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CAD/CAM

the international C.E. magazine of digital dentistry

2 2013

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_technique
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The evolution of digital dentistry

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It's a brand new day

Dr. Mike Moroni

_In many ways, the evolution of dentistry is tangibly evident. The basic principles of performing dentistry have been ingrained in our DNA since our time in dental school. What we do with the knowledge and ability we develop in dental school depends on our ability to expand and evolve our skills to solve increasingly complex problems to the benefit of our patients.

The practice of dentistry is continuously evolving. It started with computers to track appointments; then digital radiographs, leading to digital CT scans. While we have firmly rooted knowledge in the basic principles of dentistry, there is massive change on the horizon. Many of us do not take impressions for a crown anymore. There is no need to send a single crown to a lab to be fabricated. In fact, many labs were first adopters and continue to embrace this technology. With CAD CAM, we can now produce lab-quality restorations within our own offices.

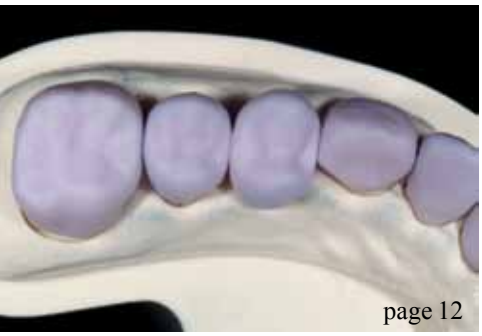
The same basic preparation of a tooth is slightly modified and evolved to smoother edges with no sharp angles. This allows the CAD/CAM restoration to fit as perfectly as it can. We can set the marginal ramp, the adhesive gap, the thickness of the material being used; everything is within our power to control.

While CAD/CAM was introduced years ago, this technology continues to expand and evolve. E4D is leading the way in CAD/CAM dentistry with the NEVO restoration system. With the capability to quickly scan the preparation, the opposing arch and the Buccal Bite, we deliver a quality restoration in a timely manner for the patient. Because the NEVO laptop computer and scanner are so portable, dentists are no longer tethered to a large unit. With NEVO, dentists have the ability to move from operatory to operatory, creating greater efficiency for the dental office.

The advances in technology are ever-evolving. For the field of dentistry, it is a brand new day …

I hope you enjoy this issue of CAD/CAM magazine.

Sincerely,
Dr. Mike Moroni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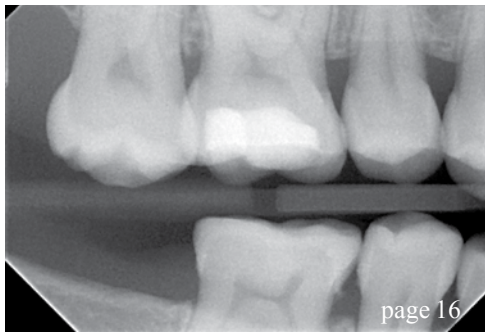
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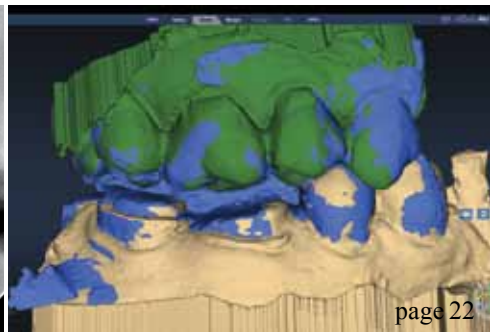
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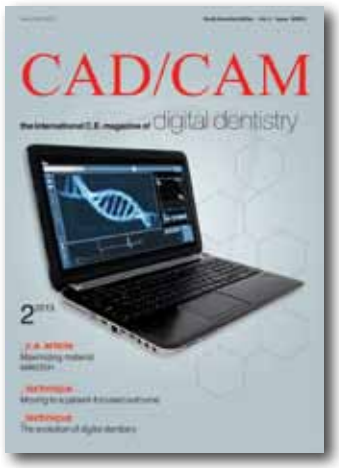

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† M. Kern et al. "Ten-year results of three-unit bridges made of monolithic lithium disilicate ceramic"; Journal of the American Dental Association; March 2012; 143(3):234-240.

††Mean observation period 4 years IPS e.max Press, 2.5 years IPS e.max CAD. See The IPS e.max Scientific Report Vol. 1 (2001-2011).

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Utilizing the Tempcap abutment with IPS e.max CAD as a final restoration

Author_Les Kalman, BSc (Hon), DDS

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_Abstract

The E4D in-office CAD/CAM unit has been employed in an investigative laboratory study to design and mill an unconventional e.max restoration that would be coupled with the Tempcap as a final implant-supported crown.

The combination of the Tempcap, in-office CAD/CAM procedures and e.max allows the clinician to create an immediate final restorative product with ideal characteristics. The procedure is a simple, efficient and effective solution for the restoration of implants.

_Introduction

Temporization of a dental implant following surgery, particularly in the anterior region, is a necessary procedure. Temporization allows for surgical healing, preservation of the gingival architecture and, most importantly, replacement of a tooth in the edentulous space for patient acceptance. Several techniques for the temporization exist, but the process has proved to be time-consuming and frustrating.

The Tempcap abutment and the process for temporization were created to provide a simple yet effective approach.[1] With the advent of CAD/CAM technology and e.max, the potential of the Tempcap to act as a final abutment seemed likely and suitable for investigation.

_Background

Following the surgical placement of a dental implant, several requirements must be met to maximize

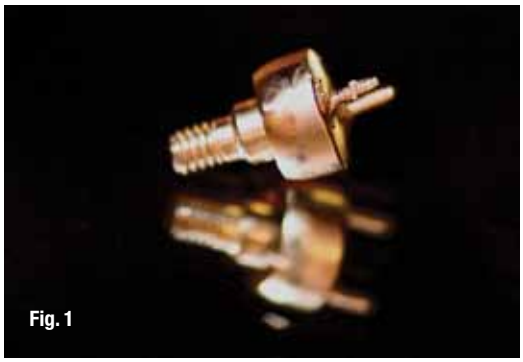


Fig. 1

Fig. 1_Tempcap abutment. (Photos/Provided by Les Kalman, BSc (Hon), DDS)


Fig. 2

Fig. 2_Retentive pins.

