# SPECTRUM

THE VOICE OF TECHNO-CLINICAL DENTISTRY

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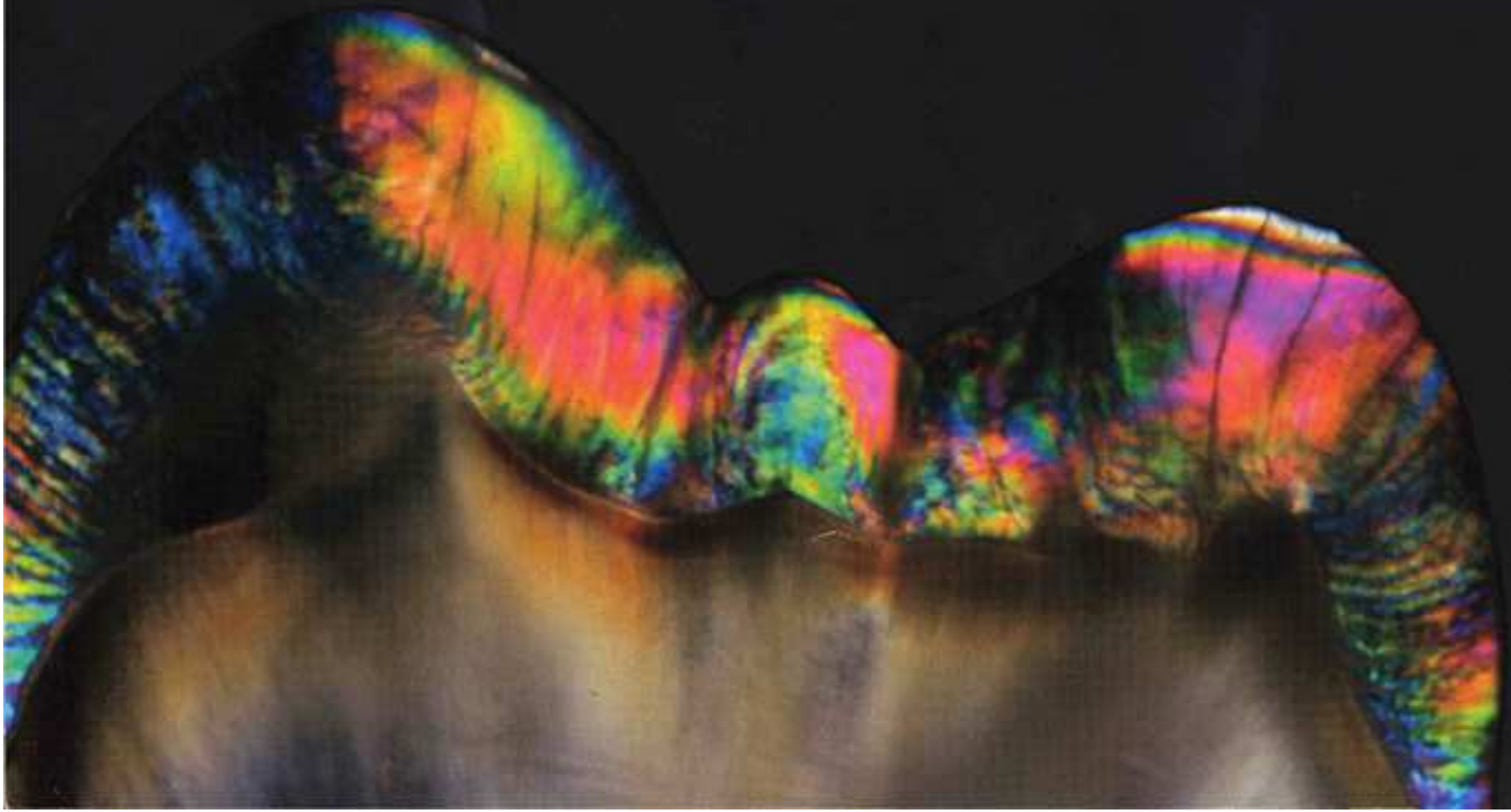
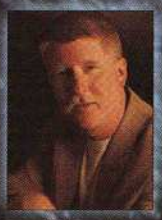


# RESTORATIVE DENTISTRY

## The Human and Robot Team Approach



Lee Culp, CDT

Dr. Michael Sesemann

There was tension and excitement in the room as the lights were slowly dimmed in the auditorium. For the next two hours I was offered a glimpse of the future. The topic was like something out of a science fiction novel, and it instilled in the audience a sense of awe, wonder and just a touch of fear.

