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The next generation of chairside CAD/CAM: CEREC Software 4.0

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The launch of
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...We live in an exciting time of innovation and creativity in the dental field. Now, more than ever, it is important to keep up with all the fast-developing trends and technologies, especially in the world of digital dentistry.

Sirona Dental Systems has once again set the stage for the next generation of digital virtual restorative dentistry. Having pioneered and perfected the dental virtual theater for the past 26 years, Sirona is eager to introduce its most current CEREC Software 4.0 release.

CEREC SW 4.0 is designed to streamline the optical impression and design process. The software has an intuitive workflow with self-explanatory icons and photorealistic graphics. The noted Biogeneric tooth and bridge software design features are now accompanied with dual-arch digital capturing, creating the option for multiple restorative tooth designs on opposing arches. The digital optical bite registration provides occlusal mastery precision, setting a new standard in dentistry.

The design tool wheel presents some new Biogeneric morphing design assets, facilitating efficient and smooth virtual design modification to satisfy the morphological and occlusal desires of the user. The customized crown, inlay/onlay and veneer parameters provide the refinement to translate virtual reality to restorative fit perfection. CEREC SW 4.0 takes the dental professional to a new level of visual expression on-screen, which in turn will be seen in the clinical theater with even more amazing final restorations than in the past.

For the dental practice, the launch of CEREC SW 4.0 represents a complete CAD/CAM picture where the magic digital dentistry combination is CEREC AC powered by CEREC Bluecam with CEREC SW 4.0. In this convenient package, you will find the ability to create chairside, durable, highly esthetic all-ceramic bridges, crowns, inlays/onlays and veneers using materials such as IPS e.max CAD and IPS Empress CAD. When combined with Galileos 3-D imaging, CEREC can further enhance the dental practice with the ability for surgical and prosthetic implant planning.

Welcome CEREC Software 4.0, introducing the next generation of digital dentistry!

Sincerely,

James Klim, DDS, FAGD, FADFE, PC
Private Practice in San Francisco, and Director of CADStar”
CEREC® Software 4.0
Features & Benefits Overview

Intuitive Workflow

- It's always clear where you are in the process and what step comes next.
- Allows jumping from one design step to the next without the linear approach of "Next" and "Undo".
- Going back to a different design step(s) does not undo the work you've already done.

Multiple Restoration Design

- Work on as many different restorations as you wish (even in different quadrants/arches).
- Restorations do not have to be designed in the same design mode, allowing complete freedom to choose the ideal design mode for each restoration.

Work Direct on the Tooth

- Adjust and refine your restorations by executing design tools direct on the tooth, such as adding or removing material, rotating or positioning, or expanding or reducing tooth size.
- Provides greater control and adds an intuitive "hands-on" feel to the design process.

Streamlined Restoration Design

- At the bottom of the design window, each step is clearly defined, showing you the current step as well as what step came before and what comes next.
- Can move backward and forward without undoing previous design steps.
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The digitized occlusion: Using something old with something new

Author_Todd Ehrlich, DDS, FAGD

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There is an envelope of occlusal function that we are constantly mastering for our patients. Many times it is exceptionally easy to find a position or shape of a tooth that fits within the patient’s comfort and functional zones. However, there are many instances where it can be quite challenging. Using something old with something new can be of great assistance to achieving a restorative shape that the patient will immediately find comfortable.

Using something new

Computerized dental anatomies have greatly evolved over the years. There was a time during CAD/CAM computer design where only limited anatomies were available, and these patterns had to be manipulated greatly by the clinician to fit the clinical situation. This made for a longer design time and, most importantly, made the restoration appear more natural. Today, there are more advanced mathematical calculations for dental anatomy. Modern tooth-modeling software uses a database detailing the measurements of several thousand naturally occurring tooth samples. Common structures such as cusp tips, cusp slopes, marginal ridges and fissures give the blueprint for computer determination of the “average tooth.” The differences between this average tooth and the scanned referenced teeth make up the core for the mathematical calculation, much like with facial recognition software used by government intelligence agencies. Analysis reveals that only 20 data location points are...
necessary to describe 83 percent of the variability in naturally occurring tooth surfaces. This mathematical calculation for tooth morphology therefore predicts the virgin state of the tooth. It has been shown to have a digitally proposed surface within 156 µ of the original surface. Because the described process obtains its results through data derived from naturally occurring teeth, the method is referred to as Biogeneric tooth modeling.

This mathematical calculation of dental anatomy starts with designating the tooth number to be designed. This establishes which database of dental anatomies that it will use to determine the calculations. In other words, the true tooth number needs to be selected for the calculation, or a different tooth number anatomy will be generated (Fig. 1).

The next step for the calculation is to show the computer a tooth that it can use for guidance on the proposed design. This can be done a couple of ways. Primarily, a tooth within the prepared quadrant (not the prepared tooth) will be analyzed automatically by the computer and is typically the distal neighbor of the prepared tooth (Fig. 2). If the clinician knows of a better tooth to reference, this can easily be selected within the prepared arch, within another area of the dentition or even off a model. This referenced dataset will trigger the computer to search the entire database, which may contain hundreds of different virgin anatomies for that particular tooth number.

The computer proposal will morph into various shapes as it is going through the calculation. It also looks for ratios of tooth size and position within the arch. This is a great advantage because these digital dental anatomies are not limited by size but can fit within any range of tooth dimensions.

The finalized digital anatomy is a reflection of what the computer discovered through its analysis of the reference tooth. It also places the three-dimensional shape in contact with the opposing teeth (Fig. 3). If the clinician would like to see variations of the Biogeneric calculation, a slider allows that to happen. This tool is referred to as Biogeneric Variation. If images have to be re-taken, Biogeneric Variation is the new name (Fig. 4). The slider travels through anatomies within the Biogeneric database and reveals them through morphing of the proposal. This allows for a truly customized shape for the clinical situation and within function.

**Digital scanning**

During the course of treatment, the upper and lower arches or quadrants are scanned into the computer using the CEREC Bluecam digital scanning camera. The CEREC system can have multiple preparations within the same arch or in opposing arches. Each arch is saved in its corresponding library of images within the software and evaluated for quality of margin integrity, path of draw, preparation geometry, etc. (Fig. 5). The major advantage of digital impressions is that the physical impression is eliminated from the process. This allows for immediate feedback to the clinician if the information is correct, rather than waiting to evaluate the inverse of the physical impression many minutes later. There are never any tears or bubbles with digital impressions. They also never distort. Therefore, they have tremendous value to the clinician and the patient, especially because the images are taken so easily and within a minute.
After the upper and lower arches are captured, they are articulated by images taken from the buccal direction.

The articulation for the upper and lower jaws is done in a static maximum intercuspation position utilizing what is referred to as the “buccal bite.” This would be similar to a triple tray type using physical impression material, but by doing it digitally, the position never changes. Articulation of the models is completed within the software, and the maximum intercuspation position is always repeatable. There is never flex or variation with the articulator because of its digital nature. Therefore, if taken correctly, the buccal bite can place the maxillary and mandibular teeth in a very specific position that can be designed to within microns of space. Another major advantage of an optical buccal jaw registration is that the position can be seen in the computer as the scan is taking place, much like when preparation images are being taken.

How many times does a patient try and help the procedure by biting toward the area of work during an impression? Or can you even find their centric occlusion through impression material and while anesthetized? The relation is hidden under physical impression material and may not be realized until physical stone models are mounted on an articulator. However, with digitally scanned articulation, it can easily be seen that it may be incorrect, or the jaws are not stable, during the imaging (Fig. 6). The clinician simply stops the scan, coaches the patient into the proper position and then scans again (Fig. 7). This greatly enhances the predictability of occlusion of the final restoration.

The operator takes control of the articulation of the three models: upper, lower and buccal bite. The buccal bite is dragged to the corresponding portions of the upper and lower models. The software then recognizes similar surfaces and “shrink wraps” the buccal bite down. The same is done for the opposing arch. This establishes the digital maximum intercuspation position within the software (Figs. 8–10).

The repeatable digital maximum intercuspation position also allows for multiple units to be designed in a highly predictable manner. Whether the restorations are being designed side by side or from one arch to another, the occlusal morphology and pinpoint placement of occlusal stops can be confidently placed knowing the arches are stable within the digital world.

**Case example No. 1**

A 45-year-old female presented with two porcelain-fused-to-metal crowns with recurrent caries on teeth #14 and #15. They were estimated to be about
5 years old. Her chief complaint was that it was difficult to floss between them. Clinically, the crowns had very tight interproximal contacts and closed embrasures. Dental floss was nearly impossible to penetrate through the contact, and recurrent caries subsequently developed (Fig. 11). The crowns were removed, core build-ups completed and the intraoral scans taken:

- Preparation quadrant (upper left)
- Opposing quadrant (lower left)
- Buccal bite images

The models within the CEREC Software 4.0 were articulated, and the Biogeneric calculation was completed for the two teeth. Because the interproximal contacts were of utmost concern for the patient, both designs were manipulated at the same time to achieve better contact strength and embrasure shape. The interproximal contact between #13 and #14 was designed to mimic the same shape between #12 and #13. The initial Biogeneric proposal for #15 placed the mesial portion into the distal of #14 (Figs. 12, 13). Right-clicking the proposal brought up the myriad of tools to adjust the proposal (Fig. 14). A tool was selected that would reposition just the mesial portion of #15. It could then be repositioned in any direction (Figs. 15, 16). It was simply moved distally. A broader contact was established between the two designs, but with better embrasures than the prior crowns. Minor customization of the occlusal scheme was then done.

The digital crowns were milled with CEREC’s MC XL milling chamber out of IPS e.max CAD blocks (Ivoclar Vivadent). Each crown milled in roughly 10 minutes, and they were tried in to evaluate fit and interproximal contact. The crowns were then fired in a ceramic oven CS (Ivoclar Vivadent) to convert the lithium metasilicate material (“blue block”) into the final lithium disilicate structure known as e.max (color conversion and glazing also occurs during this process).

The crowns were removed from the oven, tried in and inserted. Because of the accuracy of CEREC’s design calculations, easy modification methods and milling accuracy, no adjustment was required for this case (Fig. 17). The patient was shocked there were no adjustments, as she remembered multiple adjustments being made for her prior restorations. She was quite pleased with the result.

Using something old

Many times, large direct restorations will fail and eventually require an indirect restoration. The occlusal pattern of the old restoration may not have detailed anatomy, but it most likely has the occlusal guidance paths already worked out over many years of service. For instance, a tooth may have a very large amalgam restoration with recurrent caries that requires replacement. Although failing, it has tremendous value to the design steps in the CAD...
The surfaces of the restoration have the occlusal motion paths developed over it (Fig. 18). Using the pre-operative surface as a guideline for a digital restoration could very well aid in preventing occlusal interferences from being designed into the restoration. This is a feature within the CEREC program and is referred to as Biogeneric Copy. This is an alternative method from the Biogeneric Tooth Model Biogeneric Individual with buccal bite articulation.

The pre-operative occlusal pattern is easily scanned in prior to treatment. This is usually done while waiting for anesthesia and is done similarly to a physical impression to be used for a provisional restoration. A pre-operative scan must accurately capture the three-dimensional shape of the soon-to-be-prepared tooth, along with adjacent teeth. Crossing the midline is not usually necessary unless working on anterior teeth. The adjacent teeth’s anatomies are used as stitching abutments within the software. This means that the pre-operative model will be compared with the prepared tooth digital model, and the two models are spliced three-dimensionally (Fig. 19). If the stitching abutments within the preoperative model and the prepared model are not the same or lacking data, the models would not be able to be spliced. The scanned data is saved within the program and used later during the restoration design phase.

The design phase of Biogeneric Copy is simply drawing a zone for which the computer will duplicate (Fig. 20). Then the design is manipulated as the clinician sees fit. Decisions can be made for restoration shape while comparing the proposed design to the
pre-operative scan taken before tooth preparation. The pre-operative surface is essentially a shell to construct the digital design of the restoration. The Biogeneric calculation determines the rest of the areas outside of the copied zones.