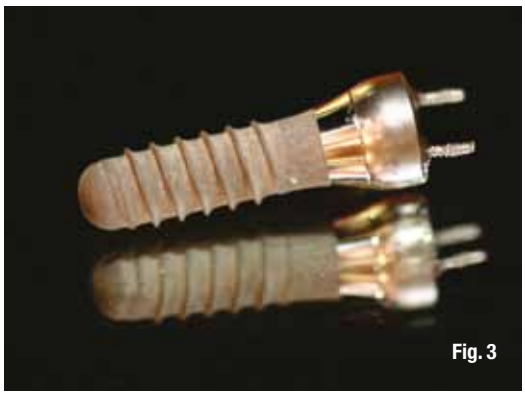


Fig. 3


Fig. 4


Fig. 5


Fig. 6

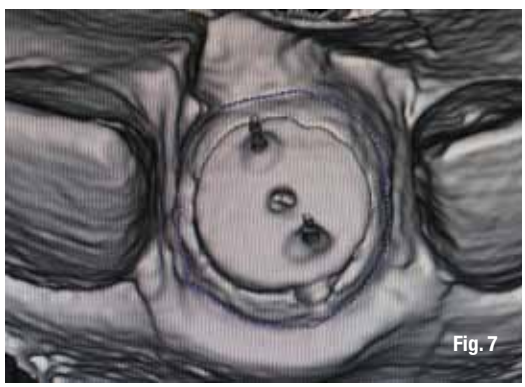


Fig. 7

Fig. 3_Tempcap with Straumann implant.

Fig. 4_Use of existing instruments.

Fig. 5_Temporization form and function.

Fig. 6_Tempcap on soft-tissue model with Ankylos implant.

Fig. 7_Digitized images of arch.

healing and osseointegration of the implant body to bone:

- Minimal forces, if any, should be exerted on the implant body, permitting proper healing and preventing a non-osseous union.[2]
- The gingival architecture must be managed meticulously to prevent contamination, minimizing the risk of peri-implantitis and possible failure.[3]
- There must be sufficient time for the process of osseointegration.[4]
- Temporization and immediate restorations should not violate these factors.[5]

The Tempcap (Research Driven) is a healing cap and restorative platform combined (Fig. 1). It has an all-metal construction, and it contains two to three retentive pin projections (Fig. 2).

Tempcap is available in different widths and heights to accommodate different implant sizes (Fig. 3) and is compatible with existing instrumentation (Fig. 4). The function of the Tempcap is to:

- allow for optimal gingival healing
- prevent contamination of the surgical field
- minimize forces and micro-vibrations on the implant
- facilitate the simple yet successful restoration of the implant (Fig. 5).

CAD/CAM stands for computer-aided design and computer-aided manufacturing. CAD enables the individual to digitally capture an image of a prepared tooth or structure and then design an indirect (out-of-the-mouth) restoration by using software.[6] After the ideal restoration has been produced, the design is then fabricated out of a material by a milling machine.

Fig. 8_Tempcap digitized.

Fig. 9_Digitized delineation of Tempcap.

Fig. 8

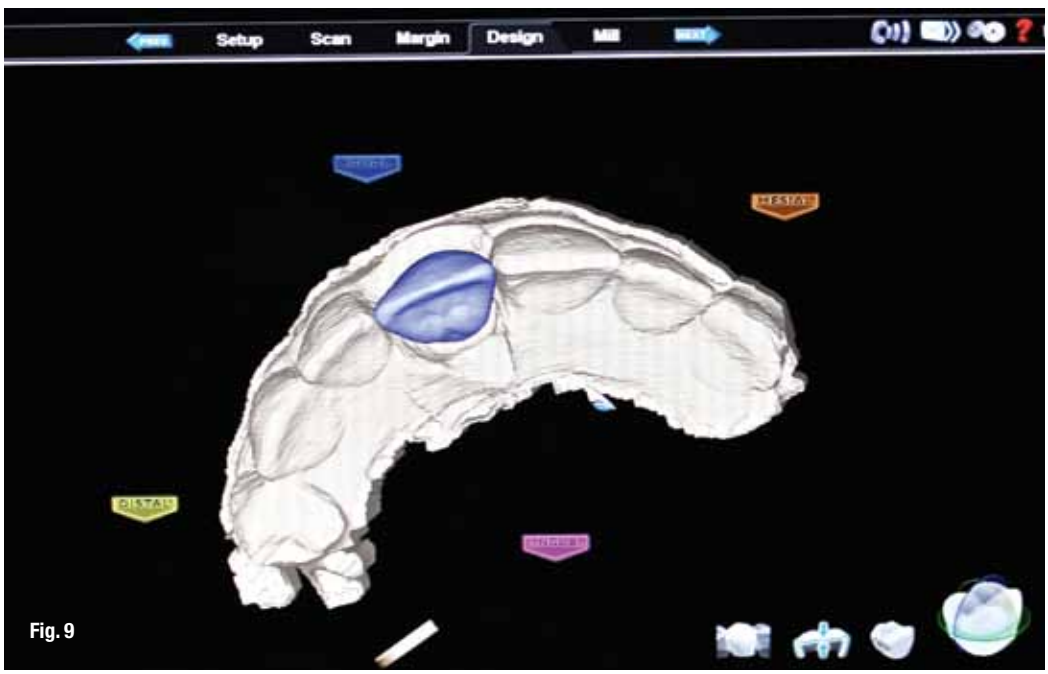


Fig. 9

In-office E4D systems (E4D Technologies) are currently available to allow for immediate chairside fabrication without the use of a commercial laboratory.

IPS e.max CAD (Ivoclar Vivadent) is a relatively new metal-free dental material used in indirect restorations. It is an esthetic material composed of lithium disilicate and has ideal physical and esthetic properties, allowing it to be the first choice for CAD/CAM restorations. e.max has strength second only to gold and has the ability of detailed CAM production.[7]

_Methodology

The Tempcap was selected and placed on an Ankylos (DENTSPLY) implant body (master cast with soft tissue) (Fig. 6). Digitization was achieved by using an