As the lights came up everyone sat in stunned silence as they contemplated all the possibilities offered by the presenter. That presentation was given over 20 years ago in a lecture presented by François Duret on the application of computer-assisted design/computer-assisted manufacturing (CAD/CAM) technology into restorative dentistry. It seems as though the new millennium was the catalyst for change in dental CAD/CAM technology, as more than fifteen different systems were released within a few years of each other.

Fig. 1 Technician at Sirona inLab design center.

Dentistry should welcome this technology that was promised so long ago. Unfortunately, there has been an alarming decline in graduates from the remaining few dental technology schools, and we are seeing fewer of our young people enter the profession as apprentices. CAD/CAM technology seems to have arrived just in time as these machines can create some of the more mechanical aspects of the restorative process with accuracy and ease of use.

Based on technology adopted from aerospace, automotive, and even the watch-making industry, this technology is accepted due to its advantage of increased speed, accuracy, and efficiency. Today's CAD/CAM systems (eg, Procera, Nobel Biocare, Yorba Linda, CA; Lava, 3M ESPE, St. Paul, MN; Cercon, Dentsply Ceramco, Burlington, NJ; Cerec, Sirona, Charlotte, NC) are being used to design and manufacture metal, alumina, and zirconia frameworks, as well as all-ceramic full-contour crowns, inlays, and veneers that may be stronger, fit better, and are more esthetic than restorations fabricated using traditional methods.

Fig. 2 Complete Sirona inLab CAD-CAM system.



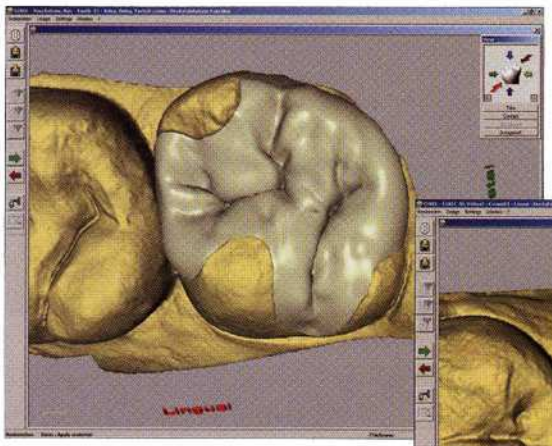



Fig. 3 Digital inlay design.

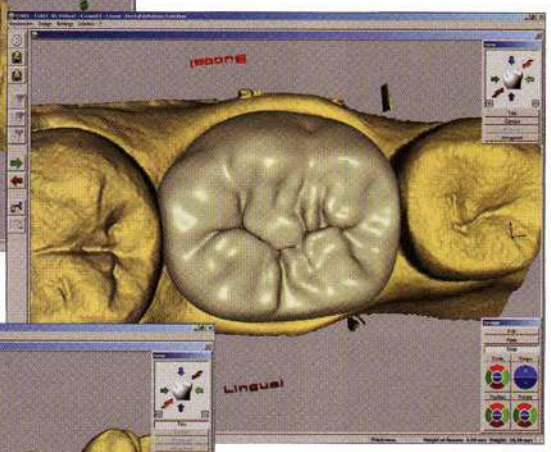



Fig. 4 Digital full crown design.

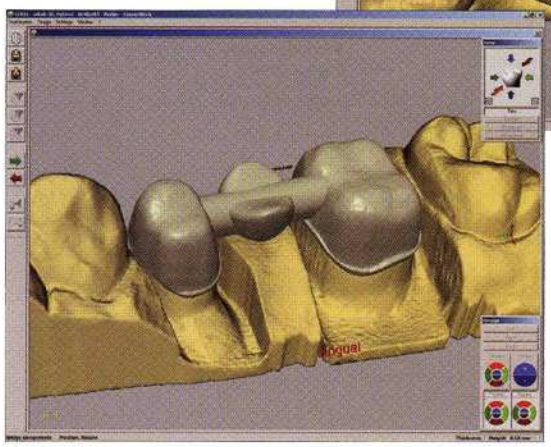


Fig. 5 Digital framework design.