The design (in white) is compared to the pre-operative scan (in gray) (Fig. 21). A speckled gray/white appearance shows the two surfaces are in complete congruence. For any area where there is white, it is protruding outside the boundary of the original tooth surface and may cause an interference with occlusion. With good clinical judgment, this is usually not a problem.

**Case example No. 2**

A 38-year-old male went through extensive jaw surgery and orthodontics to alleviate a severe Class II malocclusion. His vertical dimension of occlusion was opened up about 2 mm in the posterior and stabilized with composite.

During the course of many months, the composite was adjusted and monitored for chewing efficiency and comfort (Fig. 22). After many occlusion checks in the office, it was time for the definitive restorations. Having all of the patterns of occlusion agreeable to the patient, the three-dimensional shapes just

---

**Fig. 18** An old restoration may still have valuable occlusion information.  
**Fig. 19** The preoperative model is spliced with the preparation model.  
**Fig. 20** A circle is placed to designate areas for the computer to copy the preoperative surface.  
**Fig. 21** The preoperative shell (gray) is compared to the digitally designed restoration (white).
needed to be reproduced into ceramic. Biogeneric Copy was the method of choice. Anesthesia was given, and the lower quadrants were scanned in prior to removing the composite and amalgam. Conservative preparations were completed, and the prepared quadrant was scanned into the software. Using the pre-operative shape as a guideline for the final restoration, CEREC was able to reproduce the shape developed into composite during many months. The crowns were milled and inserted with no occlusal adjustment.

The patient was happy there was no difference between the established composite shapes and the finalized ceramic shapes (Fig. 23). The major advantage to this technique is that it uses the ultimate articulator: the patient himself.

Using something new with something old

There are two exceptional methods used in the CEREC Software 4.0 program to establish anatomical design and occlusion:

1. Biogeneric Individual: a mathematical calculation with buccal bite articulation
2. Biogeneric Copy: the reproduction of current anatomy

The buccal bite articulation sets the digital teeth in one static occluding position and does not show lateral or protrusive interferences. A CR-CO movement is also not capable in this static position. This should be considered a snapshot of the patient’s occlusion, and the clinician needs to be very aware of potential interferences outside the CO position. This is not difficult to do because adjacent tooth incline planes can be compared as well as cusp tip positions, for example.

With the articulation of upper and lower models with the buccal bite, one can see the true intermaxillary space and build the design appropriately. However, there are no motion paths within the CEREC program, and this will probably be a desirable feature in the future. The pre-operative surface is the best indicator to the motion paths of the jaws currently.
The Biogeneric Copy method as illustrated earlier will show motion paths of the mandible through years of service. However, it has a limitation as well: a previously placed restoration may not have complete three-dimensional height for occlusion in some areas. In other words, it may not have function in all areas that it possibly could because the restoration was made in infraocclusion in some areas.

For instance, a large amalgam may not have a marginal ridge that is in occlusion because the operator did not make it high enough directly in the mouth years ago. Therefore, the new Biogeneric Copy milled restoration copied from this amalgam would be limited as well at the same amalgam marginal ridge.

Although each method has a specific limitation, they can now be utilized together in the new CEREC Software 4.0. Therefore, the best of both methods can be used to determine the occlusion points and avoid interferences with jaw motion paths. The Biogeneric mathematical calculation is used to make the best anatomy and place the design in harmony with the maximum intercuspation position. Then, the Biogeneric Copy model can be utilized to analyze potential interferences that were not present with the prior failing restoration. It is truly the best of both worlds to establish anatomy and determine occlusion in the digital world.

**_Case example No. 3_**

An onlay was necessary for tooth #30 after recurrent caries of a large amalgam. Prior to preparation, preoperative images were taken for the Biogeneric Copy model. The tooth was prepared and three sets of images were then taken: preparation quadrant, opposing quadrant, and buccal bite images. The software now had everything required to calculate the restoration.

The upper and lower digital models were articulated using the buccal bite images, and the lower Biogeneric Copy model was automatically spliced to the lower preparation model. The margin was marked and the Biogeneric calculation took place (Fig. 24). The occlusal contacts of the Biogeneric proposal appeared to be correct, but after comparing it to the preoperative Biogeneric Copy model, it revealed there was an interference along the incline plane of the buccal cusp. So this area was relieved (Fig. 25). However, the Biogeneric proposal actually calculated a better position for the distal marginal ridge, and it was left as designed. The prior amalgam was deficient in height at the marginal ridge.

The digital restoration was milled out of IPS e.max CAD (Ivoclar Vivadent) and crystallized. The restoration was bonded in with Multiilink Automix (Ivoclar Vivadent), and no occlusal adjustments were required (Fig. 26).

**_Conclusion_**

The newest CEREC Software 4.0 has opened doors that were only dreams years ago: better flow, more efficient tools, multiple models and multiple-unit design. Having the ability to design multiple restorations in unison has greatly increased the design mode. It has a major impact when designing any adjacent restorations, but it is phenomenal at the midline between teeth #8 and #9. The esthetic position of the midline is achieved easily because of this.

Esthetic dental anatomies are also easier to achieve with the ability of the software to calculate exceptional designs that are customized for every tooth. But the function does not suffer because the design can be compared to a preoperative shape as well as the intermaxillary space. This makes for a very efficient method in achieving proper occlusion digitally and, ultimately, in the final restoration delivered to the patient.

**_References_**

The next generation of chairside CAD/CAM: CEREC Software 4.0

Author: Sameer Puri, DDS

Although CAD/CAM technology has been around for more than 25 years. Although there are several digital imaging systems on the market today, the pioneer in this field has been the CEREC system by Sirona (Fig. 1). Thousands of clinicians worldwide have utilized the CEREC system to restore millions of teeth. It is estimated that a CEREC restoration is placed approximately every seven seconds.

Early generations of the CEREC system were difficult to use and required an extensive learning curve. No doubt these initial CEREC systems could create an acceptable restoration when properly utilized, as evidenced by the multitude of long-term studies completed by numerous private practitioners and universities alike; however, their limited indications (simple inlays and onlays) and the extended learning curve (up to six months or more for some practitioners) limited the field of potential users to a handful of clinicians who were more interested in the technology instead of having a system that was predictable and integrated easily into private practice.

In 2003, after 18 years of being based on DOS architecture, the software evolved to show the user the first 3-D rendition of a tooth by utilizing the now-popular Windows platform (Fig. 2). This software allowed the user to take individual images of the teeth to be restored and see the models generated in three dimensions. The clinician had the ability to manipulate the model in virtually any direction by moving the integrated trackball in the CEREC machine.

The new software platform allowed the user to fabricate more intricate restorations, such as full-coverage crowns (Figs. 3a, 3b). Further updates led to more indications, as users had the ability to not only design restorations chairside but, by using the laboratory version of the system, could design and mill their implant abutments and final restorations chairside (Fig. 4).

Advanced users used the system to fabricate their final bridges by milling the frameworks from zirconia and then milling the layering porcelain to go on top (Fig. 5). Those users who did not want to delve so deeply into their software had the option of taking a digital scan of their case and sending it off to the laboratory for the fabrication of a model, saving the time and expense of a physical impression (Fig. 6). Laboratories using the system quickly realized the advantages of being able to mill their own models in their milling units (Fig. 7).

All of these advances led to an increase in the number of users in the system; but still, the majority of dentists felt that CAD/CAM systems were not quite ready for their practices or were too difficult to use.

Since 2003, all subsequent updates to the CEREC software were based on a platform that was first developed in the early 2000s, and each new feature released yearly was simply stacked on top of the previous software features by the programmers. While the quality of the restorations that have been fabricated has always been well within clinically acceptable standards when properly done, all improvements and updates in the software allowed the user to improve only the speed and efficiency of their designs.

Initially, the developers were able to utilize the existing software platform to improve the software...
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Features such as automatic thickness detection, automatic contacts and occlusion, as well as intraoral bite calculations, were all added. In fact, as the software evolved, the quality of the restorations did not necessarily get better (not that they needed improvement!); what improved was the user experience. What used to take 10 to 15 minutes to design a single restoration now took two to three minutes. Many of the features that initially required manual input were now automated.

The platform, however, eventually started to show its age. Despite the advances the engineers were able to program in the software, the fact remained that in 2011, the CEREC software was still being programmed on a 9-year-old software platform. In computer years, this may as well have been eternity. This older platform limited what could actually be placed in the software, as the programmers were limited to working within the confines of the existing architecture.

Competitors of the CEREC system were able to come to the market and claim a competitive edge with their machines because of improvements in their own software architectures. The fact remained, however, that rival companies had the edge in that they could take the work of CEREC and reverse-engineer the software and not be limited by an older programming platform.

This supposed competitive edge appears to have ended with the release of the CEREC Software 4.0 (Fig. 8). Based on an entirely new programming language, CEREC Software 4.0 is every CEREC owner’s dream come true, with software features that users have been asking for for years that were not able to be programmed on the previous version.

Designed from the ground up starting in the fall of 2009, more than two years in the making, CEREC Software 4.0 shows an entirely reworked graphical user interface, or GUI, as referred to by insiders (Fig. 9).

While reworked, it still keeps features that will allow existing users to feel at home and not lose sight of the fact that this is still in fact the CEREC software. It will also allow new users to catch on more easily to its use, thereby reducing the learning curve. It allows for faster performance, more features and the ability to design an unlimited number of restorations (up to 32 teeth at once) if the user wishes.

Because the software is based on a new programming platform, future developments will come much faster because of the programmer’s ability to quickly and efficiently code these developments into the software.

This new upgrade for CEREC, planned for a September release, will no doubt contribute toward making CEREC dentistry more mainstream. Currently, there are approximately 11,500 CEREC owners in the United States and roughly 33,000 worldwide. While this may seem like a large user base, in reality, the number of users is still in its infancy.

If you look at the integration of any technology, you have “early adopters” who are the first to purchase anything new. These are the people who stood...
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in line for hours, if not days, to get the first iPhone. The “early majority” comes next, and it is the group of people who realize the technology is ready for prime time and are more apt to purchase and integrate the new technology.

The “late majority” comes after that. These are the people who don’t want to be the first on the block with anything new, but they certainly don’t want to be the last on the block either.

The final group of people is considered “laggards.” Laggards are the ones who only buy a touch-tone phone now because rotary phones are no longer available; in other words, you have to drag them kicking and screaming into purchasing and integrating anything new.

In relation to CEREC users, the early adopters can be considered the few thousand CEREC owners who integrated the technology in the first 20 to 25 years of its existence. In relation to the roughly 140,000 practicing dentists in the United States, 11,000 CEREC owners is a small number of users who have decided to integrate the technology. One can surmise that we have yet to see the early majority of CAD/CAM users, simply because we are still in the infancy of adoption, even after 25 years.

_Clinical example_

A new patient presented to the office as an emergency, with the chief complaint of a broken tooth (Fig. 10). The clinical history stated the patient had received an all-ceramic restoration on tooth #31 at another office a number of years ago. The restoration had fractured and needed replacement. Several treatment options were presented and discussed with the patient, and it was decided the treatment would be to restore tooth #31 with an IPS e.max CAD restoration (Fig. 11) fabricated chairside with a CEREC unit.

Because the radiograph also showed that #30 had interproximal decay under the existing amalgam, the patient opted to have both teeth restored in a single visit to save time.

The clinical challenge was not in the restoration of either tooth; the CEREC can handle that with ease. The challenge was that multiple design techniques were needed to restore both teeth because, in addition to needing a new restoration, #30 was also the retaining tooth for a clasp that was attached to a retainer the patient wore nightly and did not wish to replace, as it might not fit with the placement of a new crown on #30.

To avoid having to replace the retainer, the Biogeneric Copy technique was used to restore the tooth. A photo of the existing tooth contours was captured with the CEREC system and used to replace the restoration.

With tooth #31, an entirely different approach was taken, simply because there was no existing tooth structure present to copy. With tooth #31, the tooth was prepared and an image of the preparation was taken with the CEREC Bluecam camera (Fig. 12). An image of the opposing dentition was also captured, along with the intercuspation of the upper and lower jaws utilizing the Buccal Bite technique.