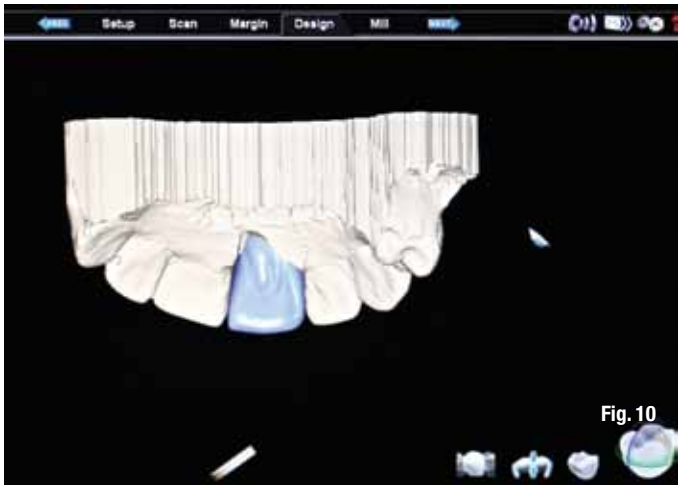
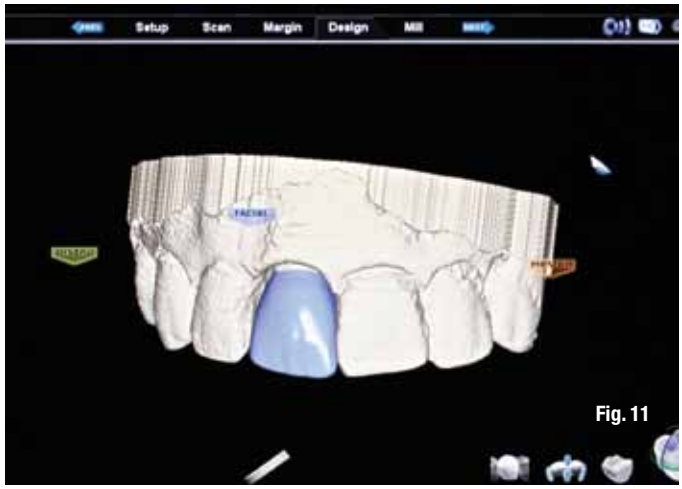


Fig. 10



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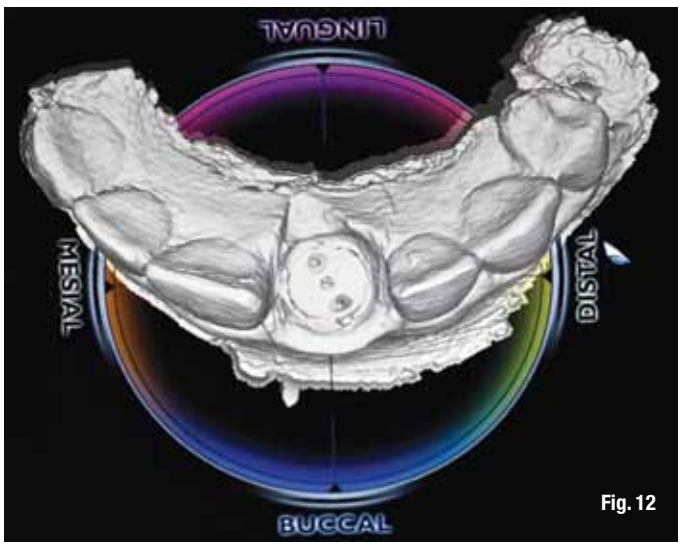

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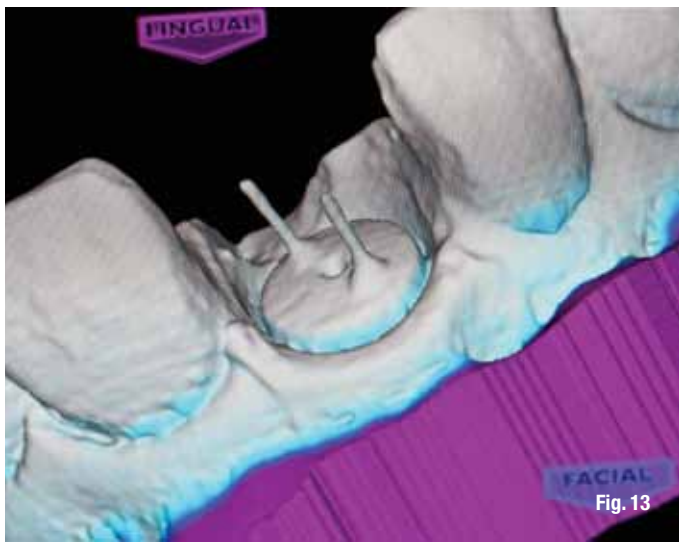

Fig. 13

E4D camera, in which several images were captured to compile an accurate image (Figs. 7, 8). CAD design was used with E4D software to determine and delineate margins (Fig. 9). Tooth design was initiated incorporating several parameters:

- ideal esthetics and emergence profile (Fig. 10)
- adequate proximal contacts
- appropriate occlusal scheme
- material thickness requirements
- internal surface morphology to adapt to Tempcap
- design that can be milled via CAM technology.

Numerous design iterations were required to achieve the desired design requirements (Figs. 11–13). e.max was selected for milling (Fig. 14) and was executed by an E4D CAM unit (Fig. 15). Milling limitations, such as bur contact and prosthesis fracture, required CAD design modifications. Reiterations in CAD/CAM design were carried out until a successful restoration was achieved (Fig. 16).

The unfired e.max crown was tried for fit and esthetics and then subsequently fired (Fig. 17), resulting in its color change. The crown was further stained, glazed and fired (Fig. 18), resulting in a highly esthetic final restoration (Fig. 19). The restoration's internal aspect (Fig. 20) was assessed for path of insertion, retention and fit.

The e.max prosthetic crown was further assessed for fit, taking into account marginal fit, occlusion and proximal contacts (Fig. 21).

A secondary investigation utilized a more complex Tempcap to assess the limitations of the CAD/CAM unit's capability. A standalone Ankylos implant body was coupled with a Tempcap abutment with three retentive pin projections (Fig. 22). The abutment was digitized with the same methodology as described. An e.max crown was executed and assessed (Figs. 23, 24).

_Discussion

This study has determined that the Tempcap can be successfully and accurately digitized and milled by in-office CAD/CAM technology (E4D Technologies) to create an ideal prosthetic crown from e.max

Fig. 10_Development of emergence profile.

Fig. 11_Occlusal view of restoration.

Fig. 12_Lingual view of restoration.

Fig. 13_Facial view of restoration.

Fig. 14

Fig. 14_e.max CAD/CAD block.

Fig. 15_E4D CAM unit.

Fig. 16_Milled e.max restoration.

Fig. 17_Ivoclar furnace.

Fig. 18_Staining and glazing.


Fig. 15


Fig. 16

Fig. 17

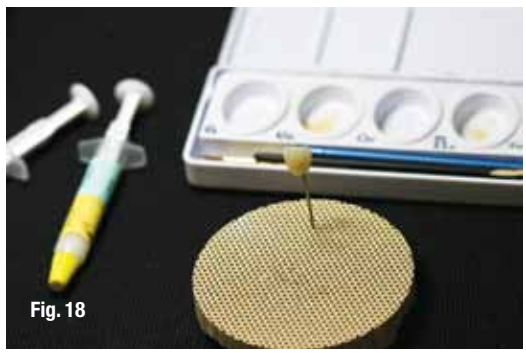
Fig. 18

within a laboratory setting. CAD software can be manipulated to generate forms beyond the scope of the unit. Complex units, such as the three-pronged Tempcap, may be successfully designed and milled.

e.max has the capability to be milled in complex patterns while still maintaining its structural integrity. However, further laboratory studies to quantitatively assess stresses and strengths and to utilize a larger sample size are required to validate the concept.