Today's state of the art CAD-CAM systems fulfill the promise made 20 years ago. Computer technology and materials have evolved together during this new era of digital dentistry,and the 15 year success of Vita Inceram high strength alumina cores and Ivoclar Vivadent's press ceramic system IPS Empress have laid a foundation for confidence in the fabrication and clinical use of all ceramic restorations.

As dental technology evolution continues, the dentist-technician team desiring a more efficient, consistent, and predictable restorative process should investigate the array of CAD-CAM systems being offered on the market today. Our laboratory has embraced this technology from its inception watching as the technology, and software advanced, and assisting in its design and applications. We create a large percentage of our laboratory work sitting at a computer, rather than a lab bench. (Fig. 1) CAD-CAM technology like the Sirona inLab (Fig. 2) system offer the technician the efficiency and the predictability of a controlled environment, but also offer unlimited creativity in restoration design, whether it be an inlay-onlay, full crown, or framework design. (Figs 3,4,5)

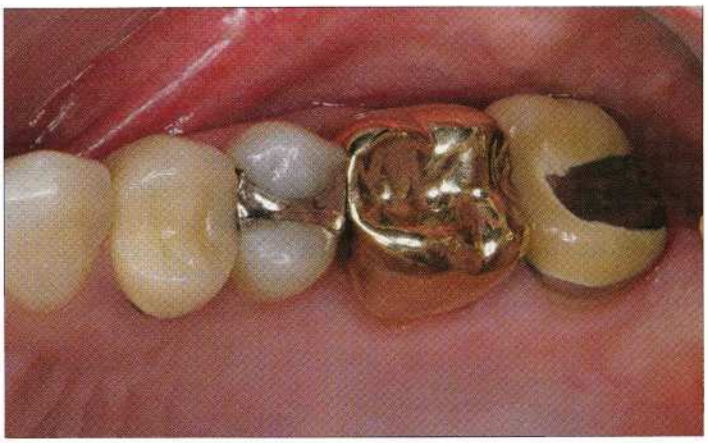


Fig. 6 Clinical preoperative condition, occlusal.

Fig. 7 Clinical preoperative condition, facial.

Fig. 8 Shade determination of natural teeth.

Fig. 9 Posterior preparations, occlusal.

# Clinical

The patient, a 40 year old female is an assistant in Dr. Michael Sesemann's office, desired the removal of her old un-esthetic posterior restorations, to match her natural un-restored anterior teeth (Figs 6 & 7) A full esthetic functional diagnostic analysis was completed to determine a proper treatment plan and restorative options. To satisfy the high esthetic expectations of the patient, and to fulfill function and strength requirement in the high-stress posterior region of the oral environment, Ivoclar Vivadent's E-Cad, a high strength lithium disilicate all ceramic core and, Emax Ceram a nano-fluorapatite layering ceramic for esthetics was chosen. Treatment was started with shade determination to allow natural blend of anterior to posterior teeth. (Fig. 8) Preparations were done following reduction recommendation for all ceramic restorations in the posterior region by the manufacturer. The teeth were reduced to approximately 1.5–2.0mm occlusally, the axial walls were prepared to approximately 1.5mm, and the margin design was prepared for a deep champher with approximately 1.0mm reduction. (Figs 9, 10 & 11) Impressions were then taken and temporary restorations were placed. All models, RX forms, and digital images were then sent to the laboratory for model and restoration fabrication.

Fig. 10 Posterior preparations, facial.

