintering the restoration. This is automatically transferred to the *SpeedFire oven* following milling. Other sintering ovens have been introduced with speed sintering cycles for in-office use including the *Programat CS4* (*Ivoclar*).

Clinical Longevity

There are a significant number of published studies that report the long-term clinical performance of *CEREC* restorations, in contrast with a general lack of clinical evidence regarding other chairside systems. This is primarily due to the fact that the *CEREC System* has been available since the early 1990's and other systems have been more recently introduced.

A systematic review of 29 clinical studies (2,862 CEREC ceramic inlays), reported a survival rate of 97.4% after a period of 4.2 years.[17] The primary mode of failure was fracture of the ceramic restoration. Less common failure modes included fracture of the tooth, wear of the cement, and postoperative sensitivity. Another systematic review focused on survival rates of longer-term clinical trials.[18] A total of 1,957 single-tooth restorations (98%

anterior) fabricated with CAD/CAM technology were followed more for than 3 years of functional service. The calculated failure rate was 1.75% per year estimated per 100 restoration years, based on the survival rate of 91.6% after 5 years. The most common modes of failure reported were fractures of the restoration or the tooth.

A number of longer-term studies of *CEREC* restorations have also been published. One study evaluated the longitudinal performance of 310 CEREC onlays.[19] One operator placed all restorations with an effort to create all preparation margins within enamel. After 8 years of follow up, 286 paired onlays were available for evaluation. The calculated survival probability was 99.3%. The only two failures observed in this study were fractures on maxillary premolars of one patient with occlusal parafunction.

A study of 2,328 inlays and onlays for 794 patients in a private practice reported 35 failures over 9 years.[20] The Kaplan-Meier survival probability reported was 97.4% at 5 years and 95.5% at 9 years. Another study reported a Kaplan-Meier survival probability of 90.4% after 10 years for 200 *Vitablocks Mark II* restorations placed in 108 patients in private practice.[21] In a follow-up report of that study, the authors reported an 88.7% success rate at 17 years.[22] A series of papers from 1991 to 2006 reported the clinical status of 1,011 CEREC restorations for up to 18 years.[23-25] The survival probability was 95% after 5 years, 91.6% after 7 years and 90% at 10 years. It declined to 84.9% at 16.7 years.

There are a few studies of high strength chairside CAD/CAM restorations. One reported the performance of chairside CAD/CAM-generated IPS e.max CAD crowns.[26] A *CEREC* system was used to deliver 41 *IPS e.max CAD* full-contour crowns (34 patients). One crown exhibited secondary caries and two crowns received root canal treatment after two years. An ongoing longitudinal clinical study is evaluating the clinical performance of 100 *IPS e.max CAD* full-contour crowns.[27,28] The first 62 crowns were delivered with a self-etching bonding agent and resin cement (*MultiLink Automix [Ivoclar]*) or an experimental self-adhesive resin cement. A second group of 38 crowns was placed at a later time using a newer self-etching, self-curing, cement (*SpeedCem [Ivoclar]*). Each of the full-contour crowns was placed in a single treatment appointment with the *CEREC* system. There were no reported failures after two years and no chipping or cracking were clinically visible. The percent alpha score (the percentage of examined restorations with an evaluated characteristic not significantly different from the baseline evaluation) were above 95% for color match at all recall intervals and remained at 100% for margin adaptation and absence of caries for all crowns at five years. Four crowns debonded, (3 cemented with the experimental cement [13, 20 and 36 months] and 1 with *MultiLink Automix* [36 months]). One crown cemented with *SpeedCem* presented evidence of crown fracture without loss of material at 48 months.[29]

In summary, the current state of the evidence on the clinical performance of CAD/CAM generated restorations is favorable and indicates that these restorations perform predictably well. Adhesive retention of these restorations does not seem to be a significant issue when careful luting technique is followed. The incidence of post-operative sensitivity and/or recurrent caries is generally an insignificant finding. Margin adaptation is initially very good, however there is a tendency for increase in margin discontinuity and discoloration over time as a function of the wear of the resin luting cement. Irreversible pulpitis is a rare finding and can generally be attributed to extensive tooth damage pre-operatively. A small tendency for material chipping and fracture may happen over time.

Conclusion

The clinical application of computerized technology is one of the most significant developments for restorative dentistry in recent years. Laboratory and clinical evidence confirms the accuracy of chairside CAD/CAM restorations. A significant number of clinical studies have documented the clinical success and durability of the restorations. Ongoing developments of computerized systems continue to expand the clinical applications to multiple unit restorations and implants with the introduction of newer materials specifically designed for chairside CAD/CAM restorations.