The tooth was designed by using the contours
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and anatomy of the adjacent teeth as a guide, in a technique known as Biogeneric (Fig. 13). The CEREC software utilizes mathematical analysis of the teeth that are present in the patient’s jaw to determine what the proposal on a preparation should look like in the Biogeneric process. By analyzing the anatomy, the contours, the cusp tips and the grooves, the software is able to precisely calculate how the final restoration should appear.

Once the restorations were designed, each restoration was milled in the CEREC MC XL milling chamber, which takes anywhere from four to 10 minutes per restoration, depending on its size.

Since IPS e.max CAD was used as the restorative material, it must be processed to its final color and strength by crystalizing the material in an oven. By placing the restoration in the oven for approximately 19 minutes, the lithium metasilicate crystals undergo a phase transformation and grow in size. This converts the lithium metasilicate to lithium disilicate, which gives IPS e.max CAD its final color and strength. Once crystallized, the restorations achieve a final strength of roughly 360-400 MPa. In relation, regular feldspathic porcelain is roughly 90-140 MPa in strength. This increase in strength makes IPS e.max CAD restorations a good choice of material for molars.

After crystallization, the restorations are bonded in place, the occlusion adjusted and the patient is dismissed. The advanced CEREC software allows the entire process to finish in approximately 90 minutes (Fig. 14).

Advances in programming technology have allowed the CEREC system to enter its next phase of evolution. The ability to design multiple restorations at once, the ability to mix and match design techniques, the ability to mill restorations in minutes, and the ability to choose from a multitude of materials allow the user to utilize the CEREC system not just as a limited-use machine but one that can be an integral part of any dental office.

The end result of this evolution of the software is that CEREC users are able to go way beyond simple restorations. Users are able to fabricate permanent bridges by milling both the framework as well as the overlying porcelain. In addition, the user can completely control the planning, design and fabrication of implant restorations from the abutment to the final restoration by integrating the CEREC system with the GALILEOS cone beam (Fig. 15).

There is no doubt the evolution of this technology will lead to a surge in utilization by dentists everywhere as the system gets easier to use, has an increased range of indications and can provide restorations that rival the quality of a good laboratory. It appears we are at the point where the early majority of users will soon be CAD/CAM-ing their restorations chairside._
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Using lab-fab and chairside lithium disilicate to satisfy different case requirements

Author_David Juliani, DDS

Fig. 1 View of endodontically treated tooth #18 prior to restorative treatment. (Photos/Provided by Dr. David Juliani)

In recent years, manufacturers have developed new ceramic materials that provide improved strength and esthetics to enhance the predictability of outcomes that can be achieved when delivering CAD/CAM fabricated restorations. To improve fit and function, such materials withstand chairside or laboratory CAD/CAM processing without chipping or fracturing, regardless of whether they’re brought to full contour during milling or pressing.

Among these materials is lithium disilicate (IPS e.max, Ivoclar Vivadent, Amherst, N.Y.), which consists of 70 percent by volume needle-like crystals in a glassy matrix. Because it is available in a pressable format (IPS e.max Press) or for CAD processing (IPS e.max CAD), the versatile material is indicated for anterior and posterior restorations, including thin veneers (0.3 mm), minimally invasive inlays and onlays, partial crowns and full crowns, implant superstructures, three-unit anterior/premolar bridges (Press only), and three-unit bridges (zirconium-oxide supported IPS e.max CAD only).

Demonstrating strength values between 360 MPa (Press) to 400 MPa (CAD), lithium disilicate glass ceramic (IPS e.max) offers many improvements over previous generations of ceramic material. Restorations fabricated with this material can be adhesively bonded or conventionally cemented, so case requirements can be met regardless of location in the mouth or placement limitations. Improvements to cementation and adhesive systems have also enabled dentists to provide a strong bond between the restoration and underlying tooth substrates. IPS e.max also demonstrates lifelike optical qualities for producing highly esthetic and natural-looking restorations.

Despite the different manners in which the lithium disilicate material can be processed (e.g., pressed or milled), it demonstrates no differences clinically or radiographically. Rather, the key processing difference is when crystallization occurs. Crystallization of CAD/CAM processed lithium disilicate (IPS e.max CAD) stops and is completed following chairside milling.

Among the technology available for processing the CAD/CAM lithium disilicate is the CEREC Connect (Sirona Dental, Charlotte, N.C.), a new generation of CAD/CAM systems that makes it easy for dentists to select between chairside and laboratory fabricated restorations, depending on specific case requirements. Today’s CEREC system includes a light-emitting diode (LED) camera (CEREC Bluecam, Sirona Dental) for greater accuracy and higher quality images when capturing digital impressions than previous infrared-emitting camera systems. Then, the CEREC Connect facilitates use and transfer of digital impressions and case information via the internet to dental laboratories. Laboratories can then fabricate restorations using the CEREC inLab System (Sirona Dental). Alternatively, with significantly higher speeds and greater memory, CEREC 3D design
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software allows users to view tooth designs as they would when evaluating traditional stone models.5,6

Additional features include automatic software downloads, simple display guides and network connectivity, while the milling chamber design enables easy block clamping without tools. Whereas conventional CAD/CAM software and machines presented in-office setup challenges, the new CEREC in-office design features a milling chamber (CEREC MC XL system, Sirona Dental) separated from the image capture and design hardware, so one restoration can be designed while another is milled. Single tooth restorations can be processed in six minutes and quadrant restorations in three to four minutes in a single appointment. The powerful and accurate low-noise chairside CAD/CAM milling system demonstrates precision and accuracy within the range of +/- 25 microns, and the 7.5µ milling resolution creates restorations with improved fit and smoother surfaces.  

_Clase presentation No. 1

A patient presented following endodontic treatment on tooth #18 that required restoration (Fig. 1). It was determined that a laboratory CAD/CAM fabricated lithium disilicate crown restoration (IPS e.max CAD) would be placed. The tooth was prepared and a core build-up created (Fig. 2).

The core build-up preparation for tooth #18, adjacent teeth and the soft tissues were sprayed with a contrast medium to facilitate digital impression taking using the LED scanning unit (CEREC Bluecam). The anatomical form of the teeth and soft tissues were scanned and the case information and impressions transferred to the laboratory via CEREC Connect.

At the laboratory, the three-dimensional software (CEREC 3D) was used to design the crown contours and occlusal relationships. A prefabricated high translucency lithium disilicate block (IPS e.max CAD) was then milled into a crown for tooth #18. Lithium disilicate was the material of choice in this case because it demonstrates high strength and life-like optical properties. After milling, the crown was layered with a veneering ceramic (IPS e.max Press) to complete the restoration contours, characterized and returned to the practice for seating.

To seat the restoration, the preparation first was etched, rinsed and air dried. Then, dual-curing luting composite (Multilink Automix, Ivoclar Vivadent) was used. Multilink is indicated for use with metal, all-ceramic, metal-ceramic and composite restorations and provides a strong hold on all surfaces. Available in transparent, yellow or opaque shades, it ensures proper esthetics are achieved. The cement does not need to be protected from ambient light during mixing and placement, so clinicians have ample working time.

The primer liquids (Multilink A/B) were mixed in a 1:1 ratio before applying to the preparation. A microbrush was used to apply and lightly scrub the primer mix on the core build-up, after which it was air thinned to evaporate the primer solvents. Light-curing was unnecessary at this time because the primer is self-curing.

The internal aspects of the lithium disilicate crown were carefully and fully covered with the luting com-
posite (Multilink Automix), which was extruded from the mixing tip. The crown was then seated on tooth #18, and slight pressure was applied. Excess cement was removed from interproximal and cervical areas using a microbrush, and additional pressure was applied to the crown to ensure complete and proper seating during the initial cleanup steps. Dental floss was then used to complete removal of excess cement in the interproximal areas.

The crown was cured using an LED curing light (Bluephase, Ivoclar Vivadent) from the buccal, mesial, lingual and distal aspects, after which it demonstrated exceptional fit, function and esthetics (Fig. 3). Additionally, a postoperative radiograph confirmed excellent marginal adaptation was achieved (Fig. 4).

Case presentation No. 2

A patient presented with failing amalgam restorations on tooth #19 in need of restoration (Fig. 5). After a thorough examination and consultation with the patient, it was determined the tooth could be treated with same day, in-office CAD/CAM restorations fabricated from a lithium disilicate material (IPS e.max CAD).

The defective amalgam restoration was removed, and tooth #19 was prepared for restoration with a CAD/CAM (CEREC MC XL) processed lithium disilicate crown (IPS e.max CAD). The preparation, surrounding dentition and soft tissues were sprayed with a contrast powder, and the anatomical form of the tooth and soft tissues was then captured using the scanning unit (CEREC Bluecam).

After scanning, three-dimensional software (CEREC 3D) was used to design the crown contours and occlusal relationships, and the selected prefabricated high translucency lithium disilicate block (IPS e.max CAD) was then milled chairside (CEREC MC XL) into a crown for tooth #19 (Fig. 8). The crown was tried in the patient’s mouth to evaluate fit, contour and anatomical harmony prior to crystallization (Fig. 6).

The crown was removed, cleaned and dried. Stains were placed to mimic natural tooth characteristics, after which the crown was crystallized and ready for seating.

The primer liquids from a dual-cure luting cement (Multilink A/B) were mixed in a 1:1 ratio before applying to the preparation. A microbrush was used to apply and lightly scrub the primer mix on the preparation, after which it was air thinned to evaporate the primer solvents. Light-curing was unnecessary at this time because the primer is self-curing.

The internal aspects of the lithium disilicate crown were carefully and fully covered with the luting composite (Multilink Automix). The crown was seated on tooth #19, and slight pressure was applied. Excess cement was removed from interproximal and cervical areas using a microbrush, and additional pressure was applied to ensure complete and proper seating. Dental floss was used to complete removal of excess cement in the interproximal areas.

The crown was cured using an LED curing light (Bluephase, Ivoclar Vivadent) from the buccal, lingual and distal aspects, after which it demonstrated exceptional fit, function and esthetics (Fig. 3). Additionally, a postoperative radiograph confirmed excellent marginal adaptation was achieved (Fig. 4).
Many dentists are unaware that lithium disilicate is a strong, esthetic and durable restorative material suitable for pressable techniques and also chairside and laboratory CAD/CAM processing.

**Conclusion**

Many dentists are unaware that lithium disilicate is a strong, esthetic and durable restorative material suitable for pressable techniques and also chairside and laboratory CAD/CAM processing. As demonstrated in the cases presented here, and radiographically (Figs. 9, 10), the materials and their clinical and material characteristics are similar — whether in terms of performance or esthetics. The only difference is that chairside IPS e.max CAD crystallization is stopped and finished after chairside milling.

**References**

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Creating a functional ‘Hollywood smile’ in a single appointment

Author: Kevin Pawlowicz, DDS

Fig. 1. The patient presents to the office seeking esthetic restoration of the full upper arch. (Photos Provided by Kevin Pawlowicz)

Fig. 2. The unesthetic anterior dentition is to be restored with CAD/CAM processed lithium disilicate veneers, while the posterior dentition is to be restored with CAD/CAM processed stainless steel supported lithium disilicate crowns.