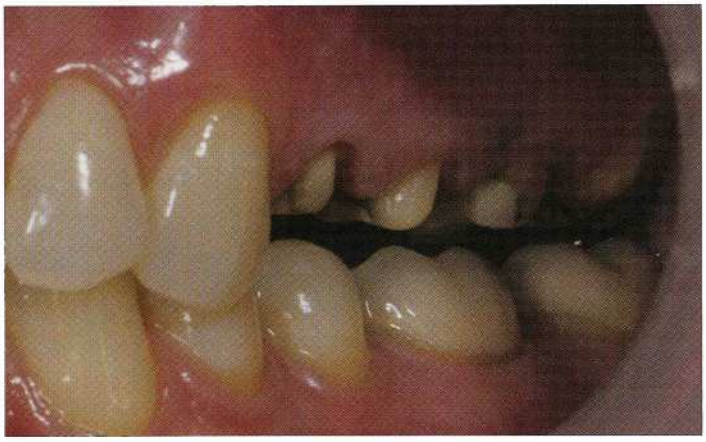


Fig. 11 Patient in maximum intercuspation showing recommended preparation reduction.

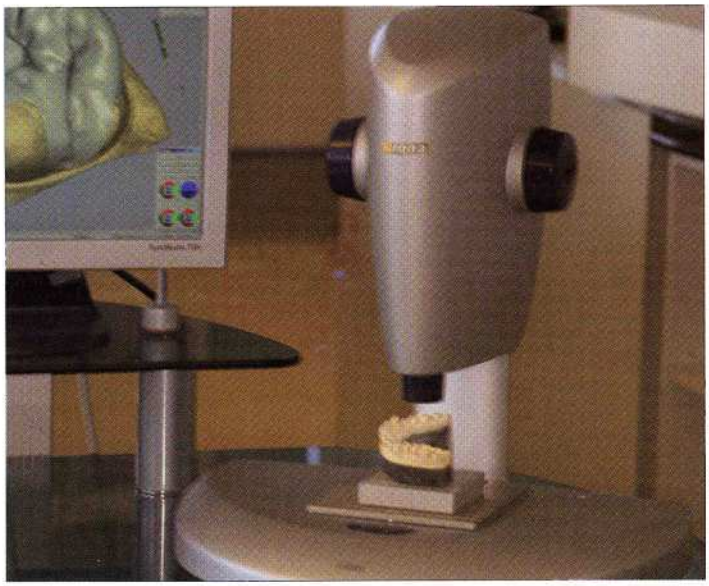


Fig. 12 Model placed in inLab inEOS scanner.

## Laboratory

The foundation of all successful restorative laboratory work is still based on precision model fabrication. Once the model work is completed, the die model is positioned at the inLab inEOS scanner for digital capture of the case (Fig. 12) Scanning is completed after a series of images is taken to insure that preparations and adjacent teeth are accurately digitally documented. These images are then "uploaded" to the computer where the software automatically creates an exact digital, three dimensional copy of the original model. (Fig. 13) After the digital model is created the design process is initiated. Since our computer design is for single coping frameworks, the design process is very simple. Fist margins are identified with the automatic "margin finder" tool, this is somewhat like marking the margin with a red pencil. (Fig. 14) To economically and efficiently mill the copings the two premolars were "splinted" digitally. This allows both units to be milled at the same time, and both are milled out of 1 single block of material. (Fig. 15) Additional "digital wax" can be added to create proper functional support for the veneering ceramic. (Fig. 16) The same process is carried out to design the two molar frameworks.

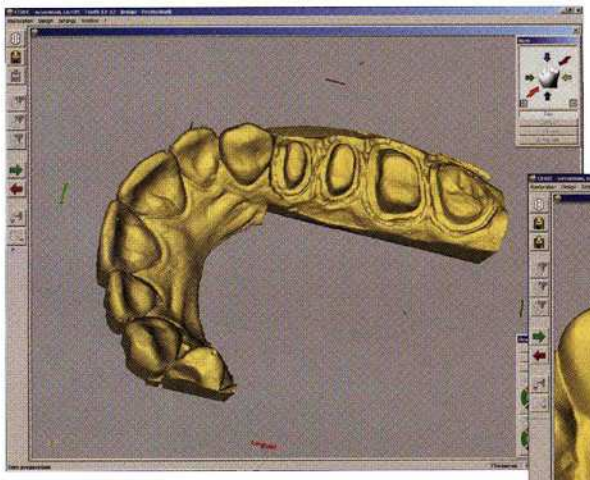


Fig. 13 Completed digital model.