Subsequent clinical investigations are required to assess the clinical significance and viability of the Tempcap with CAD/CAM technology. The potential to fabricate the Tempcap entirely from e.max should also be considered.

_Conclusion

In-office CAD/CAM technology can be utilized and manipulated to generate digitized forms beyond the scope of the morphogenesis. CAM manufacturing has limiting factors that must be realized when producing modified prostheses. CAD modifications must account for these discrepancies. e.max has the ability to be milled in extremely detailed designs.

The Tempcap can be optically scanned and digitized in order to design and create a CAD/CAM e.max restoration using E4D technology. The utilization of the Tempcap as a successful provisional abutment has been documented[1]; the utility of the abutment as a simple, efficient and cost-effective component seems promising. These advances simplify the procedure and reduce the cost, ultimately allowing a greater accessibility for both patients and clinicians._

Disclaimer: Kalman is the co-owner of Research Driven and the inventor of the Tempcap.

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Fig. 19

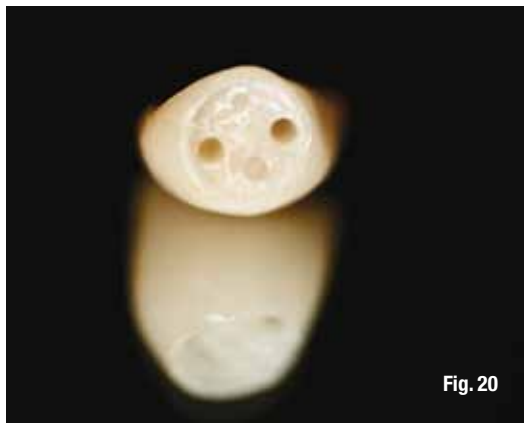


Fig. 20

Fig. 19_Facial aspect of final restoration.

Fig. 20_Internal aspect of restoration.

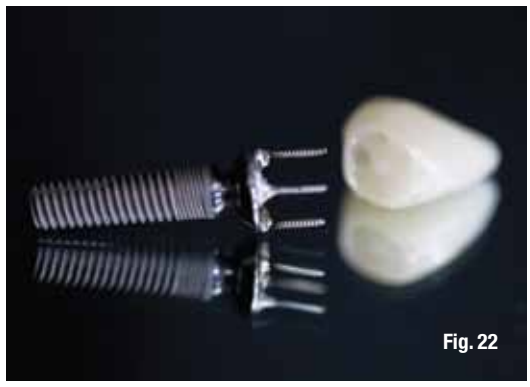
Fig. 21_Final CAD/CAM e.max restoration.

Fig. 22_Ankylos implant with complex Tempcap and milled e.max crown.

Fig. 23_Internal aspect of e.max crown for three-pronged Tempcap.

Fig. 24_Final implant-supported e.max crown with Tempcap.


Fig. 21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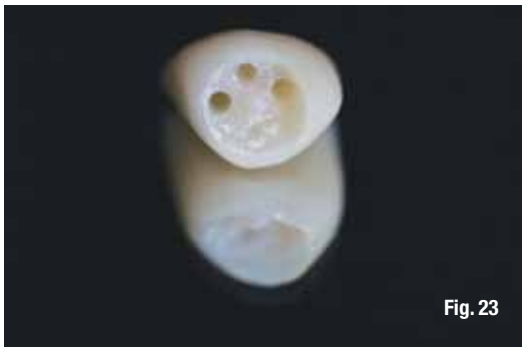
Fig. 23


Fig. 24

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_about the author

CAD/CAM

Les Kalman, BSc (Hon), DDS, graduated from the University of Western Ontario with a DDS in 1999. He then completed a GPR at the London Health Sciences Centre. He has been involved in general dentistry in private practice since 2000 and has served as the chief of dentistry at the Strathroy-Middlesex General hospital. In 2011, he transitioned to full-time academics as an assistant professor at the Schulich School of Medicine & Dentistry. Kalman is also the coordinator of the Dental Outreach Community Services program, which provides free dentistry within the community.

Kalman is a member of the American Society for Forensic Odontology, International Team for Implantology, Academy of Osseointegration, American Academy of Implant Dentistry and the International Congress of Oral Implantology, where he has been recognized with master distinction.

He can be contacted at (519) 661-2111 ext. 86097, *lkalman@uwo.ca* or through *www.researchdriven.ca*.

Maximizing material selection with CAD/CAM dentistry

Author_ John C. Schwartz, DDS

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_Depending on the clinical situation and the location of teeth, materials with different mechanical properties need to be employed when restoring teeth with fixed porcelain veneer crowns. This is pivotal in full-mouth rehabilitation. However, the use of many different materials may entail difficulties in achieving harmonious shading or even render a uniform outcome impossible.

The exceptional properties of lithium-disilicate glass-ceramic enable dental professionals to create natural-looking restorations that fulfill the different requirements, without having to make concessions with regard to shading.

Typically, strength values of dental porcelains are relied on to indicate porcelain crown performance. However, strength is a conditional rather than an inherent property of dental porcelains. In vitro strength data alone cannot be used to assume a material's long-term performance in vivo. In two-phase porcelain systems consisting of a framework and veneering material, the design of the substructure has a decisive influence on the overall strength. It is therefore logical to consider fabrication design as a factor in the overall strength performance of an all-ceramic crown in vivo.

Apart from the physical properties of the materials, the correct dimensional relation between the veneer and the substructure is a prerequisite for the success of two-phase porcelain systems. While the substructure functions primarily as the system's strength, the veneering porcelain provides its esthetics. Examples of two-phase porcelain systems include porcelain-fused-to-metal crowns, zirconia crowns and veneered lithium-disilicate crowns. Increasing the strength function of the system would imply thickening the substructure. Thickening the substructure creates less room for the outer phase to perform its esthetic function.

Traditionally, creating a structural design to maximize esthetics has reduced the strength value of biphase systems because of small dimensions of the substructure. An example is limiting a substructure to a coping form. While esthetic, the coping design leaves the veneering porcelain unsupported in cusp-to-fossa function and vulnerable to long-term stress fracture. A high-strength substructure that has considerable esthetic advantages over other substrates can improve the strength of a system without compromising esthetic values.

A hybrid substructure design that supports a cusp-to-fossa relationship increases the strength of the system. Refractive index values increase when the substructure thickens; increasing the thickness of the substructure results in a crown of higher value. By acknowledging the individual strengths and weaknesses of the components of the biphase porcelain systems, it is possible to engineer structural stabilization factors in esthetic crown design. The material that most closely fits these ideal synergistic criteria is lithium disilicate.