Today’s patients often present to the dental office seeking the ideal "Hollywood smile."¹ The increase in demand for this type of “smile makeover” treatment is related to the current focus in the media and society on the appearance and esthetics of individuals.¹ Therefore, patients often believe their teeth should appear very bright, perfectly straight and white.²,³ Although teeth that appear straight and white are more esthetically pleasing, patients often fail to understand the implications of dental treatment that does not correct underlying functional issues.²,³

To address patient concerns without doing harm, dentists have since adopted comprehensive treatment philosophies that address both the esthetic concerns of a patient and the functional requirements of the case.⁴,⁵ Therefore, today’s dentists typically focus on providing care through a multi-disciplinary approach that balances esthetics with proper oral health.⁶ This is often achieved through incorporating various methods of treatment in a comprehensive and minimally invasive treatment plan.⁴,⁶ Combined with the advanced all-ceramic materials and CAD/CAM technologies now available to dental professionals, minimally invasive, comprehensive and same-day treatment has become the new standard of care.⁴,⁶

_CAD/CAM technology_

Computer aided design and manufacture (CAD/CAM) technologies contribute greatly to restorative dentistry and provide clinicians the ability to create highly esthetic restorations that improve function.⁷,⁸ CAD/CAM systems and materials also provide treatment options for various indications, including inlays, onlays, fixed partial dentures and full dentures, thin veneers and crowns.⁷,⁸ Various restorative materials, including metal, metal-ceramic, composite and all-ceramic, may be CAD/CAM fabricated to best meet the needs of the case and patient.⁷,⁸ Further, CAD/CAM systems are available for both chairside and laboratory applications, so dentists now have the ability to create highly esthetic and strong restorations in-office and on the same day.⁷,⁸

The CEREC (Sirona Dental, Charlotte, N.C.) CAD/CAM system was developed to simplify the restorative process.¹¹,¹² Utilizing a separate milling chamber and image capture device, dentists can now si-
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clinical smile makeover

multaneously design one restoration while milling another.\textsuperscript{11,12} Further, the CEREC 3-D design software allows users to view tooth designs as they would when evaluating traditional stone models.\textsuperscript{11,12} Additionally, a light-emitting diode (LED) camera (CEREC Bluecam, Sirona Dental) provides greater accuracy and higher quality images than previous infrared-emitting camera systems.\textsuperscript{11,12} Dentists also benefit from the recent addition of CEREC Connect (Sirona Dental), which allows impression and restoration information to be digitally acquired and transmitted over the internet to dental laboratories.\textsuperscript{11,12} Laboratories can then fabricate restorations using the CEREC inLab System (Sirona Dental).\textsuperscript{11,12}

_new material considerations

New generations of all-ceramic materials have been developed to withstand CAD/CAM processing and can be brought to full contour during milling to improve fit and function.\textsuperscript{11} These materials also enable dentists to choose adhesive bonding or conventional cementation to meet all case requirements.\textsuperscript{11} Improvements to cementation and adhesive systems have also enabled dentists to provide a strong bond between the restoration and underlying tooth substrates.\textsuperscript{2,10}

IPS e.max CAD

IPS e.max CAD (Ivoclar Vivadent, Amherst, N.Y.) is an innovative all-ceramic lithium disilicate material composed of 70 percent by volume needle-like crystals in a glassy matrix. Exhibiting high strength and durability, IPS e.max CAD demonstrates many improvements over previous generations of ceramic materials.\textsuperscript{13} Available in a pressable format (IPS e.max Press) or for CAD processing (IPS e.max CAD), the material offers strength values between 360 MPa (Press) to 400 MPa (CAD).\textsuperscript{13} IPS e.max also provides lifelike optical qualities that enable dentists to create highly esthetic and naturally appearing restorations simply and efficiently.\textsuperscript{13}

The versatile lithium disilicate glass-ceramic material is indicated for anterior and posterior restorations, including thin veneers (0.3 mm), minimally invasive inlays and onlays, partial crowns and crowns, implant superstructures, three-unit anterior/premolar bridges (Press only), and three-unit bridges (zirconium-oxide supported IPS e.max CAD only).\textsuperscript{13}

Case presentation

A woman presented to the office seeking esthetic treatment with veneers on her upper dentition (Figs. 3, 4, 5, 6).
The patient had previously tried orthodontia and tooth whitening treatments. However, she remained displeased with the appearance of her dentition, specifically teeth #8 and #9. Upon further discussion with the patient, it became apparent the patient desired a "Hollywood smile." The patient had brought photographs of different celebrities to demonstrate the exact smile she was seeking. Additionally, the patient presented with stainless steel crowns in the posterior that required replacement. Through further discussion with the patient on the importance of proper function, a comprehensive treatment plan was developed that would focus on both esthetics and overall oral health.

This minimally invasive treatment plan included gingival recontouring, along with CAD/CAM processed lithium disilicate glass-ceramic veneers in the anterior and lithium disilicate crowns in the posterior and on anterior teeth #8 and #9. Although the restorations would be completed in a single appointment, the patient would be fitted with provisional. These provisional restorations would allow the patient to trial the fit, function and esthetics of the definitive restorations before they were fabricated and seated intraorally.¹⁴

Clinical protocol

Prior to restoration, preoperative models of the patient’s maxillary arch were poured from the full-arch impression. A preliminary wax-up was then created from the model and an occlusal matrix was fabricated for 10 upper anterior teeth from a silicone impression material (Sil-Tech, Ivoclar Vivadent, Amherst, N.Y.) to begin fabrication of the provisionals (Figs. 3, 4). Temporary restorations were then created in wax on the model with the matrix in place (Figs. 5, 6). The provisionals were then fabricated from the scanned images demonstrated the condition of teeth #8 and #9 after gingival recontouring.
matrix and a temporary material in shade BL3 (Telio CTeB, Ivoclar Vivadent, Amherst, N.Y.). The provisional restorations were seated intraorally on the patient’s upper dentition (Figs. 7–9). However, the patient decided shade BL3 was not bright enough. Therefore, it was decided BL2 would be used for the final restorations.

After placing the provisional restorations, the patient’s gingival tissues were recontoured, minimal preparation completed and the previously placed crowns removed. The patient’s teeth were sectioned off and scanned into the CAD/CAM system (CEREC, Sirona Dental, Charlotte, N.C.). The three-dimensional CAD/CAM software (CEREC 3D Version 4.0, Sirona Dental, Charlotte, N.C.) was then used to design the preparation and definitive restorations from the scanned models, matrix and temporaries (Figs. 10, 11). The restoration design began at teeth #8 and #9 (Figs. 12, 13). Moving backward, each tooth in the upper arch was then designed.

Once designed, the anterior veneers and posterior crowns were milled with the CAD/CAM system (CEREC) from highly esthetic blocks of lithium disilicate glass-ceramic (IPS e.max CAD). Although CAD/CAM material is typically used in only the posterior, it was also used in the anterior because lithium disilicate demonstrates natural shading and vitality.

After the veneers and crowns had been milled, the restorations were then tried in the patient’s mouth to confirm fit, function and esthetics. Once cleaned and dried, the enamel of the prepared dentition was etched for 30 seconds with a 37 percent phosphoric etchant (Total Etch, Ivoclar Vivadent, Amherst, N.Y.). Excess etching agent was removed using copious amounts of water, and the preparation was air dried.

Microfilled esthetic resin cement (Variolink Veneer, Ivoclar Vivadent, Amherst, N.Y.) was chosen as the ideal material to seat the definitive lithium disilicate veneers and crowns. The microfilled resin cement is available in various shades to impart value on thin veneers and crowns. To meet the esthetic requirements of this case, shade (Variolink Veneer) value shade +3 was chosen.

The esthetic resin cement was placed on the internal surfaces of the lithium disilicate veneers and crowns, which were then seated individually. Excess cement was removed from the margins of the restorations using the dental explorer. Pressure was then applied to the veneers, and excess cement was removed from the interproximal contacts with dental floss. The veneers and crowns were light cured with a LED curing light (Bluephase, Ivoclar Vivadent, Amherst, N.Y.).

Upon completion of the case, the CAD/CAM processed lithium disilicate glass-ceramic veneers and crowns demonstrated excellent fit and function, while the addition of the high-value +3 shaded resin cement contributed to the high esthetics that were achieved (Figs. 14, 15).

**Conclusion**

Utilizing a highly esthetic all-ceramic material, CAD/CAM processing and provisionalization, the dentist in this case was able to provide the patient with restorations that demonstrated excellent fit, function and natural esthetics. Further, the patient benefited from the dentist’s ability to create the restorations chairside and in a single appointment. Chairside CAD/CAM technology and materials enable dentists to provide comprehensive and minimally invasive esthetic treatment, while reducing cost, chair-time and the number of patients for the dentist.4,8,9

Editorial note: A complete list of references is available from the publisher.
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A powerful new feature with the CEREC Software 4.0

Author_Armen Mirzayan, DDS

The new CEREC Software 4.0 and its functionality have set a new precedent for us dentists who have made the transition into the digital impressioning world! Many longtime users marvel at the progress that has been made, as most remember archaic and cumbersome processes in the technology during the first few decades of its inception. This article serves to highlight one of the many features that has the user base excited about the implementation of the CEREC Software 4.0 upgrade.

Traditionally, the CEREC approach was limited to scanning an intraoral preparation, designing the restoration and milling the all-ceramic material for immediate delivery. The occlusion was derived from either a database of pre-formed anatomy in relation to the opposing arch or from the pre-existing condition.

A common approach was to scan a pre-existing crown into the machine and then remove the prosthesis and scan the modified preparation. The pre-operative condition was essentially transferred to the preparation, and the final product was a duplicate of the pre-existing condition. The term for this approach was labeled “correlation,” and many users fancied this modality, as the clinician could replicate a crown that had rest seats and contours to accept a partial denture with clasps on a surveyed crown that was plagued with recurrent decay.

With CEREC Software 4.0, users now have the opportunity to incorporate both approaches for a single case, and the nomenclature has drastically changed to properly reflect the progress the software has made. Database designs have now become “Biogeneric Proposals,” because the software derives its contours, form and function from the anatomy of the adjacent teeth; and “correlation” is now called “Biogeneric Copy.”

This article documents a case that utilizes the technology and accurately reflects the “state” of CAD/CAM dentistry. A patient with no significant health history presented to our office with a fractured crown (Fig. 1). As a patient of record, she was advised in years past that there was an open margin on the upper left second molar and that we would continue to monitor the area on recall. The open margin, combined with the fractured crown, ultimately convinced the patient to address the matter with a replacement crown.

The pre-existing restoration had a zirconia substructure that was layered for esthetic reasons. The lack of clearance from the adjacent teeth did not allow for adequate thickness of the layered ceramic, which led to its demise. The trend in dentistry now is to move toward monolithic restorations that require strength in the posterior of the mouth, whereas patients do not wish to compromise on esthetics. The two predominant materials of choice now are full-contour zirconia or IPS e.max CAD lithium disilicate restorations. Zirconia restorations need to be sintered in a specialized oven, which can take from 90 minutes to four hours, and precludes them from being used as single-appointment processes. IPS e.max CAD has rapidly become the material of choice for many clinicians because of these circumstances.

Clinically, the patient was anesthetized, and the important optical impressions were captured during the onset of anesthesia. The patient closed to maximum intercuspation, and the buccal scan was captured in the Buccal Live Window (Fig. 2). The buccal scan is used to digitally occlude the opposing arches and captures the facial surfaces of the unprepared teeth in relation to each other. The patient then opens, and the Isolite system is placed to act as the bite block as well as for retraction, isolation and illu-
mination of the operating field. The CEREC Bluecam (Fig. 3) then captured the opposing lower arch as well as the remaining parts of the fractured crown that will serve to replicate the position of the remaining three cusps (Fig. 4) because the software now allows the user to capture more information than previously available with the “Add Area” feature (Fig. 5).

This task is generally accomplished in less than two minutes, which is adequate time for anesthesia in the working field. The crown was removed, and great care was taken not to damage the underlying tooth structure. Once the area was accessed, all traditional principles of dentistry were utilized to gain access to the margins visually. After hemostasis was achieved, the digital optical impressions were taken.

One of the significant concepts with digital impres-
CEREC Software 4.0

The clinician can instantly assess if the margins were properly captured, as opposed to waiting for up to five minutes for traditional PVS impressions to set and determine if the margins were void of any artifact or errors (Fig. 6).

The clinician now delineated the margins (Fig. 7), and the restoration is ready for design. The articulated models (Fig. 8) allow the clinician to determine if there is enough clearance with the opposing dentition to justify the use of all-ceramic restorations. The speckled look of the pre-existing model that is overlaid on the preparation model (Fig. 9) allows the clinician to see the relationship between those two models as well. In the design process, the copy line (Fig. 10) is used to delineate the parts of the pre-operative crown that one wants to re-create in the final restoration. Once the initial proposal is rendered (Fig. 11), the copy line is used to delineate the parts of the proposal that are a re-creation (Fig. 12) and the parts that were calculated by the software to complete the crown to full contour.

The white area of the model that is perforating through the gray is the area that was developed outside of the biogeneric copy principles and was rendered by taking the opposing anatomy and occlusion into consideration. The design tool wheel (Fig. 13) can be activated, allowing the restoration to be altered in many ways to suit the needs of the clinical situation. The restoration can be physically moved to any desired position, which allows for gross movements, whereas other tools, such as the new Shape tool, allow you to focus on specific areas for design edits (Fig. 14).