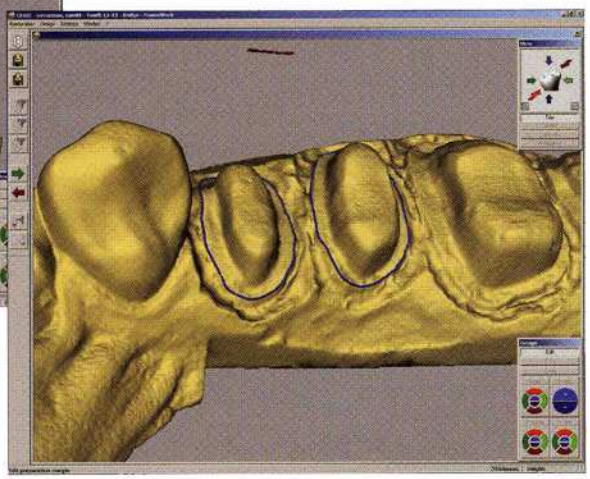


Fig. 14 Automatic margin finder tool.

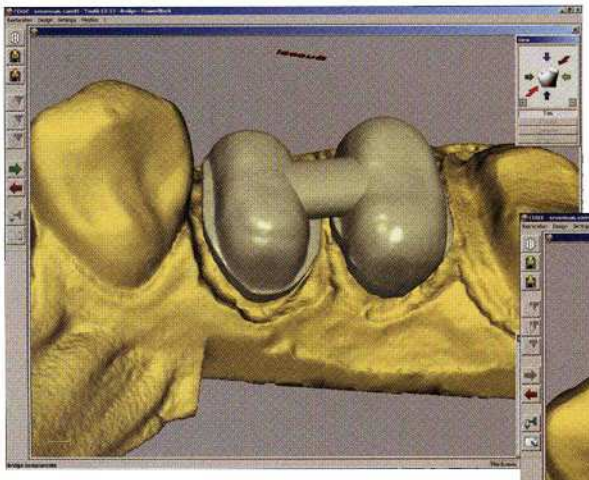


Fig. 15 Bicuspid splint frame design.

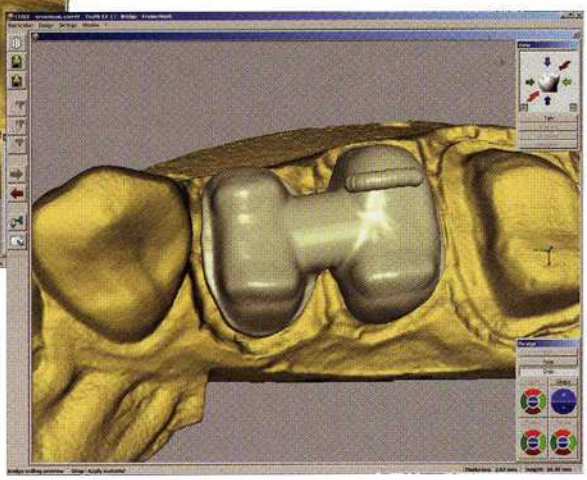
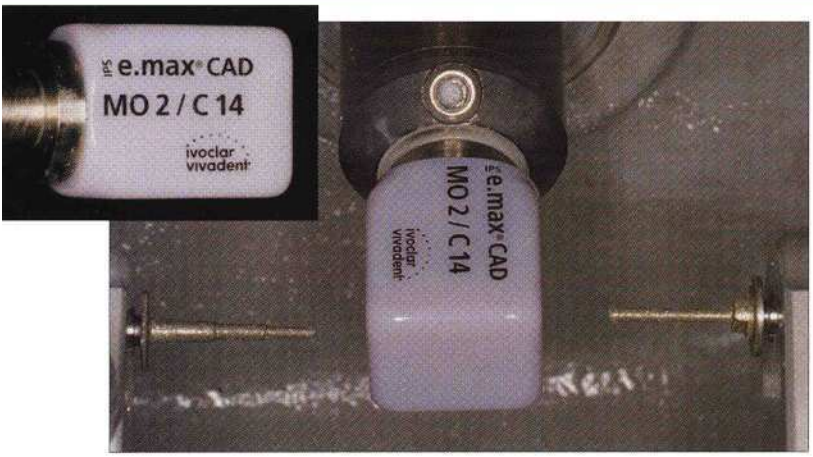


Fig. 16 Digital waxing tool to optimize framework design.