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POST-TEST

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1. **The CAD/CAM chairside systems which are most similar are**
   a. CEREC and IOS FastDesign systems
   b. CEREC and E4D Dentist NEVO systems
   c. CEREC and PlanScan CAD/CAM Restoration systems
   d. IOS FastDesign and PlanScan CAD/CAM systems
   e. IOS FastDesign and E4D Dentist NEVO systems

2. **Which of the following clinical applications are not possible with chairside CAD/CAM systems?**
   a. Single tooth restorations (inlays, onlays, veneers and crowns)
   b. Short-span fixed partial dentures, adhesively bonded fixed partial dentures, temporary fixed partial dentures
   c. Custom abutments, screw-retained crowns, splinted implant restorations
   d. Surgical guides for dental implant therapy

3. **Regardless of the CAD/CAM system used, the workflow to fabricate a restoration is relatively similar.**
   a. True
   b. False

4. **The resilient material that is designed for easy handling, with strength and surface finish of ceramics without the brittleness, and which is marketed for use in all of the CAD/CAM milling systems discussed is:**
   a. leucite reinforced ceramic
   b. zirconia-lithium silicate ceramic
   c. Nano-ceramic
   d. Composite
   e. PMMA temporary acrylic

5. **What is the outcome of the *in vitro* study that measured the fit of CEREC crowns compared to those fabricated using a variety of laboratory techniques?**
   a. There was a significant difference in crown margin fit.
   b. Mean margin gaps varied from 79.32 ± 63.18μm for buccal margins and 50.39 ± 35.98μm for lingual margins.
   c. There was no significant difference in crown margin fit.
   d. The quality of the preparation significantly influenced the accuracy of the margin fit, and ideal preparations had a mean margin gap of 38.5μm.

6. **Chairside milling times in excess of ___ minutes are usually considered "extended" milling times.**
   a. 5 minutes
   b. 10 minutes
   c. 15 minutes
   d. 20 minutes
   e. 25 minutes

7. **Chairside CAD/CAM restorations are:**
   a. composed of a single, porous material
   b. composed of a single, dense material
   c. composed of a coping and veneer layer
   d. composed of a bilayer restoration

8. **The clinical outcome of the restoration is primarily determined by the choice of the restorative material. The adhesive bonding provides retention and contributes to the strength of the restoration to resist fractures.**
   a. Both sentences are true.
   b. Both sentences are false.
   c. The first sentence is true and the second sentence is false.
   d. The first sentence is false and the second sentence is true.

9. **Which is a portable direct-USB connection camera that can be used with a laptop computer:**
   a. True Definition Scanner (3M ESPE)
   b. TRIOS Scanner (3Shape)l)
   c. CS 3500 Intraoral Scanner (Carestream Dental)
   d. CEREC OmniCam (Sirona Dental Systems)
   e. iTero Intraoral Scanner (Align Technology)

10. **The most common mode of failure reported for CEREC ceramic inlays in clinical studies is:**
    a. fracture of the tooth
    b. wear of the cement
    c. fraction of the restoration
    d. postoperative sensitivity

Registration/Certification Information (Necessary for proper certification)

Name (Last, First, Middle Initial): ________________________________

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City: ________________________ State: ________ Zip: ____________

Telephone: ________________________ Fax: ________________________

Date of Birth: ________________________ Email: ________________________

State(s) of Licensure: ________________________ License Number(s): ________________

Preferred Dentist Program ID Number: ________________ ☐ Check Box If Not A PDP Member

AGD Mastership: ☐ Yes ☐ No

AGD Fellowship: ☐ Yes ☐ No Date: ____________

Please Check One: ☐ General Practitioner ☐ Specialist ☐ Dental Hygienist ☐ Other

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Evaluation - Chairside CAD/CAM Dentistry 2nd Edition

Providing dentists with the opportunity for continuing dental education is an essential part of MetLife's commitment to helping dentists improve the oral health of their patients through education. You can help in this effort by providing feedback regarding the continuing education offering you have just completed.

Please respond to the statements below by checking the appropriate box, using the scale on the right.

1 = POOR 5 = Excellent

	1	2	3	4	5	
1. How well did this course meet its stated educational objectives?	☐	☐	☐	☐	☐	
2. How would you rate the quality of the content?	☐	☐	☐	☐	☐	
3. Please rate the effectiveness of the author.	☐	☐	☐	☐	☐	
4. Please rate the written materials and visual aids used.	☐	☐	☐	☐	☐	
5. The use of evidence-based dentistry on the topic when applicable.	☐	☐	☐	☐	☐	☐ N/A
6. How relevant was the course material to your practice?	☐	☐	☐	☐	☐	
7. The extent to which the course enhanced your current knowledge or skill?	☐	☐	☐	☐	☐	
8. The level to which your personal objectives were satisfied.	☐	☐	☐	☐	☐	
9. Please rate the administrative arrangements for this course.	☐	☐	☐	☐	☐	

10. How likely are you to recommend MetLife's CE program to a friend or colleague? *(please circle one number below:)*

10	9	8	7	6	5	4	3	2	1	0
extremely likely					neutral					not likely at all

What is the primary reason for your 0-10 recommendation rating above?

11. Please identify future topics that you would like to see:

Thank you for your time and feedback.