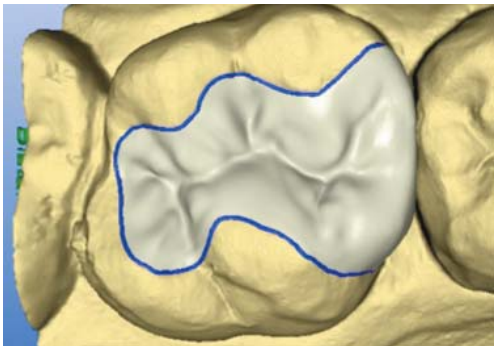
Digitally designed restorations

By James Klim, DDS, FAGD, AAACD

"Whereas the CEREC chairside CAD/CAM system has always been an interesting 'process', many dentists who looked at the system at varying times during its 24-year evolution have been less than satisfied with the 'outcomes' it produced. The myth that CEREC restorations don't fit and are ugly, however, is now no longer true..."



Technological breakthroughs in computer-aided design and manufacturing (CAD/CAM) have created a comparable alternative to laboratory-generated indirect ceramic restorations.

The digitally milled restorative process has now been available for over 20 years and like most new technologies, chairside CAD/CAM has progressed through an evolution in both its hardware and software capabilities.

Whereas the CEREC chairside CAD/CAM system has always been an interesting "process", many dentists who looked at the system at varying times during its 24-year evolution have been less than satisfied with the "outcomes" it produced. However, as a CEREC skeptic for many years myself, I can now say that the myth that CEREC restorations don't fit and are ugly is no longer true.

Figure 1a. Pre-operative quadrant. CAD/CAM is ideal for conservative design of amalgam replacement restorations and full crowns.

Figure 1b. Upper left arch after conservative inlay/onlay CEREC restorations on first and second premolars. Restored with Empress CAD B1 Multi blocks. Patient was so pleased with the one appointment process, she chose to improve the molars.

Figure 1c. Soft tissue troughing with Navigator diode laser facilitates clean, crisp margins and tissue welding for hemorrhage control.

Figure 1d. Bite registration with Luxa-Bite and CEREC Opti Spray application ready for optical bite impression.

Figure 1e. CEREC optical impression.

Figure 1f. CEREC Opti Spray reflective medium for an accurate and precise optical impression.

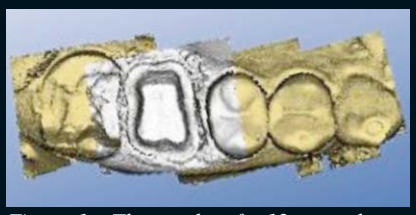


Figure 1g. The results of a 12 second CEREC optical impression.

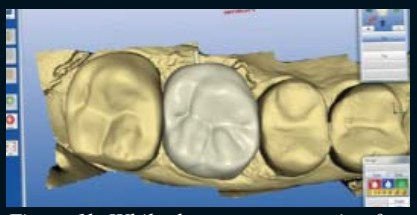


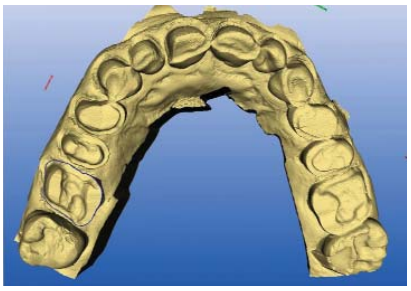
Figure 1h. While the e.max restoration for the second molar is milling, the CEREC software has the design features to sequentially propose the next virtual restoration.

Figure 1i. Single-step stain and glaze crystallization of e.max B1 HT provides the CAD/CAM clinical theatre the most functional and aesthetic ceramic available today.

Figure 1j. Completed CAD/CAM quadrant following bonding of the molars.

Figures 3a-b. Anterior Crown and Veneer.

Figures 2a-b. Conservative CEREC inlay/onlay restorations replacing amalgams.


Figures 4a-c. Completed full upper arch demonstrates preferable cusp angles and occlusal plane alignment to best the functional envelope. This was all planned from the initial diagnostics and implemented via wax-up prototype that was scanned and then used as a 3D matrix in the CEREC AC virtual design process.