Inset: Fig. 17 E-Cad block. Above: Fig. 18 E-Cad block placed in milling chamber.

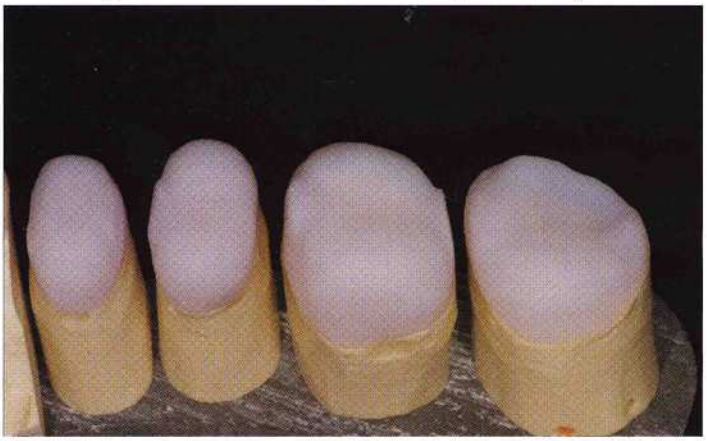


Fig. 19 E-Cad "Blue Phase" framework on model.

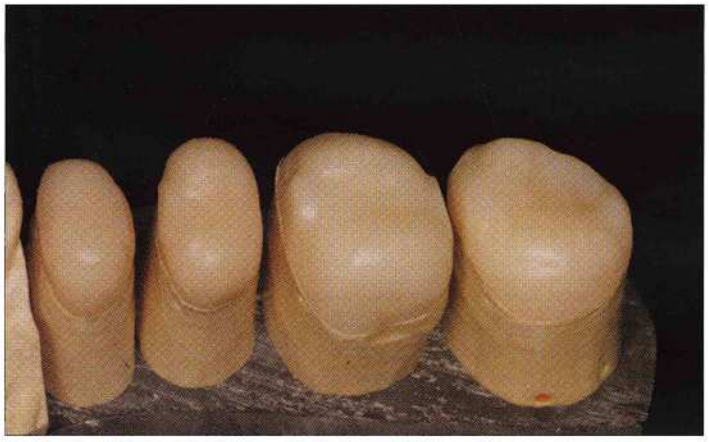


Fig. 20 E-Cad crystallized framework on model.

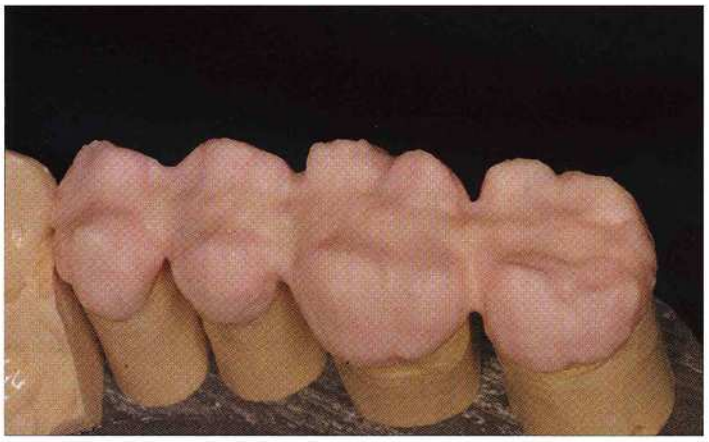


Fig. 21 Application of E-Max Ceram, dentin.