Fig. 1_Different indications require different fabrication and layering techniques: IPS e.max lithium disilicate allows uniform results to be achieved. (Photos/Provided by John C. Schwartz, DDS)

_Applications of lithium-disilicate glass-ceramic

Monophasic lithium-disilicate crowns can be used on molars, for which strength is a desirable trait. For anterior reconstructions, however, veneered


Fig. 2


Fig. 3

lithium disilicate should be used to emphasize esthetics. A synergy between the strength of the lithium-disilicate substructure and the esthetics of the veneering material can be attained with the IPS e.max CAD System. This product allows all-ceramic restorations to compete with traditional restorations in terms of in vitro strength. At the same time, the esthetic value expected from all-ceramic crowns is not compromised.

Monophasic lithium-disilicate restorations can be used in posterior areas where strength is most important. When used in the bicuspid region, the facial aspect (visible portion) should be layered using IPS e.max Ceram. As a result, esthetics are improved without compromising the core integrity strength. In the fabrication of anterior crowns, the artistic skills of dental technicians are utilized to achieve high esthetics.

When creating full-contour, monophasic IPS e.max LS2 crowns, the cusp-to-fossa relationship should be studied. Proper "waxing" in cusp-to-fossa physiology limits compression and shearing forces. Monophasic construction also allows higher resistance to fracture. The ideology behind the monophasic lithium-disilicate crown is similar to that of full-cast gold crowns (Fig. 1).

_Case presentation

In this particular case, a 59-year-old male complained about his unattractive smile and wanted one that was more esthetically pleasing. At the time of presentation, the patient had a long dental history of missing posterior teeth, root canal therapy, tooth mobility issues, sensitive teeth, full-metal crowns, PFM crowns, amalgam fillings, discolored teeth and difficulty in chewing (Figs. 2, 3).

Additionally, the clinical and radiographic examination revealed clicking and popping upon opening of the mouth in both temporomandibular joints (TMJs). Upon palpation, there was also a slight discomfort of the posterior capsule of the right TMJ, but the left posterior and lateral capsules were within normal limits.

_Diagnosis: Occlusion

The patient's maxillary and mandibular midlines were aligned but demonstrated tracking to the right upon opening. There was a Class III occlusal relationship with a deep overbite that approached an edge-to-edge overjet anterior position, with a lack of anterior guiding patterns.

_Diagnosis: Gingiva

A periodontal examination revealed generalized pocketing of 1 to 3 mm, with isolated pocketing of 4 mm. Additionally, anterior and posterior isolated gingival recession was noted, with associated isolated thinning of keratinized gingiva. Other issues, such as wide keratinized gingival banding, blunted papillae and uneven periodontal outline form, were observed during the examination. The gingiva was irritated and demonstrated isolated bleeding upon probing.

_Diagnosis: Dental hard tissue

During the dental evaluation, missing teeth, crowns, amalgam fillings, composite fillings, heavy wear facets, exposed dentin surfaces, enamel splintering and clinical crown loss estimated between 20 and 70 percent were revealed.

_Treatment plan

The diagnosis from this evaluation encompassed worn dentition, collapsed occlusion, generalized chronic mild gingivitis, generalized chronic mild periodontitis and mild MPDS/TMD. Based on this diagnosis, it was necessary to develop an extensive treatment plan that would not only increase the esthetic value of the patient's teeth but also their functionality. The treatment plan included opening the bite and establishing a vertical dimension of occlusion, establishing anterior guidance patterns and restoring the dentition.

Fig. 2_Preoperative frontal view of the patient's condition: The areas of heavy wear are clearly visible. Clinical crown loss is estimated to be between 20 and 70 percent.

Fig. 3_Preoperative occlusal view of the patient's maxillary arch.


Fig. 4

Fig. 4_The diagnostic wax-up should be created with care as it forms the basis for the restoration.

Fig. 5_Lithium disilicate substructures for the anterior crowns.

Fig. 6_The lithium disilicate CAD/CAM restorations (IPS e.max CAD) are placed on the model in their 'blue' phase after milling.

Fig. 7_Customized build-up of the anterior crowns.

Fig. 8_A porcelain enamel layer is applied to the layered crowns.


Fig. 5


Fig. 6


Fig. 7


Fig. 8

It was also decided that a diagnostic wax-up, based on photographic analysis, would be used in this treatment plan (Fig. 4), which allowed the planned restoration to be built up in a precise and detailed manner. The wax-up was used to establish the length-to-width parameters of the natural teeth, the incisal plane, occlusal plane and the fixed arch parameters. These steps were all necessary to provide an outcome that was both esthetically pleasing to the patient and, more importantly, functional.

_Fabrication considerations

The benefits of hybrid restorations (veneered frameworks) are that the design of the framework can be adjusted to the requirements of the clinical situation and optimum support of the veneering ceramic can be ensured regardless of whether the press or CAD/CAM technique is used. In the case presented, the CAD/CAM technique was employed (E4D Dentist CAD/CAM System, E4D Technologies, Richardson, Texas). The copings were designed on the computer as described below. A coping form of 1.25 mm to 1.5 mm minimum thickness was designed. The central developmental lobes were designed to within 1 mm of the final desired cusp allocation. Next, the proximal developmental lobes were waxed to within 1 mm of the desired marginal ridge location.

Located on the buccal and lingual aspects of a natural tooth, there is an area of demarcation between enamel and dentin. Ceramists term this the "enamel break," which is where the enamel appears to become thicker and less supported by the thickness of the dentin. The location of the enamel break should be determined from preop photographs. On the working cusps of the crown, a ledge should be waxed at the enamel break to within 0.5 mm of the final survey outline form of the crown. This strengthens the working cusp and creates a stress breaker in the middle of the crown. This stress breaker relieves tension at the margin of the crown where the bond can be subjected to long-term effects of occlusal stresses.

The working ledge can be concealed due to the chameleon effect of the lithium-disilicate material. The balancing (i.e., nonworking) cusps do not require a working ledge of support. However, nonworking cusps should be prepared for the development of parafunctional interferences by waxing shearing stress breakers into the coping design. Once this had been accomplished, the lithium-disilicate high-strength copings were milled using IPS e.max CAD lithium-disilicate blocks (Figs. 5, 6).

Creating the esthetics began with the application of deep stains to the lithium-disilicate coping. Next, to lower the value of the coping and create a luminary zone for light refraction, the crown was built up entirely using IPS e.max Ceram Transpa neutral. Enamel


Fig. 9


Fig. 10


Fig. 11


Fig. 12

stains and characterizations were applied (Fig. 7). This enhances the esthetics, particularly in the anterior region. Finally, the outer enamel layer was finished in the appropriate shade S2 enamel, and the crowns were baked again (Fig. 8). The crowns were then texture finished with stones and surface polished with the Astropol® polishing system. A light layer of glaze was then applied for the final bake.