Figures 5a-c. Fracture lateral incisor root is replaced with an implant and CEREC AC technology designed and machined final implant crown. With the wide variety of aesthetic blocks to choose from, the proper ceramic transparency, gradient, and colour was selected and milled with precision.

Its fifth generation advancement, the all new Biogeneric CEREC AC Bluecam, arrived on the clinical scene in January 2009 and the critical perception of this technology should now be reevaluated by anyone who dismissed it for reasons of clinical efficacy in the past. Today's CEREC AC Bluecam boasts an ease of digital capture; software virtual design; precision of milling and fit; and an impressive selection of aesthetic ceramic blocks.

Most importantly however, CEREC restorations are comparable and in some cases better than laboratory-produced restorations from both a clinical and aesthetic standpoint; and with a workflow that increases efficiencies within the dental practice.

As an example, most CEREC restorations are placed in a single appointment without the need for an impression or a provisional. With proper adhesive technique, bonded CAD/CAM conservative restorations recapture and exceed virgin tooth strength.

CAD/CAM milled restorations are ideal for conservative amalgam replacements and patients, in particular, enjoy the minimal tooth reduction associated with it's preparation design. In addition to enamel conservation, CEREC restorations have the clinical longevity of gold according to several clinical studies.

When using the current generation bonding adhesives according to manufacturer instructions, the CEREC ceramic will re-create tooth-like strength. This results from the micro-adhesion between the ceramic and the enamel and dentin within the tooth.

The software used to design the restoration precisely stitches together multiple digital images captrured in situ by the CEREC Bluecam to propose an effective virtual die.

Biogeneric software takes over the design process for inlay and onlay restorations drawing from hundreds of examples of natural teeth in the software's data bank library. Interproximal contacts are precisely set automatically, allowing the operator to design multiple restorations from a single virtual quadrant die.

The precision milling of the CEREC MC XL milling centre is achieved with a 7.5µm milling resolution. The operator can expect the marginal precision integrity of gold.

Preset design parameters provide the operator with full control over interproximal contact firmness, occlusal contact strength/design and the cement spacer.

The advantage of a milled ceramic over pressed or laboratory-fabricated ceramics is in the inherent strength and quality of the material. Milled ceramic blocks have the lowest probability of internal flaws (porosity, inconsistent firing, and cooling shrinkage stress), enhancing functional performance.

The aesthetic challenges of historical CAD/CAM restorations have been solved with a wider selection of colour, transparency, and multilayered blocks. Before milling, the designed virtual restoration is positioned in the virtual gradated block to adjust the gradation of the restoration for an ideal clinical match.

The finishing process involves a light polish of the margins with a diamond finishing wheel and inverted cone lab diamond to refine the primary grooves.

Anterior tooth design is very similar to posterior capture and design protocols. CEREC software comes with a library of multiple pre-designed templates for both anterior and posterior full crowns. Additional aesthetic design options capture the contralateral tooth. The software will mirror the proposal for the restoration design.

A hand staining and glazing technique allows individual characterization if required.

Chairside CAD/CAM restorations have a broad clinical application based on the clinician's skill and experience with all-ceramic restorations. The primary clinical limitations are isolation requirements for sound adhesive techniques, occlusal space limitation, proper preparation, as well as ceramic volume design to meet the clinical biomechanical demands of the clinical application.



Figures 6a-c. Implant Aesthetic Restoration and Veneers.


Figures 7a-b. Anterior CAD/CAM Aesthetics.

The limitations are no longer in the precision of the CEREC system. The limitations are now primarily in the expectation, skill level and experience of the operator.

Having now experienced the CEREC 3D system for several years in my own practice and the CEREC AC Bluecam, I can testify with an enthusiastic and honest heart, it is the most satisfying decision I have made in my 25-year career.

Having bonded restorations since the mid 80s, my experience is vast with all ceramic applications. I have traveled the learning curve and have high confidence in what dental adhesion and proper technique will accomplish with predictable ceramic dentistry. The CEREC AC Bluecam ceramic restoration has taken my clinical results to a whole new level.

I really believe that the CAD/CAM restoration is becoming the new gold standard in dentistry. The historical reputation of CEREC is a myth. The new CEREC AC Bluecam with the Biogeneric software is reality.