## After Design

When final design is complete, the digital restorations are down loaded to the milling chamber. The proper size and shade E-Cad block is selected and placed into the milling chamber. (Figs 17 & 18) Milling is initiated and each coping takes approximately 15 minutes to mill. After milling is complete, frameworks are removed, and are separated from the remaining block, and each other with a diamond disc. Frames are then placed on the model to verify precision fit. (Fig. 19) Notice the unique "blue" color of the coping after milling. The E-Cad component of the Ivoclar-Vivadent E-Max system is a high strength lithium disilicate framework material that is milled in a "soft" blue state. It then goes through a crystallization process that will allow the material to realize its full strength and proper tooth color. The copings are placed on a firing tray and processed in a conventional ceramic furnace for 35 minutes. The crystallized, full strength, dentin colored copings are returned to the model. (Fig. 20) The proper E-Max Ceram dentin, enamel and special effects ceramic are selected and applied to the E-Cad frameworks in a conventional manner. (Figs 21, 22 & 23)

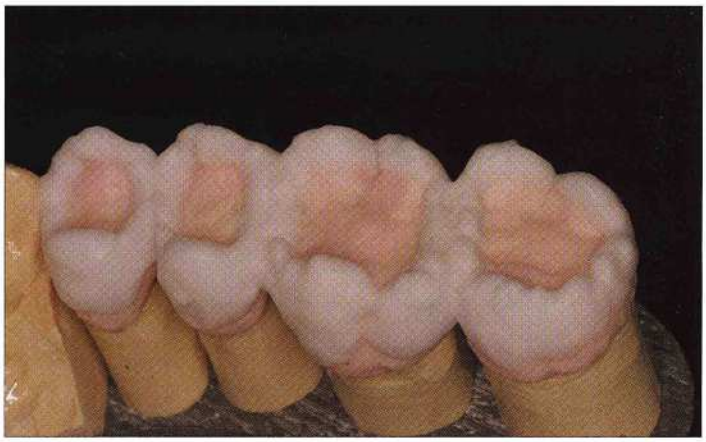


Fig. 22 Application of E-Max Ceram, enamel.

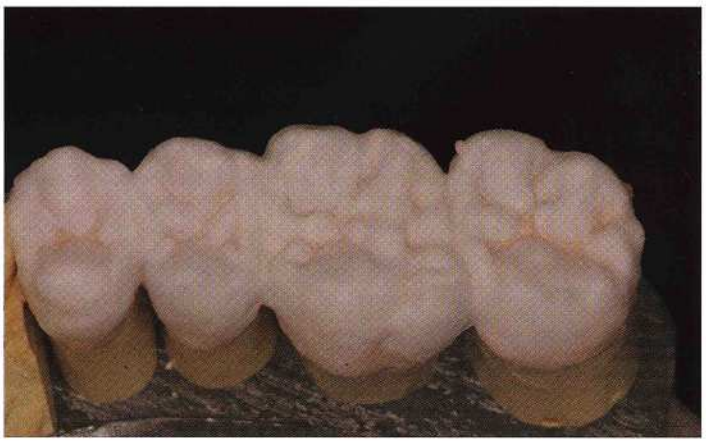


Fig. 23 Application of E-Max Ceram, occlusal.


Fig. 24 Ceramic firing in ceramic furnace.

Fig. 25 Ceramic restoration after second firing, before final contouring.

Fig. 26 Final restorations on master model after stain, glaze, and polish.

Fig. 27 Final evaluation before clinical placement, inside core surface.

The restorations are fired in a ceramic furnace (Fig 24), a second application of E-Max Ceram is applied to correct any deficiencies, and perfect anatomical and occlusal detail. (Fig 25) The all ceramic restorations are adjusted to ensure proper occlusal contacts and excursive freeway space, and minimally contoured to create natural anatomic contours and occlusal anatomy. E-max Essence stains are applied to the surface to further detail anatomical highlight. The restorations are then glazed in a conventional process, and returned to the model for final esthetic-functional evaluation. (Fig 26)

## Clinical

The CAD-CAM fabricated restorations are returned to the dentist for clinical inspection and placement (Figs 27 & 28) The E-Cad framework material was chosen to be used in posterior region of the oral cavity in single restoration because of its strength, this strength also allows the use of a simple to use self-etching primer, composite cementation system. (Fig 29) Restorations were placed to verify fit, function, and esthetics and cemented into place (Fig 30) The final E-Max restorations after placement. (Figs 31, 32 & 33)

Automation has been slow in coming to dentistry and although new equipment has been introduced to make our jobs easier, we still create complex dental prosthetics using techniques that are thousands of years old. And, even though the "lost wax" technique is still a tried and true method of fabrication, there will come a day in the near future when all frameworks and full anatomical crowns will be designed on computer. Only then will we truly realize the wonder and awe of dental CAD-CAM technology that we were introduced to so long ago.