Once activated and selected (Fig. 15), the specific cusp can be narrowed into occlusion with the opposing cusps (Fig. 16) and the appropriate contact strength can be applied. Figure 17 shows the original missing cusp at full contour, in relation to the opposing, and Figure 18 demonstrates the area that was added to the original contour of the pre-existing crown. The final crown was then seated (Fig. 19), and the post-operative adjustments were minimal, even when checking excursively.

The new opportunities that have been unveiled with CEREC Software 4.0 allow the clinician to incorporate diagnostic and restorative options that were once left only to the imagination. The amount of effort required to capture all this information with traditional impressions that involved fabricating stone models inherently discourages clinicians to look at incorporating information that can be utilized during the restorative process. With digital impressions, no material or time is wasted in capturing pertinent diagnostic information that can aid the clinician in delivering a definitive restoration in a single appointment.
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Richard Rosenblatt, DMD

SIMPLE STEPS TO CHARACTERIZE YOUR CAD/CAM RESTORATIONS
Richard Rosenblatt, DMD

Friday, January 27, 2012
ESTHETIC ENHANCEMENT FOR CAD/CAM RESTORATIONS—STAIN AND GLAZE
Michael Skramstad, DDS

INTRAORAL IMPRESSION SCANNING DEVICES AND CAD/CAM
Paul Feuerstein, DMD

Saturday, January 28, 2012
IMPLANT PLACEMENT UTILIZING GUIDED SURGERY WITH CAT SCAN AND CAD/CAM TECHNOLOGY
Carl Bosckett, DMD

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Providing optimal long-term provisional fit, function and esthetics with Telio CAD

Author_ Darin O’Bryan, DDS

_Fig. 1_ Preoperative view of the patient’s lower central incisors. (Photos/Provided by Dr. Darin O’Bryan)

_Figs. 2, 3_ The laterals are prepared and the central incisors extracted.

As elective dentistry and implant therapy become more popular, provisional restorations are being used for longer durations. Increased restorative procedures have placed new demands on the dental industry for long-term provisional materials that provide optimal function, fit and esthetics for anywhere from weeks to months and sometimes longer. This intermediate phase is crucial for the proper preparation and confirmed success of the final restorative outcome. This article presents two cases in which Telio CAD was used to provide patients with durable, reliable and esthetically pleasing long-term temporaries quickly and efficiently.

_Introduction_

Because of the rise in elective procedures, temporary restorations are playing an increasingly important role in today’s dentistry. Properly fitted and reliable provisional restorations are relied upon by patients for utility and esthetics, and by dentists to prevent deterioration of the patient’s jawbone and maintain stability in the mouth. A critical phase in restorative procedures, temporary restorations can be required for anywhere from two weeks to 12 months or more, generating the need for dependable, long-term provisional materials suitable for chairside use with CAD/CAM applications and crown and bridge restorations.

As a solution, the new Telio (Ivoclar Vivadent, Amherst, N.Y.) system has been developed featuring three lines of materials for shade and material compatibility. Telio CAD, Telio CS and Telio Lab comprise a system that addresses the needs of dentists, dental technicians and in-office CAD/CAM users. The chairside and laboratory products were designed for compatibility, enabling collaboration between dentists and lab technicians across all phases of treatment.

Telio CAD acrylate polymer blocks can be used with CAD/CAM technology to fabricate long-term temporary crowns and bridges. Telio CAD eliminates the challenges associated with traditional temporization processes, such as polymerization shrinkage, impression errors, mixing errors and
Demonstrating durable shade stability and lifelike fluorescence, Telio CAD blocks are available in six shades and two bridge sizes, which makes it easy to fabricate provisional restorations, including temporary anterior and posterior crowns, bridges with up to two pontics, temporary restorations on implants and therapeutic restorations for correcting TMJ problems and occlusal adjustments. Boasting a high flexural strength of 130±10 MPa and flexural modulus of 3200±300 MPa, Telio CAD demonstrates durability and flexibility and, as a result, is considered an ideal provisional restorative material for implants and other clinical situations requiring long-term temporary placement.

Case presentation No. 1

A patient presented requiring a bridge restoration to replace the lower central incisors (Fig. 1). The laterals were subsequently prepared and a retraction cord was placed. The central incisors were then extracted, and a collagen plug was sutured into place to decrease bleeding and allow for an easier scan (Figs. 2, 3). The anterior teeth were scanned along with the antagonist (Fig. 4). The bridge was then designed in buccal bite with biogeneric software (Figs. 5–7).

Laboratory fabrication techniques

Because of the nature of the case, the temporary restoration was fabricated using a long-term provisional restorative material (Telio CAD, Ivoclar Vivadent, Amherst, N.Y.) according to the steps outlined by the author’s specific CAD/CAM system. For reliable restorative results, manufacturer instructions were adhered to and minimum thicknesses and connector dimensions were observed. Telio CAD was the provisional restorative material of choice based on its acrylate polymer (PMMA) blocks, which can be milled on-site, chairside using CAD/CAM technology. PMMA blocks provide the durability and reliability of plastic, making them ideal for the fabrication of long-term temporaries. When milling was completed, the restoration was separated from its holder using a fine tungsten carbide bur; a diamond separating disk may also be used. The restoration was then fitted in the patient’s mouth. Adjustment of the occlusion was made prior to polishing.

Finishing and polishing

The efficiency of this processing technique leads to an esthetic result quickly and easily. Any white
Clinical provisional restorations

Spots resulting from the milling process were removed using a tungsten carbide bur. Fine cross-cut carbide burs were used to finish the restoration, and the cross-cut tungsten carbide bur was also used to smooth out the attachment and perform any necessary shape adjustments. Caution was taken to avoid overheating the material.

The restorations were then tried in the patient’s mouth and carefully finished. The proximal and occlusal contact points were examined before surface grinding the entire occlusal surface with a fine diamond to smooth out the surface structure. Adjustments did not compromise minimum thickness requirements. Because residue from the milling additive may weaken surface bonding, the restoration was thoroughly cleaned before further processing. The restoration was tried in as needed.

For this fully anatomical processing technique, the restoration was polished and incorporated immediately after milling. Polishing reduces plaque accumulation and resulting shade disturbances, making it a prerequisite for an optimum esthetic result. Special attention was paid to crown margins, interdental areas, occlusal surfaces and the basal rest area of pontics. Surface luster was achieved by manual polishing utilizing rotary instruments and polishing paste (Universal Polishing Paste, Ivoclar Vivadent, Amherst, N.Y.). To achieve a lifelike surface gloss, close attention was given to the contact points and margins during polishing. Little pressure was applied, and the corresponding speed was used to avoid heat development.

Rubber polishers and silicone polishing wheels were used to smooth the convex areas of the natural structures, as well as the marginal ridges, to obtain an added luster after high-gloss polishing. Pre-polishing was completed with a handpiece, goat-hair brushes and fine pumice polishing paste (Universal Polishing Paste, Ivoclar Vivadent, Amherst, N.Y.). Next, the restoration was polished to a high gloss using goat hair brushes. Depending on the type of high gloss desired, leather buffing wheels could be used to achieve a high shine, while cotton buffs produce a lower luster.

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**Fig. 8** View of the anterior temporary bridge in place the day of the extraction after hemostasis is obtained.

**Fig. 9** Facial view of the temporary bridge for suture removal and examination of wound two weeks post-extraction.

**Fig. 10** Occlusal view of the temporary bridge for suture removal and examination of wound two weeks post-extraction.

**Fig. 11** A CEREC AC scan of the preparation on the lower premolar bridge.

**Fig. 12** The design of the premolar bridge utilizing the biogeneric software.

**Fig. 13** The design of the premolar bridge showing the antagonist.

**Fig. 14** Occlusal view of the premolar bridge design.
A low speed and limited pressure was used for optimal results while high-gloss polishing. To successfully polish the interdental areas and occlusal surfaces, the goat hair brush was modified into a star shape. With this modification and given the small size of the brush, only the desired areas were polished.

After finishing and polishing the restoration, it was tried in with minimal adjustments. When the patient was happy with the esthetics, it was placed with temporary cement (Telio CS Link, Ivoclar Vivadent, Amherst, N.Y.) (Fig. 8). To prepare the restoration for cementation, the inner aspects were blasted with Type 100 Al2O3 at 1 bar/29 psi pressure. Another technique for the cementation of restorations is to roughen the inner aspects with a rough diamond bur.

The patient was seen one week after the extraction for suture removal (Figs. 9, 10). After six weeks of healing, the final scan for a bridge (Emax Cad-on, Ivoclar Vivadent, Amherst, N.Y.) will be performed.

Case presentation No. 2

A woman presented unhappy with the fixed partial denture spanning teeth #27–29. The bridge was removed and the preparation refined and scanned (Fig. 11). A lower premolar provisional restoration bridge was then designed using the biogeneric software (Figs. 12–14). The temporary was fabricated using a long-term provisional restorative material (Telio CAD, Ivoclar Vivadent, Amherst, N.Y.) in the MCXL milling chamber, according to the steps outlined by the author's specific CAD/CAM system, and then characterized with color shades (Tetric color, Ivoclar Vivadent, Amherst, N.Y.).

The characterization materials were layered onto the incisal and occlusal area of the reduced, milled restoration. A highly esthetic restoration was quickly and efficiently achieved because of the limited application requirements of the layering material.

For a smooth transition between the temporary restoration material and the characterization material, targeted grinding of the transition areas to the cut-back regions was required, and the stains were applied with a brush in very thin layers of up to 0.2 mm. Any other suitable instrument also could have been used. The restoration was then light cured for one minute in a curing oven and finished and polished according to the protocol previously described in case No. 1. Regular hand-held light curing can also be utilized.

The patient has worn the temporary for three and a half months while waiting for the implant to integrate. With the temporary removed, the healing of the implant site could be seen (Figs. 15–18). The temporary showed no signs of wear, and the characterization stains remained steadfast.

Conclusion

The growing necessity for temporary restorations has put high demands on dental professionals to incorporate the use of long-term provisional restorative materials for this vital intermediate step. Temporary restorations are required to provide durability, reliability, accuracy of fit and optimal esthetics. The longer the provisional restoration is to remain in the mouth, the more important these characteristics become. With the development of acrylate polymer blocks specifically formulated for use with CAD/CAM technology, impression errors and polymerization shrinkage have been eliminated and lifelike, long-term reliable temporaries can be fabricated with accuracy and ease.

Editor's note: A complete list of references is available from the publisher.
Simple and efficient crown fabrication with an advanced CAD/CAM system

Author_Brian Buehler, DDS

Fig. 1. The patient presents after undergoing endodontic treatment one week earlier. (Photos/Provided by Dr. Brian Buehler)

Fig. 2. Temporary material remains on tooth #13. Additionally, decay and tobacco stains are noted on the adjacent teeth.

Fig. 3. Tooth #13 after preparation.