About the author

Dr James Klim is an international speaker, author and instructor on dental technology, practice development and aesthetic dentistry and has taught at several advanced post graduate institutes around the US. He has been awarded fellowships from the Academy of General Dentistry and Academy of Dental-Facial Esthetics and currently has a full time restorative practice in Santa Rosa, California. He is the founder and director of CADStar™, a learning centre for advanced CEREC education.

CAD/CAM literature references

CAD/CAM now equals the laboratory restoration in marginal integrity and precise fit

1. Estafan D, Dussetschleger F, Agosta C, et al. Scanning electron microscope evaluation of CEREC II and CEREC III inlays [published correction appears in Gen Dent. 2003;51:583]. Gen Dent. 2003;51:450-454.
2. Nakamura T, Dei N, Kojima T, et al. Marginal and internal fit of CEREC 3 CAD/CAM all-ceramic crowns. Int J Prosthodont. 2003;16:244-248.
3. Bindl A, Mörmann WH. Clinical and SEM evaluation of all-ceramic chairside CAD/CAM-generated partial crowns. Eur J Oral Sci. 2003;111:163-169.

CAD/CAM restorations equal the clinical longevity of gold

4. Posselt A, Kerschbaum T. Longevity of 2328 chairside CEREC inlays and onlays. Int J Comput Dent. 2003;6:231-248.
5. Otto T, De Nisco S. Computer-aided ceramic restorations: a 10-year prospective clinical study of CEREC CAD/CAM inlays and onlays. Int J Prosthodont. 2002;15:122-128.
6. Martin N, Jedynakiewicz NM. Clinical performance of CEREC ceramic inlays: a systematic review. Dent Mater. 1999;15:54-61.
7. Bremer BD, Geursten W. Molar fracture resistance after adhesive restoration with ceramic inlays or resin-based composites. Am J Dent. 2001;14:216-220.

CAD/CAM restorations recapture and exceed virgin tooth strength

8. Hickel R, Manhart J. Longevity of restorations in posterior teeth and reasons for failure. J Adhes Dent. 2001;3:45-64.
9. Tinschert J, Zwez D, Marx R, et al. Structural reliability of alumina-, feldspar-, leucite-, mica-, and zirconia-based ceramics. J Dent. 2000;28:529-535.
10. Chen HY, Hickel R, Setcos JC, et al. Effects of surface finish and fatigue testing on the fracture strength of CAD/CAM and pressed-ceramic crowns. J Prosthet Dent. 1999;82:468-475.
11. Jedynakiewicz NM, Martin N. CEREC: science, research, and clinical application. Compend Contin Educ Dent. 2001;22(6 Suppl):11-12.

Digitally designed restorations are anatomically correct offering control over occlusal contact placement

12. Mehl A, Blanz V. New procedure for fully automatic occlusal surface reconstruction by means of a biogeneric tooth model. Int J Comput Dent. 2005;8:13-25.
13. Mehl A, Blanz V, Hickel R. A new mathematical process for the calculation of average forms of teeth. J Prosthet Dent. 2005;94:561-566
14. Mehl A, Blanz V, Hickel R. Biogeneric tooth: A new mathematical representation for tooth morphology in lower first molars [published correction appears in Eur J Oral Sci. 2005;113:499]. Eur J Oral Sci. 2005;133:333-340.

There are inherent clinical advantages of CAD/CAM ceramics over traditional laboratory restorations

15. CRA Newsletter. 2001;25:3-4.
16. Chen HY, Hickel R, Setcos JC, et al. Effects of surface finish and fatigue testing on the fracture strength of CAD- CAM and pressedceramic crowns. J Prosthet Dent. 1999; 82:468-475.
17. McLaren E. CAD/CAM all-ceramic restorations achieving ultimate esthetics: clinical and laboratory perspective.Paper presented at the Academy of Computerized Dentistry of North America Annual Meeting; June 2006; Scottsdale, AZ.
18. Wiedhahn K. From blue to white: new high-strength material for Cerec - IPS e.max CAD LT. Int J Comput Dent. 2007;10:79-91.
19. Klim J. Clinical Applications of Chairside CAD/CAM Dentistry. CompendContin Educ Dent. 2007; Vol. 28, No. 11 (Suppl 2): 19-26.