Fig. 28 Close up of final ceramic work.


Fig. 29 Ivoclar Vivadent Multilink cementation set up.

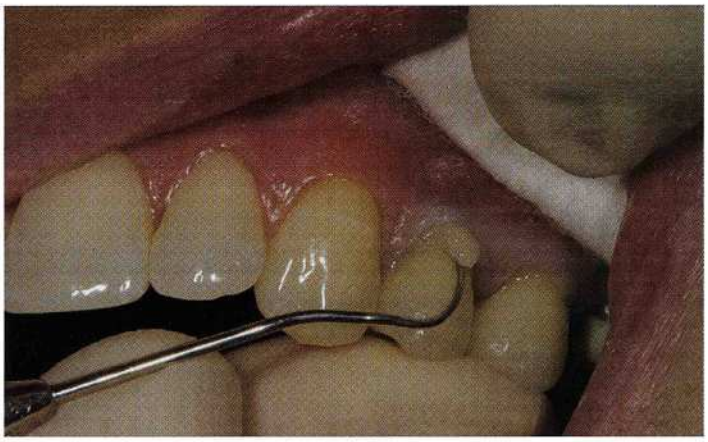


Fig. 30 Removing excess cement before final cure.

Fig. 31 Intraoral view of completed restorations, facial.

Fig. 32 Occlusal view of E-Max all ceramic restorations.

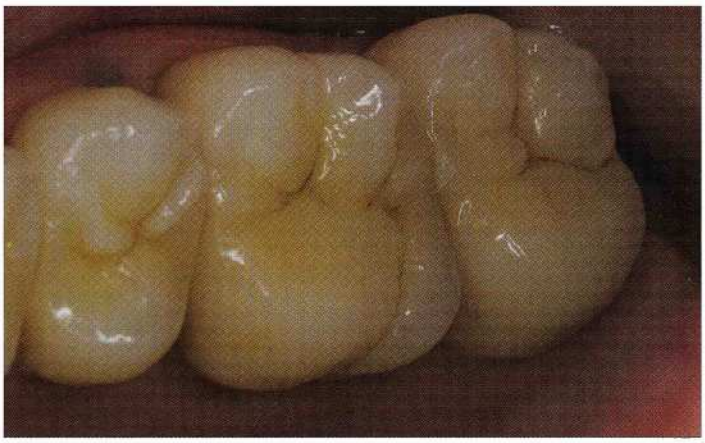


Fig. 33 The combination of digital design, and ceramic artistry produces beautiful results.



## About the author

*Lee Culp, CDT is the founder of Mosaic Studios and the Institute for Oral Art and Design. He maintains an active teaching schedule at IOAD, as well as the Dawson Center for Advanced Dental Study, and other post graduate teaching centers focusing on reconstructive and esthetic dentistry.*

*Lee is the executive editor of Spectrum, a dentist technician communication journal. He is also on the editorial board of Signature, Signature International, Practical Periodontics and Aesthetic Dentistry, and Compendium, Contemporary Esthetics and Restorative Practice.*

*Dr. Sesemann currently maintains a full-time practice in Omaha. He lectures internationally and has published several articles on the techniques necessary for successful completion of the comprehensive restorative case. He is proud to serve as a faculty member at the Dawson Center for Advanced Dental Study in St.Petersburg, FL, the Institute of Oral Art and Design in Sarasota, FL, and the Beverly Hills Institute of Dental Esthetics. In addition, he serves on the editorial boards of Practical Procedures and Aesthetic Dentistry, the Journal of Cosmetic Dentistry, and Spectrum, a techno-clinical publication.*