Once the final bake had been completed, the monophasic lithium-disilicate crowns were ready for seating in the mouth (Figs. 9, 10). The lithium-disilicate crowns were tried in to ensure proper seating and to prevent any issues during the final cementation and polishing processes. Once any issues had been addressed, final placement of the lithium disilicate restorations could be accomplished.

_Permanent cementation

The prepared teeth were pre-treated using conventional procedures. The pre-treatment of the crowns was carried out according to the respective directions for use. The inner surfaces of the crowns were etched with hydrofluoric acid for 20 seconds, after which a silane coupling agent was applied. Dentin and enamel surfaces were wetted using a bonding agent (ExciTE®). Excess was blown off using pressurized air, and the surfaces were light cured for 20 seconds. A light-curing bonding agent (Heliobond) was applied on top of the ExciTE layer, and the excess was blown off. A dual-cure adhesive luting composite (Variolink®II) was placed in the crowns, after which they were carefully seated, cleaned and light cured. The postoperative all-ceramic crown results exhibited excellent biomimetic behavior and physiologic function (Figs. 11, 12).

_Conclusion

Creating high-strength lithium-disilicate crowns without compromising the esthetic function of the all-ceramic restorations can be achieved by utilizing monophasic molar crowns, biphasic bicuspid crowns with facial layering and anterior biphasic crowns with lingual support (Fig. 1). In vitro strength values of dental porcelains may indicate the performance of these restorations, but these data alone cannot be used to assume the structural performance of the restoration in vivo. Therefore, it is not only important but necessary to consider fabrication design as a factor in the overall strength and performance of an all-ceramic crown.

The use of a lithium-disilicate material, as described herein, can enable dentists and laboratory ceramists to provide patients with structurally durable and esthetically pleasing restorative results even in difficult cases when slight functional problems are present._

Figs. 9, 10_View of the completed restorations on the model.

Figs. 11, 12_View of the IPS e.max lithium disilicate restorations after seating: the completed full-mouth rehabilitation has a natural and harmonious appearance, even though different procedures were employed.

_contact CAD/CAM

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CAD/CAM in the dental office: Moving to a patient-focused outcome

Author_Heather A. Hurst, DMD

_Dentists today have the ability to implement newer technology into the practice, and a CAD/CAM system is certainly an attractive option. The reasons for adding such technologies are repeated so often they almost border on cliché: greater practice profitability, an appearance of being a state-of-the-art, cutting-edge practice, savings in lab fees, etc.

While these are all valid reasons for integrating technology, it is time for dental practitioners to realize that we must undergo a paradigm shift in the way we view technology in the practice.

Technology should be implemented based on its benefits for patients, not just dentists and their team members. It isn't until we place the most emphasis on patient satisfaction and outcomes that we can measure the true success of technology integration in our practices.

_Benefits for dentists

The importance of technology to dentists and their team members in the practice cannot be overstated. Without question, systems such as in-office CAD/CAM provide us with opportunities to improve the quality of care we are able to provide our patients. It also can enable team members to learn and master new aspects of restorative care — such as digital impression taking and restoration design — which can enhance their enthusiasm and professional satisfaction.

Chairside CAD/CAM systems involve the latest technology available; thus, accuracy of impression scans and restoration fabrication is greatly enhanced.[1] Systems such as E4D (E4D Technologies, *www.e4d.com*) require no powder or contrast agents when scanning, which improves not only accuracy but the overall experience for the patient.[2]

'This new crown procedure was totally 'stress-free' for me. The resulting crown looked and felt like it was my natural tooth!'

— Ann Lewis, patient with LAVA Ultimate and IPS e.max CAD restorations

The use of in-office CAD/CAM can help provide a so-called "state-of-the-art" image for the practice, attracting new patients and retaining current ones.[1] There are often few, if any, laboratory fees, and because the system is digital, there are fewer opportunities for error when compared to traditional impression taking techniques, saving dentists both time and money.[1]

Chairside CAD/CAM systems are also affording dentists the ability to expand the reach of services they offer. Options such as full-arch digital impressions are now a possibility, and dentists can perform effective single-visit quadrant dentistry.[3]

Significant improvements in terms of clinical dentistry are also possible when using CAD/CAM technology. Marginal integrity is critical when evaluating the overall success of a restoration,[2] and the marginal fit of restorations designed with a chairside CAD/CAM system has been shown to be just as accurate as traditional methods, without the discomfort to patients and potential for errors.[4,5]

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Fig. 1a_This case concerned tooth #30. Pre-operative photo shows standard porcelain-fused-to-metal crown with large mesial and distal overhangs. Patient complained that the tooth was never 'quite comfortable.' (Photos/Provided by Heather A. Hurst, DMD)

In fact, CAD/CAM technology has advanced to the extent that margins now fit within 50 micrometers, if all preparations are properly followed.[6]

Occlusion is always an area of concern when fabricating and placing restorations, as any occlusal interferences can place adverse stress on restorations, resulting in permanent failures.[7] However, a CAD/CAM system such as E4D is equipped with software that allows dentists to place accurate occlusal contacts, refine the proximal contact areas with adjacent teeth and correctly mark the margins.[2]

Additionally, the milling technology of CAD/CAM systems has progressed to the point where anatomy and design are more accurate and precise. This, in turn, improves form and function of the restoration.[6] Finally, there is the potential for less tooth sensitization, because temporary restorations are no longer needed.[1]

_Moving toward patient-centric outcomes

These and other reasons alone should be enough to convince clinicians to make the switch to a CAD/CAM system. However, the intangible benefits to patients often outweigh any business advantages we experience as a result of a technology upgrade. Dentists can use newly integrated technology to achieve practical, qualitative success that can be measured in terms of real-life cases that we treat in our practices every day.

There are obvious reasons why a CAD/CAM system is beneficial to patients. Digital scanners are preferable to unpleasant impression-taking materials, especially for patients who gag or cannot tolerate impression material in the mouth for several minutes.[8]

Perhaps the most obvious reason of all is that patients are able to have their tooth prepared and scanned and have a permanent restoration designed and fitted in the same day.[6]

However, once I integrated CAD/CAM into my practice, I witnessed that there are many indefinable advantages for patients. Despite being a recent dental school graduate, it had taken me awhile to determine whether our practice would benefit from introducing CAD/CAM.