Today’s computer-aided design and manufacture (CAD/CAM) technologies contribute greatly to restorative dentistry and provide clinicians with advanced treatment options for various indications, including inlays, onlays, fixed partial dentures and full dentures, thin veneers and crowns.1,2 These systems also allow use of many restorative materials, including metal, metal-ceramic, composite and all-ceramic, to best meet the needs of the case and patient.1,2 Further, CAD/CAM systems are available for both chairside and laboratory applications, so dentists now have the ability to create highly esthetic and strong restorations in-office.1,2

Unlike earlier generations of in-office systems that presented clinical challenges, today’s technology and materials are cost-effective and efficient. Past systems lacked advanced software to accurately control the tool path and design a restoration, and inadequate scanning technology made it difficult to detect the delicate margins created during tooth preparation.1,2 The lack of advanced material sciences also contributed to a number of clinical challenges experienced with early CAD/CAM technology, and dentists struggled to properly seat CAD/CAM processed restorations. To address the clinical challenges experienced with early CAD/CAM technology, manufacturers have developed systems offering many advantageous features, including greater cost effectiveness, simplicity and efficiency.1,3

The CEREC System

Among this new generation of CAD/CAM systems is CEREC (Sirona Dental, Charlotte, N.C.), which was developed to address many concerns dental professionals had over the setup of conventional CAD/CAM software and machines.5,6 The milling chamber is now separated from the image capture and design hardware, allowing dental professionals to simultaneously design one restoration while milling another.5,6 With significantly higher speeds and greater memory, CEREC 3D design software allows users to view tooth designs as they would if evaluating traditional stone models.5,6

Today’s CEREC system includes a light-emitting diode (LED) camera (CEREC Bluecam, Sirona Dental) for greater accuracy and higher quality images than previous infrared-emitting camera systems, and the recent addition of CEREC Connect (Sirona Dental) allows impression and restoration information to be digitally acquired and transmitted over the Internet to dental laboratories.5,6 Laboratories can then fabricate restorations using the CEREC inLab System (Sirona Dental).5,6

The CEREC MC XL system (Sirona Dental) is a powerful and accurate low-noise chairside CAD/CAM
milling system offering simplicity and efficiency for processing single-tooth restorations in six minutes and quadrant restorations in three to four minutes in a single appointment.5-7

The CEREC MC XL demonstrates precision and accuracy within the range of +/- 25 microns, and the 7.5µ milling resolution creates restorations with improved fit and smoother surfaces.5-7 Additional features include automatic software downloads, simple display guides and network connectivity, while the milling chamber design enables easy block clamping without tools.5-7

**Material considerations**

To address CAD/CAM material concerns, manufacturers have developed new ceramic materials that provide improved strength and esthetics.5 These newer ceramics withstand CAD/CAM processing without chipping or fracturing and can be brought to full contour during milling to improve fit and function.7

Dentists can choose adhesive bonding or conventional cementation when seating these restorations, which ensures that case requirements are met.5 Improvements to cementation and adhesive systems have also enabled dentists to provide a strong bond between the restoration and underlying tooth substrates.1,4

**IPS e.max CAD**

Composed of 70 percent by volume needle-like crystals in a glassy matrix, lithium disilicate glass ceramic (IPS e.max, Ivoclar Vivadent, Amherst, N.Y.) offers many improvements over previous generations of ceramic materials.8 Available in a pressable format (IPS e.max Press) or for CAD processing (IPS e.max CAD), the material demonstrates strength values between 360 MPa (Press) to 400 MPa (CAD).8

IPS e.max also demonstrates lifelike optical qualities that enable dentists to create highly esthetic and naturally appearing restorations in a variety of cases.8 The versatile material is indicated for anterior and posterior restorations, including thin veneers (0.3 mm), minimally invasive inlays and onlays, partial crowns and crowns, implant superstructures, three-unit anterior/premolar bridges (press only),

**Fig. 4** The preparation of tooth #13, surrounding dentition and soft tissues are sprayed with CAD/CAM scanning powder prior to scanning with CEREC AC.

**Fig. 5** The IPS e.max CAD lithium disilicate crown after milling in CEREC MC XL.

**Figs. 6, 7** The lithium disilicate crown is tried in the patient’s mouth to confirm fit, contour and anatomical harmony prior to firing.

**Fig. 8** Tobacco stains are placed on the crown to mimic the surrounding dentition, and the crown is crystallized.

**Fig. 9** Luting composite is placed on the internal surfaces of the crown.
Clinical crown fabrication

Case presentation

A 53-year-old man presented after undergoing recent endodontic treatment on tooth #13 (Figs. 1, 2) and was unhappy with the tooth’s appearance. Along with decay on the adjacent dentition, tobacco stains were also present because the patient was a smoker. Although the patient requested treatment be confined to only tooth #13, after a routine head, neck and oral cavity examination, the patient was informed of multiple treatment needs and advised that a comprehensive treatment plan should be started as soon as possible.

Treatment plan

The patient brought to the office the endodontic report from his other clinician, advising that a good prognosis was expected from his endodontic treatment. Although the report did not detail the possible need for crown lengthening or gingivectomy procedures, these were areas of diagnostic concern in this case. However, biologic width encroachment did not appear to be an issue during cleaning and probing.

To address the patient’s concern with the esthetic appearance of tooth #13, high-translucency and high-strength lithium disilicate glass-ceramic would be CAD/CAM processed into a crown. Milled to as thin as 300 um, the lithium disilicate crown would instill a contact lens effect on the gingival-facial margin of tooth #13.

The crown would then be bonded in place with an adhesive, demonstrating high radiopacity to ensure excess cement was not inadvertently left behind, specifically in the deep distal margin in this case. The adhesive bonding agent also ensured that cementation was predictable. When complete, the tooth would appear natural and indistinguishable from the surrounding dentition.

Clinical protocol

After thorough examination and prophylaxis, tooth #13 was prepared for restoration with a CAD/CAM (CEREC MC XL) processed lithium disilicate crown (IPS e.max CAD) and the temporary material removed. A specialized mouthpiece (Isolite, Isolite Systems, Santa Barbara, Calif.) was placed intraorally to ensure total isolation was achieved (Fig. 3).

Prior to scanning, the tooth #13 preparation, the surrounding dentition and the soft tissues were sprayed with a CAD/CAM powder (Fig. 4). The anatomical form of the dentition and soft tissues were then captured using an LED scanning unit (CEREC/Bluecam). After scanning, three-dimensional software (CEREC 3D) was used to design the desired crown contours and occlusal relationships. A pre-fabricated high translucency lithium disilicate block (IPS e.max CAD) was then milled chairside (CEREC MC XL) into a crown for tooth #13 (Fig. 5). Lithium disilicate was the material of choice in this case because it demonstrates high strength and lifelike optical properties.

The crown was tried in the patient’s mouth over the tooth #13 preparation to evaluate fit, contour and anatomical harmony (Figs. 6, 7). Upon confirmation of proper fit and function, the crown was cleaned, removed, and dried. Stains were then placed on the crown surface to mimic the tobacco stains on the surrounding dentition. However, it was decided that cervical stains to mimic the decay on the natural
dentition would not be placed. After staining, the lithium disilicate crown was crystallized and ready for immediate seating (Fig. 8).

The specialized mouthpiece (Isolite) was repositioned in the mouth to isolate the tooth during cementation.

Dual-curing luting composite (Multilink Automix, Ivoclar Vivadent, Amherst, N.Y.) was used to seat the crown. Indicated for use with metal, all-ceramic, metal-ceramic and composite restorations, the luting composite offers a strong hold on all surfaces and is available in transparent, yellow or opaque shades to ensure proper esthetics are achieved. Additionally, the cement does not need to be protected from ambient light during mixing and placement.

Prior to application, the primer liquids (Multilink A/B) were mixed in a 1:1 ratio. A microbrush was used to apply and lightly scrub the primer mix on the preparation enamel and dentin for 15 seconds. The priming agent was allowed to set on the enamel and dentin for 30 seconds, after which time air was used to evaporate the primer solvents. Because the primer is self-curing, light-curing was unnecessary.

The luting composite (Multilink Automix) was extruded from the mixing tip and placed directly on the inner surfaces of the lithium disilicate crown (Fig. 9). The luting composite was placed carefully to ensure all internal surfaces were fully covered. The lithium disilicate crown was then seated on tooth #13 and slight pressure applied (Fig. 10).

A microbrush was utilized initially to remove excess cement from the interproximal spaces and cervical areas of the crown (Fig. 11). Further pressure was applied with dental forceps to ensure the crown remained seated in the proper position during initial cleanup (Fig. 12). Still applying pressure to the seated crown, excess cement between the interproximal areas of the crown and surrounding dentition was removed with dental floss (Fig. 13).

After flossing, the crown was cured with a LED curing light (bluephase G2, Ivoclar Vivadent, Amherst, N.Y.) on the buccal, mesial, lingual and distal surfaces (Fig. 14). The interproximal spaces were then flossed to ensure all excess cement had been removed (Fig. 15).

Upon completion of the case, the CAD/CAM (CEREC MC XL) processed lithium disilicate glass-ceramic crown (IPS e.max CAD) cemented with a dual-curing luting composite (Multilink Automix) demonstrated excellent fit, function and strength (Figs. 16–21). Additionally, a postoperative radiograph confirmed all excess cement was removed and excellent internal/marginal adaptation was achieved (Fig. 22).

The patient was very pleased with the esthetics of the crown, which appeared natural and indistinguishable from the surrounding dentition. Further, the patient was pleased he did not have to return for another appointment because the chairside CAD/CAM system allowed the restoration to be scanned, designed, milled and seated in a single appointment.

**Conclusion**

The author uses the CEREC CAD/CAM system almost exclusively in his practice because patients appreciate the quality, immediacy and not having to return for additional appointments. Restorations milled with CEREC demonstrate the form and fit required for restoring even the most challenging cases. Patients also enjoy the high esthetics and strength of lithium disilicate glass-ceramic IPS e.max that has been milled with CEREC.

Editor’s note: A complete list of references is available from the publisher.
Imagine you’re at your office at the end of the day and your receptionist tells you Dr. Burke from the Chicago Dental Society left you a voicemail.

You punch into your voicemail and listen:

“Hello, I’m Dr. Tom Burke from the Chicago Dental Society, and we’re interested in talking to you about presenting at this year’s Chicago Midwinter Meeting. I know the meeting is in two weeks, but we had one of our speakers cancel at the last minute, and I’m hoping you’re available to speak at the general session. I understand you have a lot of experience with digital impressioning and CAD/CAM dentistry and would love to hear from you as soon as possible if you’d be interested in helping us out.”

You listen to the rest of the message filling in all the details. You leap with excitement – the Chicago Midwinter Meeting! One of the best meetings in the country!

And a heartbeat later you think, “Oh wow, what am I going to talk about? How do I quickly assemble a stand-out talk to a great audience that could result in putting me on the map of top clinicians?”

Tell the truth – would you like to get this invitation to speak at the Chicago Midwinter Meeting?

If you DID get that call, are you ready?

If you’re not ready, don’t you want to be?

It’s time to get ready

Close to 30 years ago, I placed my first dental implant. Back then, in 1978, few dentists had even seen an implant and fewer yet ever placed one. Implant dentistry was in the domain of the innovator dentist, the risk taker, the visionary (although many labeled us as “nuts”).

Today, implant dentistry is introduced in undergraduate dental schools and is part of mainstream dentistry. In fact, if you’re not recommending dental implants for tooth replacements, you may be considered “nuts.”

How did implant dentistry go from being practiced by very few to mainstream dentistry? Its progress was fueled by the combination of innovative manufacturers and outspoken dentists, laboratory technicians and researchers all spreading the good news of implant dentistry at our association meetings, study clubs and publications.

Digital dentistry (digital impressioning, CAD/CAM, cone-beam radiology) is in a similar position implant dentistry occupied 30 years ago; relatively few practitioners (less than 12 percent) understand and use it on a routine basis. Even though the technology of digital dentistry is mature and predictable, it’s still in the domain of the innovator/risk taker dentist. Too often these innovators are viewed as “computer nerds” and “techies,” thereby holding minor appeal in the mainstream dentist marketplace.

However, digital dentistry has a terrific advantage over how dental implants were initially viewed, in that this technology is far more easily assimilated.
into the general practice. That critical fact, combined with today’s robust Internet communities, allows the good news of digital dentistry to travel quickly and globally.

So, what’s the final ingredient required to take digital dentistry into mainstream dentistry? We need strong and well-trained advocates telling their personal stories!

It’s time to get ready.

It’s time to tell your story of digital dentistry and transform restorative dentistry forever.

**Telling your story**

Here’s a proven process for you to tell your story of digital restorative dentistry. It’s called StorySelling®.

StorySelling links your personal story to your topic and offers the listener a glimpse into your world, giving them a sense of who you are aside from your role as a speaker.

Here’s an example of what I mean.

Let’s say I’m preparing my presentation for the Chicago Midwinter Meeting. I’ll use StorySelling in the beginning of my talk to introduce myself and my topic.

After thanking my introducer and acknowledging my host, I say: “I grew up in Elmhurst, Ill., about 20 miles west of Chicago, not far from here. Our family, the six of us — my mom and dad and my three siblings — lived in a 900-square-foot home with one bathroom.