Originally, I began my foray into the world of digital dentistry by looking for a digital scanner, because I knew I wanted to have more control over the margins of my restorations. At the time, I was sending many of my restorations back to the laboratory because I wasn't pleased with how they were designed. Yet, I felt that purchasing an entire CAD/CAM system would cost too much; I already had assumed debt from dental school and purchasing my practice.

Nonetheless, once I was introduced to the E4D System, I knew it would prove to be a tremendous asset to the practice and decided to purchase it.

Fig. 1b_Tooth #30 post-operatively. CAD/CAM e.max crown was done same day and shows well-approximated margins. Patient was very satisfied with fit and esthetics. Note: The restoration is no longer obscuring the pulp chamber and is virtually invisible on film. A small area of mesial calculus is present in post-op photo.

While I felt confident that this system would change the way we practiced dentistry, I did not anticipate the rewards my patients would experience from it. These rewards were often beyond the benefits of clinically sound dentistry, without the weight of evidence or concrete, visible proof. Rather, they're personal.

_No waiting or wondering

My patients began benefitting from CAD/CAM even before my unit was installed. While at training in Texas for my E4D System, I received an email from my laboratory saying it couldn't read an impression I sent them, which I knew, as many of you have experienced, had a completely obvious margin to me.

As I had experienced in the recent past, an impression I deemed perfect was illegible to a technician thousands of miles away who had never seen my patient.

Normally, the patient for whom the restoration was being made would have to wait until I returned to the office to take the impression again, wait an additional three weeks for the restoration to be made and then wait for an appointment to be refitted. Rather than needlessly put her through that again, I emailed the laboratory from my hotel room in Texas and asked them to send the impression back to my office.

Because the CAD/CAM equipment – including the scanner – was installed upon my return from Texas, I scanned the impression the laboratory hadn't been able to read and designed her crown myself. Instead of waiting an additional three weeks for her restoration, the patient was able to come in sooner than her scheduled appointment. It was a perfect fit, with no adjustments needed.

This was my first experience seeing the relief and convenience I could provide to patients. It was then I realized I would be able to deliver something more than just well-fitting restorations to my patients. My stress level went way down, and the convenience and quality of my restorations went way up because I was now in control of my work from start to finish. It was so liberating.

_Immediate treatments without temporaries – or repeat road trips

One of my patients travels nearly an hour each way to visit our practice. After finishing a full mouth reconstruction case, I instructed my assistant to take full mouth impressions of the upper and lower arch in order to capture all of the work I had finished for him.

The patient had spent thousands of dollars on upper and lower full porcelain crowns and veneers and was always very nervous about the longevity of his new smile. He had told me if something bad was going to happen to someone, it was going to happen

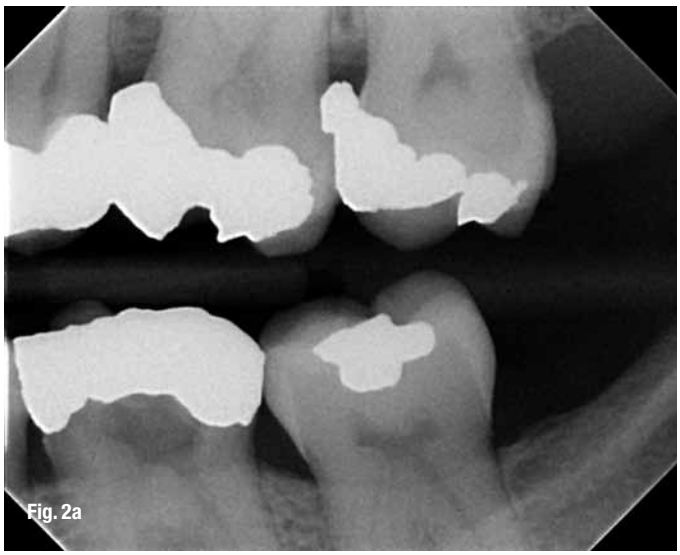
Fig. 2a


Fig. 2b

Fig. 2a, b_Case No. 2 features a root canal, post core and LAVA E4D crown in the same appointment. In these pre-operative photos of tooth #19, note the large amalgam and decay that extended into the nerve.

to him, so I decided to scan his finished smile into my CAD/CAM system after seating it.

It was almost like an insurance policy for him and for me, and because I truly care about my patients, I just wanted to keep his model in a digital format for future reference.

Well, just as he had predicted, the call came six months later that he had broken a veneer on an anterior tooth. Luckily for him and me, I had records of his final smile design in my E4D Design Center.

I told my receptionist to squeeze him into any 45-minute slot she could find in my day. We brought him in at the beginning of a filling appointment that I had scheduled in another chair, and while that patient was numbing, I scanned his prepared tooth into the system. Because I had scanned a clone of his finished case before he arrived, I was able to send an exact replica to our milling unit.

While I finished my restorative case in the next room, he took a little nap, and his restoration was ready to be seated just after I finished with my originally scheduled patient. I cemented his veneer easily in 15 minutes, and he was thrilled.

Within 45 minutes of his arrival, he had a brand new veneer that perfectly matched his previous restoration – all thanks to digital technology and in-office CAD/CAM. He claimed it was the most relaxing, stress-free appointment he ever had, and I was so pleased to offer him this type of same-day service.

Moreover, he was spared several hours of travel and chair time, because I did not need to fit him for a temporary and then ask him to return three weeks later.

He was also spared the embarrassment of wearing an uncomfortable and unpredictable temporary veneer restoration on his anterior tooth and was given peace of mind when he walked out of our office with a perfect match for his permanent restoration.

The best part of this story is that his restoration was still under warranty from the "laboratory" that had produced it and, because of the convenience and confidence I have in the strength of my own restorations, I chose to do this same day in my office. He was so grateful, and there was no added stress to my day.

_Convenient care

A new patient recently came into my practice on his lunch break to inquire about replacing a crown he had just lost. He was an attorney with a busy schedule and expected he would have to return to the office in the future for a full-length crown appointment. Because there was no evidence of decay, I asked him if he would like me to replace the restoration for him right then and there.

Thanks to the E4D System, I was able to create and place a full, definitive restoration for him before his lunch break was over. He was absolutely thrilled, and as a result, he is now one of our regular patients.

_Merging two perspectives

As a dentist, I wholeheartedly appreciate what technology, particularly CAD/CAM, can do for my practice and me. However, I have come to realize that it can do so much more for my patients. I believe that we, as dentists, can focus more on technology's benefits to patients, especially if we are still deciding whether to incorporate a new system into the practice.

Because of the faith I have in my E4D System, I warranty all of my in-office fabricated restorations for five years. The technology allows you to see if you have proper reduction, and because I have control over the design of my cases, I know they are all strong and reliable. Patients love that I can give them that


Fig. 2c


Fig. 2d

Fig. 2c_Post-operative photo of tooth #19 shows a LAVA ultimate crown cemented with relyX ultimate by 3M ESPE. No adjustment to occlusion or interproximally was needed; fit was perfect.