“My parents paid $10,000 for our house and mortgaged it for 30 years, with a monthly payment of about $50. My dad was a carpenter with an eighth-grade education, and my mom raised us kids. Every month it was tough for my parents to come up with that $50. Money was really tight.

“But growing up through grade school, I never had a sense of us being poor. I was the baby in the family, and my older brothers and sister were wildly entertaining, and I never remember being bored.

“My oldest brother, Clarke, is the original techie. Clarke built his first radio from scratch when he was 11 years old. By the time he was 15, he was building ham radio transceivers from a mail order company called HeathKit — long before there was a Radio Shack.

“Our home was heated by a coal furnace in our basement, with a coal bin room right next to it. Around the time Clarke was building ham radios, my dad converted the coal furnace to gas.

“Clarke cleaned up the coal bin and made it into his own little room where he set up all his radios. By this time, I was in second or third grade, and I’d sit there with Clarke, both of us wearing earphones.

“Clarke would let me turn the big black tuning knob, searching for distant signals that came in over his ham radio from all over the world. Nearly every day, we’d spend hours together in the radio room with me working the radio while he smoked cigarettes he stole from dad.

“Inside Clarke’s early radios were rows of thin, glass vacuum tubes. When he’d turn on the radios, it took a few seconds and the tubes would begin to glow and get warm. When they’d burn out, we’d save them and blow them up with firecrackers.

“One day Clarke showed me a radio he built that had no tubes at all.

“‘Lookie here, Paulie — no tubes,’ he said. (My brothers and sister called me Paulie.)

“‘Where are the tubes?’ I asked.

“Clarke answered, ‘They’re gone. I use transistors now; they do the same things as tubes but do it better. We don’t need tubes anymore.’

“In dentistry, what don’t we need anymore?

“We don’t need paper appointment books. We don’t need racks of patient records. We don’t need film for our cameras. We don’t need dark rooms and dip tanks. Computers and digital information technology have replaced them all.

“My first topic is how digital restorative technology is a natural extension of today’s digital information technology that you already use and enjoy.”

This introduction, using StorySelling, takes a little more than two minutes, the perfect length for introductory remarks.

The reason I start my Chicago Midwinter Meeting presentation with StorySelling is because it provides the critical component of disclosure.

**Disclosure**

Disclosure is critical for speakers who seek to influence mainstream dental audiences. Disclosure is the experience of the listener when they discover a bit of who you are aside from your role as a speaker and expert. Mainstream dentists need to know who’s influencing them.
They must buy into you before they buy into your ideas.

Typical dental speakers present their content as if it were separate from them (Fig. 1).

Most speakers are hidden behind their content—but the audience doesn’t get a sense of who they are apart from that content.

To your listener, your point of view (as a speaker) is, at times, difficult to evaluate on its technical merit. Listeners need other sources of influence to decide whether to believe the speaker and follow his or her advice.

Disclosure is a huge influencing factor.

The story about my brother, Clarke, discloses a small glimpse into my childhood and the environment I grew up in. The reason I like telling stories about growing up is it’s the one thing we all have in common—we all grew up!

I want to create the “in common” experience with my audience early in my presentation. It connects us.

The story about my brother and my home inspires listeners to think about their siblings and their home environment.

Didn’t my story remind you of a memory in your life?

Disclosure provides the listener a “keyhole” to look into my life. When they look into the keyhole, they see a little bit of themselves. This is what unites us and helps me become more influential. (Incidentally, this technique works great with patients and team members.)

Don’t completely rely on your expertise to exert your influence. Give your listener a sense of who you are aside from your content. Stories, embroidered into your content, can reveal who you are (Fig. 2).

**StorySelling®**

StorySelling links a story to your content and contains three parts (Fig. 3):

1. The story
2. The transferable concept
3. Your topic

It’s a one-two-three punch—the story provides disclosure and listener interest, the transferable concept is the link and your topic is your expertise. Link listener interest with expertise, and the result is influence.

**The story in StorySelling**

The concept of a story within the context of StorySelling is short narratives about simple memories, current/historical events, movies, books and songs. These stories are simple narratives.

Tell stories that are:
1. Short—one to two minutes
2. Character-centered, not plot-centered
3. Emotional
4. Common experiences
5. Contain metaphorical opportunities

We’re surrounded by stories. Just pay attention to what’s going on in your family, the world, seasons, special events and life in general. The important thing to remember about stories is to have them disclose a bit of who you are aside from your role as a speaker/expert.

**The transferable concept of StorySelling**

The transferable concept is a word or phrase from your story that links to your topic. This link makes your topic come to life and enables listeners to think about your content in terms of things they’re already familiar with.

The transferable concept is the “high-point” of your story. In my story about my brother, Clarke, the transferable concept is, “What don’t we need anymore?” My story ends with it and my topic begins with it. Here’s how it looks (Fig. 4).

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**Influential Speakers Present Themselves Along with Content**

**StorySelling®**

**Figs. 2 and 3**
The transferable concept should do five things:
1. Let listeners understand your content from a point of view they’re already familiar with.
2. Arrive in the last sentence or the last words of your story — then reappear in the first words or sentence of your content.
3. Create a mental picture.
4. Satisfy the listener to your motive for telling your story.
5. Be versatile enough to be called back to in other areas of your content.

_The topic of StorySelling_

Your story and transferable concept create a peak of listener interest. Now’s the time to deliver a key topic point — something you want to really stick with your listener.

Examples of strong content statements are a (an):
1. Call to action.
2. Outcome from which the listener can benefit.
3. Conclusion or a decision you want the listener to make.
4. Statement that acknowledges/overcomes an objection/resistor the listener may have.
5. Preview of what the listener is about to hear and why it’s important to him or her now.

In the story about my brother, my key topic point is, “We don’t need paper appointment books. We don’t need racks of patient records. We don’t need film for our cameras. We don’t need dark rooms and dip tanks. Computers and digital information technology have replaced them all."

“My first topic is how digital restorative technology is a natural extension of today’s digital information technology that you already use and enjoy.”

Now move right into your great content, riding the emotional momentum created by the story and transferable concept. Do this well, and your listeners will be engaged, connected and influenced — and you’ll be invited back!

_The Sirona Speakers Academy_

Early in 2010, Roddy MacLeod, who is Sirona’s vice president of CAD/CAM, and I conceived the idea of creating a training entity for existing and new CEREC® speakers. We introduced the concept at CEREC’s 25th Anniversary meeting in Las Vegas, where we received interest from more than 130 dentists and team members. Since then the Sirona Speakers Academy has grown and thrived.

Here’s how it works.

Anyone who is a Sirona advocate is eligible to join — dentists, team members, hygienists, laboratory technicians/owners, consultants, CEREC specialists, sales personnel, etc.

Workshops are held in Charlotte, N.C., during three consecutive days. We limit each seminar to 12 attendees, thereby maximizing one-on-one coaching opportunities. Observers — spouses and team members — are welcome to attend.

Feedback from those who have attended this training is overwhelmingly positive. Graduates discover how to assemble presentations in half the time with twice the impact.

As a direct outcome of this training, they’re presenting with confidence, are no longer “winging it” and experience a much greater impact and influence on their audiences.

And the benefits of joining the Sirona Speakers Academy don’t end with speaker-focused events. Attendees experience an overall improvement in their ability to connect and influence listeners in their practice and personal lives.

Dr. Mike DiTolla, director of clinical education at Glidewell Labs and editor of Chairside Magazine and graduate of the Sirona Speakers Academy, says: “The Sirona Speakers Academy not only made me a better speaker, it helped me communicate better with my patients and team. If you want to make a big difference, get involved with the Sirona Speakers Academy.”

Story Selling is just one of the many speaker competencies you’ll develop at the Sirona Speakers Academy. There’s so much more.

Visit www.paulhomoly.com/sirona-introduction.asp to read all about the Sirona Speakers Academy and get involved.

The Sirona Speakers Academy is your opportunity to spread the word of digital restorative dentistry to our profession. Sirona, the leader in digital restorative dentistry, and I invite you to be part of a worldwide community of the best speakers advocating digital restorative dentistry.

It’s time to tell your story._

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Dr. Paul Homoly, CSP, holds the highest earned designation in professional speaking — certified speaking professional (CSP) — from the National Speakers Association. He is the first and only dentist in the world to earn the CSP designation. Homoly practiced restorative and implant dentistry for 20 years, speaks worldwide on practice and professional development and now leads the Sirona Speakers Academy.
Of all the procedures performed on a routine basis, the one procedure that is universally perceived by patients as the most fearful and anxiety provoking is the dental injection. In spite of the significant advances made during the past 100 years, our profession has yet to conquer one of the greatest challenges of dentistry — or has it? Milestone Scientific, after spending the past decade responsibly and methodically studying this problem, now believes that with the introduction of its new instrument, The Wand®/STA Single Tooth Anesthesia System, this age-old problem has finally been conquered.

The Wand/STA Single Tooth Anesthesia System represents the world’s first and only technology that uses the patented Dynamic Pressure Sensing® (DPS®) technology, which accurately and safely performs a pressure-regulated intra-ligamentary dental injection. The new Wand/STA Single Tooth Anesthesia System can also perform all traditional dental injection techniques, i.e., inferior alveolar block, supra-periosteal infiltration, etc. All techniques are performed more efficiently, more effectively and virtually painlessly.

Milestone’s new technology incorporates visual and audible real-time feedback, giving clinicians an unprecedented level of control and information when performing a dental injection. The Wand/STA Single Tooth Anesthesia System replaces the antiquated heavy metal dental syringe with an ultra-lightweight disposable handpiece weighing less than 10 grams for superior ergonomics and tactile control. The experience for both patient and dentist is one that is significantly less stressful.

Milestone Scientific created and defined a new category of dental instruments called C-CLAD® (computer-controlled local anesthetic delivery) systems. These are the only dental injection instruments that have the published scientific data that substantiate the claim of eliminating or reducing pain perception when performing a dental injection.

This technology has undergone the rigors of clinical testing that has been performed in numerous universities and research centers throughout the world for more than a decade. These studies are published in some of the most highly respected dental journals in our profession. No other instrument, technology or device developed specifically to reduce pain and anxiety while performing a dental injection can currently make that statement.

With the introduction of C-CLAD technology, several newly defined injections were also introduced to dentistry. The Wand/STA Single Tooth Anesthesia System has been optimized to perform these new dental injections. The first of these techniques, the anterior middle superior alveolar (AMSA) nerve block, published in 1997 by Friedman and Hochman, is a contemporary technique to achieve maxillary pulpal anesthesia of multiple maxillary teeth from a single palatal injection without producing the undesired collateral anesthesia to the lip and face. Subsequently, Friedman and Hochman introduced a second injection, named the palatal-approach anterior superior alveolar (P-ASA) nerve block, in which pulpal and soft tissue anesthesia of the central and lateral
incisors are achieved by a single palatal injection. The general reduction in pain perception for all injections has led to innovative ways to produce more efficient and effective dental anesthesia.

In addition to the new dental injections discussed above, The Wand/STA Single Tooth Anesthesia System improves the success rate of traditional injections such as the inferior alveolar nerve block. Holding the Wand handpiece with its unique penlike grasp allows the clinician to easily rotate while simultaneously moving the needle forward, increasing accuracy by decreasing needle deflection. Advancing the ability to use the new multi-cartridge injection feature, the Wand/STA Single Tooth Anesthesia System provides numerous advantages when performing traditional injection techniques.

The introduction of The Wand/STA Single Tooth Anesthesia System represents a material improvement over previous versions of this exciting technology. Numerous innovative new features are available in the Wand/STA Single Tooth Anesthesia System, including automatic purging of anesthetic solution that primes the handpiece prior to use, automatic plunger retraction after completion of use, a multi-cartridge feature allowing multi-cartridge injections and reduction of anesthetic waste.

Milestone Scientific has developed a novel training feature in the Wand/STA Single Tooth Anesthesia System, providing clinicians with spoken instructional guidance on the use of the instrument and thereby substantially reducing the initial learning curve. The Wand/STA Single Tooth Anesthesia System is today’s most advanced C-CLAD technology and represents the next generation of computer-controlled drug delivery instruments for dentistry._

References

The sunny side of CAD/CAM: A look at products from Sun Dental Labs

_Improved turnaround times_

With CAD/CAM technology, dental technicians can quickly tell if a bite is off or a margin is inaccurate. They can then immediately contact the dentist and ask for a new file or impression. With real-time troubleshooting capabilities, remake percentages are lowered dramatically.

“Using our CAD/CAM technology, we are able to save our clients time and money,” explained Rick Brewer, CDT, Sun Dental Labs’ lab manager. “With our software, we can tell instantly if the fit of a crown and bridge is correct. If it isn’t, we can get in touch with the doctor right away for a new model or file. Ultimately, we want to deliver a crown or bridge that doesn’t require any chairside adjustments.”

_Increased accuracy_

Milling equipment is typically accurate to 50 micrometres. CAD/CAM dental restorations are comparable in fit to traditionally fabricated dental restorations. Accuracy is critical, particularly because the fit of a restoration is the key to preventing future tooth damage. For example, an ill-fitted crown can leave space between the teeth, or between the tooth preparation and the restoration, which could lead to an increased risk of infection or decay.

_Better long-term patient results_

Because these types of restorations contain no metal to block subsequent X-rays, dentists are able
to keep track of potential decay underneath a full zirconia restoration, whereas conventional PFM or traditional gold crowns block X-ray radiation, disallowing such an evaluation over time.

As CAD/CAM enables dental practitioners to seat a finished restoration in a week’s time, practitioners find that treated patients have fewer side effects, such as tooth sensitivity, following their dental treatment.

_Sun Dental Labs goes digital_

With the introduction of CAD/CAM to the dental industry, laboratory personnel must now become computer whizzes who machine single-crown or multi-unit bridge restorations and, when necessary, layer or press the veneering porcelain to the CAD/CAM copings as well as impart esthetic characterizations or final contouring to the restorations.

According to Edward McLaren, DDS, MDC: “All normal, basic and repetitive procedures will disappear and be replaced by CAD/CAM. In the not-too-distant future, most model work for single- or two-tooth restorations will be completed by CAD/CAM, since dentists will most likely incorporate digital impression taking. When traditional models are used — which will also be generated by CAD/CAM — they likely will involve multiple teeth, or cases requiring occlusal adjustments.”

Enhancements to the milling technology itself have given rise to more accurate and precise CAD/CAM restorations. Today, a patient would feel comfortable with the esthetics and fit of a CAD/CAM-generated restoration for a molar and maybe a bicuspid, but at this point, some adjustment from a laboratory ceramist may be necessary so it is customized for the patient’s mouth.

“For CAD/CAM restorations for anterior teeth — though available from chairside systems — the quality of the final esthetics from machining alone is marginal at best,” McLaren said. “Ideally, anterior teeth that are initially machined strongly benefit by skilled laboratory ceramists who can provide the finishing artistic and esthetic touches required for the esthetic zone.”

_The future of CAD/CAM_

As with any restoration, the success of CAD/CAM restorations are dependent on a good preparation, a detailed impression (physical or digital) and an understanding how to design (or traditionally wax-up) a restoration that will satisfy dentist and patient expectations.

But CAD/CAM technology has still not advanced to the point that non-dentally trained individuals could run the technology and fabricate restorations. It will still be necessary to use a true dental professional who can visualize the finished product to make CAD/CAM work. These professionals also need to understand the machining capabilities of the milling unit and how to optimize designs to work within those capabilities.

_Sun Dental Labs’ CAD/CAM products_

• **Suntech® Full Zirconia:** Using CAD/CAM technology, the anatomical features, size and shape of a Suntech Full Zirconia crown or bridge are designed from the scan of a model or from an STL file. The restoration is then milled from a single block of ceramic material in a milling chamber to a perfect replica of the digital design. The restoration is then customized with stains before being fired in a sintering oven. Then it is finished, glazed and polished to create a more natural look.

• **Suntech Pro Temporary Crown:** Suntech Pro Temporary Crowns are designed and manufactured via CAD/CAM technologies. A tooth-colored acrylic material with a high level of breaking strength, Suntech Pro is perfect for temporary crowns, bridges and long-term temporaries.

• **Suntech Custom Implant Abutments:** Another convenient application for CAD/CAM processes is the fabrication of customized implant abutments, either titanium or zirconia. This is the case for anterior teeth as well as bicuspid, because esthetic zone implants typically require customized abutment shapes. Sun-Tech Implant Abutments come in titanium, zirconia and hybrid materials, are platform independent and are available for all major implant systems.

In addition to its Suntech products, Sun Dental Labs offers e.max and Empress CAD Crowns and Copings from its CAD/CAM milling center.

To learn more about Sun Dental Labs and its CAD/CAM technologies, please visit [www.sundentallabs.com](http://www.sundentallabs.com).
Get ready for Yankee Dental Congress 2012

Do you have plans for Jan. 25–29, 2012? Well you will after reading what Yankee Dental Congress has to offer next January at the Boston Convention and Exhibition Center. With more than 300 educational courses and 450 exhibitors, all of your needs for dental education will be met as you “Ride the Wave to Success in Dentistry.”

Highlights of the meeting include:

- **Madow Brothers** — Rock ‘n’ roll dentists David and Richard Madow will give their high-powered, Las Vegas-style presentation for the first time at Yankee.
- **Disney Institute** — Chris Caracci, a lead health care consultant from the Disney Institute, will present practice management and real customer service, the Disney way.
- **Opening keynote speaker** — Come be inspired by the words of Dick Hoyt, who has competed in road races worldwide, including 30 Boston Marathons, with his wheelchair-bound son, Rick. Join him for a presentation Thursday morning followed by breakfast on the show floor. Admission to this event is free to all.
- **Face transplant pioneer** — Dr. Daniel Alam, chief of facial esthetics and reconstructive surgery at the Cleveland Clinic, will present a behind-the-scenes look and follow-up of the first ever successful face transplantation performed in the United States.
- **Team development day** — A new twist to this program will feature working through a day of not-so-typical patients, highlighting varied medical histories, emergency situations and unique clinical challenges, all with the guidance and help of experts in each field.

The following will also be back.
- **Live Dentistry** — See all-new, cutting-edge procedures performed on live patients.
- **Expanded High-Tech Playground** — Touch and try all the new gadgets at your pace without any sales pressure.
- **Free lunch on the Exhibit Hall Floor** — Now on Saturday, Jan. 28. Have a bite to eat while talking shop with 450-plus exhibitors.

Registration and housing will open on Sept. 21. Be sure to register early; more than 40 percent of the educational courses sold out last year. If you register four or more dental professionals from your office, the fifth person will go for free (some restrictions apply). Visit www.yankeedental.com for details.

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**Top.** The exhibit hall floor at Yankee Dental Congress. (Photo/Fred Michmershuizen/Dental Tribune)

**Bottom.** A view of downtown Boston. (Photo/Provided by Greater Boston Convention & Visitors Bureau)
submissions: formatting requirements

Please note that all the textual elements of your submission:
- the complete article,
- all the figure captions,
- the complete literature list and
- contact info (bio, mailing address, e-mail address, etc.)

must be combined into one text document. Please do not submit multiple files for each of these items.

In addition, images (tables, charts, photographs, etc.) must not be embedded in the text document. All images must be submitted separately, and details about how to do this appear below.

If you are interested in submitting a C.E. article, contact us for additional instructions before you make your submission.

Text length

Article lengths can vary greatly — from a mere 1,500 to 5,500 words — depending on the subject matter. Our approach is that if you need more or less words to do the topic justice then please make the article as long or as short as necessary.

We can run an extra long article in multiple parts, but this is usually discussing a subject matter where each part can stand alone because it contains so much information. In addition, we do run multi-part series on various topics.

In short, we do not want to limit you in terms of article length, so please use the word count above as a general guideline and if you have specific questions, please do not hesitate to contact us.

Text formatting

Please use single spacing and un-indented paragraphs for your text. Please do not put a blank line between paragraphs.

We also ask that you forego any special formatting beyond the use of italics and boldface, and make sure that all text is left justified.

If you would like to emphasize certain words within the text, please only use italics (do not use underlining or a larger font size). Boldface is reserved for article headers.

Please do not “center” text on the page, add special tab stops, or use underlining as all of this must be removed before layout. If you require a special layout, please let the word processing program you are using help you to do this formatting rather than doing it by hand on your own.

If you need to make a list or add footnotes or endnotes, please let the word processing program do it for you automatically. There are menus in every program that will help you to do this.

The fact is that no matter how careful one might be, errors have a way of creeping in when you try to hand number footnotes and literature lists.

Image requirements

Please number images consecutively throughout the article by using a new number for each image. If it is imperative that certain images are grouped together, then use lowercase letters to designate the images in a group (i.e., Fig. 2a, Fig. 2b, Fig. 2c).

Please put figure references in your article wherever they are appropriate, whether that is in the middle or end of a sentence but before the period.

If you are not directly mentioning the figure in the body of your article, when it appears at the end of the sentence the figure reference should be enclosed within parenthesis and appear before the final period.

In addition, please note:
- We require images in TIF or JPEG format.
- These images must be no smaller than 4 x 4 inches in size at 300 DPI.
- Images cannot be any smaller than 80 KB in size (or they will print the size of a postage stamp).

Larger images are always better, and something on the order of 1 MB is best. Thus, if you have an image that is greater than 1 MB, please do not bother “sizing it down” to meet our requirements, but send us the largest file size available.

The larger the starting image is in terms of bytes, the more leeway the designer has in terms of resizing the image to fill up more space should there be room available.

Also, please remember that you should not embed the images into the body of the text document you submit. Images must be submitted separately from the textual submission.

You may submit images through a zipped file via e-mail, unzipped individual files via e-mail or post a CD containing your images directly to us (please contact us for the mailing address as this will depend upon where in the world you will be mailing them from).

Please do not forget to send us a head shot photo of yourself that also fits the parameters above so that it can be printed along with your article.

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An abstract of your article is not required. However, if you choose to provide us with one, we will print it in a separate box.

Contact info

At the end of every article is a contact info box with contact information along with a head shot of the author.

Please note at the end of your article the exact information you would like to appear in this box and format it according to the previously mentioned standards.

A short bio (60 words or less) may precede the contact info if you provide us with the necessary information.

Questions? Comments?

Please do not hesitate to contact us for our International C.E. Magazine Author Kit or if you have other questions/comments about the article submission process:

Group Editor Robin Goodman
r.goodman@dental-tribune.com

Managing Editor Fred Michmershuizen
f.michmershuizen@dental-tribune.com
CAD/CAM
the international C.E. magazine of digital dentistry

U.S. Headquarters
Dental Tribune America
116 West 23rd Street, Ste. 500
New York, NY 10011
Tel.: (212) 244-7181
Fax: (212) 244-7185
feedback@dental-tribune.com
www.dental-tribune.com

Publisher
Torsten R. Oemus
t.oemus@dental-tribune.com

Chief Operating Officer
Eric Seid
e.seid@dental-tribune.com

Group Editor
Robin Goodman
r.goodman@dental-tribune.com

Managing Editor
Fred Michmershuizen
f.michmershuizen@dental-tribune.com

Designer
Kristine Colker
k.colker@dental-tribune.com

Designer
Sierra Rendon
s.rendon@dental-tribune.com

C.E. Director
Julia Wehkamp
j.wehkamp@dtstudyclub.com

C.E. International Sales Manager
Christianne Ferret
c.ferret@dtstudyclub.com

Marketing Manager
Anna Wołodarczyk-Kataoka
a.wołodarczyk@dental-tribune.com

Marketing Assistant
Lorrie Young
l.young@dental-tribune.com

Accounting
Melissa Chan
m.chan@dental-tribune.com

List Manager
Christopher Ceparan
database@dental-tribune.com

Product/Account Manager
Mark Eisen
m.eisen@dental-tribune.com

Product/Account Manager
Humiberto Estrada
e.estrada@dental-tribune.com

Product/Account Manager & Interactive
Gina Davison
g.davison@dental-tribune.com

International Product/Account Manager
Jan Agostaro
j.agostaro@dental-tribune.com

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