Fig. 2d_ Post-op radiograph of tooth #19 showing root canal treatment and LAVA Ultimate E4D crown done in same-day appointment, cemented with RelyX Ultimate by 3M ESPE.

kind of peace of mind, and they know I stand behind the quality of my work with a warranty that is inclusive. I truly care about my patients, and my warranty is proof of that.

For the longest time, I sought reasons *not* to buy the E4D System: it was too expensive, I had too few operatories, it would require too much retraining, etc. Now that I have been using the in-office CAD/CAM system, I wish I had purchased it sooner. Not only is it user-friendly and efficient, but the type of care we can provide to our patients is truly outstanding — and really, that is why we all chose this profession.

My staff is thrilled we have the capabilities to provide same-day treatments and such state-of-the-art care and service to our patients. It is extremely convenient and ensures the restorations I prescribe are accurate and precise. This allows my staff and me to deliver comfortable, easy treatments our patients appreciate.

One patient recently told me a restoration I created for her was the most comfortable she had ever experienced, and she wished I could replace all of her other restorations with CAD/CAM restorations. That, to me, is the clearest indication that I made the right decision to purchase the E4D System.

When you focus on doing what is in your patients' best interests, everything else falls in line. We have been able to expand the services we offer patients, such as providing inlays and onlays. We avail ourselves of the excellent support system backing from E4D, and any technical issues we encounter are quickly resolved, allowing the treatment process to remain streamlined for patients. We have seen our laboratory bills decrease by more than $18,000 for four months, and my production alone increased 31 percent in the last six months. Benefits of the technology are not mutually exclusive; if integrated correctly, it is advantageous for both patients and dentists.

_Conclusion

Although implementing CAD/CAM was originally meant to simplify dental procedures, it has been most advantageous to our patients. It has brought something very special to the way I practice dentistry, and I am so grateful I integrated this technology early on in my career. This will underscore future practice decisions, because it is the human impact of technology that is most rewarding._

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_about the author CAD/CAM

Heather A. Hurst, DMD, graduated cum laude from Allegheny College, where she majored in biology with a minor in French literature and conversation. Deciding to become a dentist at the age of 12, Hurst also attended University of Pittsburgh, where she was awarded the prestigious Dean's Ball Scholarship. While in dental school, she was recognized by the American Association on Women Dentists for her leadership skills and with a national pathology award. With a special interest in cosmetic dentistry, oral surgery, endodontics and pediatrics, she completed residency training at University of Rochester/Strong Memorial Hospital.

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The evolution of digital dentistry

Author_Bryan Couch, DDS

_The term CAD/CAM is too limiting for what I do in my practice every day. CAD is computer-assisted design and CAM is computer-assisted manufacturing,[1] but it all begins with accurately and efficiently capturing a digital impression, which is the most critical aspect of the entire process.

In 2008, after years of evaluating if it was right for my practice, I took the step into chairside CAD/CAM (and capturing) dentistry. I purchased the E4D Dentist System (E4D Technologies, Richardson, Texas) and immediately implemented it into my daily restorative protocol. The use of chairside CAD/CAM dentistry not only revolutionized and reinvigorated my practice and enthusiasm for dentistry, it changed the way I looked at restorative care and the optimal care for my patients.

While many of our profession have held back from taking the plunge into chairside CAD/CAM opportunities simply because they believe there is a compromise in some regard (in the fit, in the function, in the form or the esthetics), it should no longer be perceived that way. In fact, most of the dental laboratories (67 percent)[2] are accepting or working with digital files — as clinicians, we are now *behind* the standard of care of what we offer our patients indirectly.

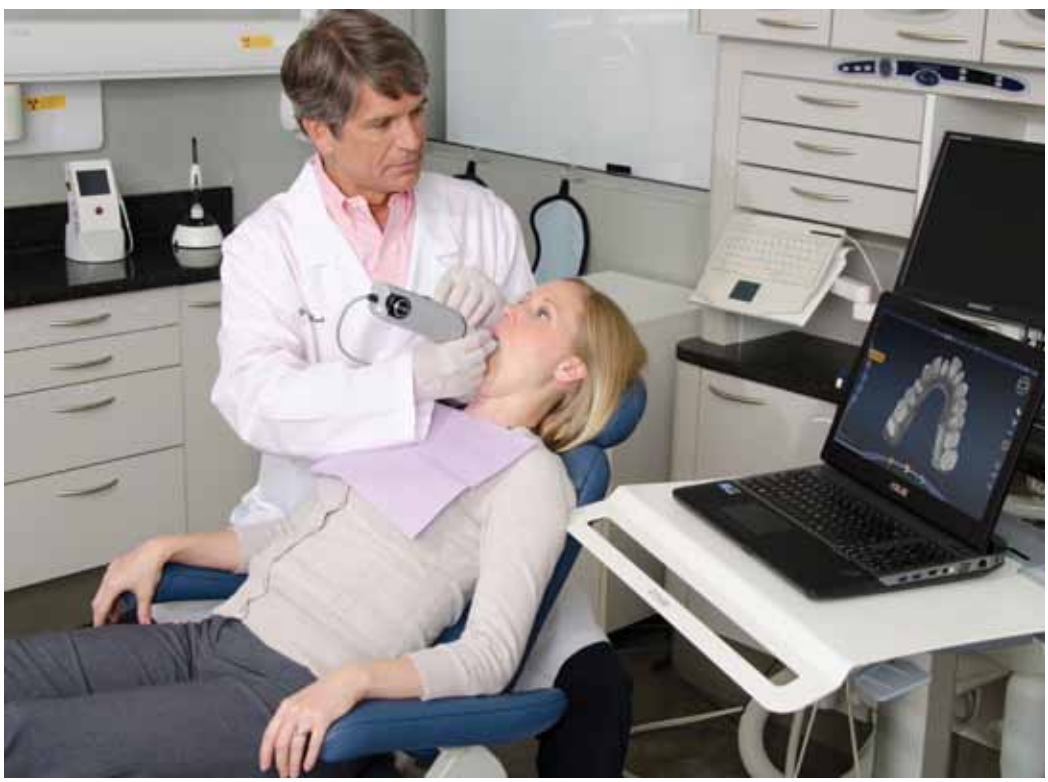


Fig. 1_ Blue-laser technology in NEVO offers faster capture and better reproduction and accuracy. (Photos/Provided by Bryan Couch, DDS)


Fig. 2


Fig. 3


Fig. 4

That being said, my relationship with my dental technician partners has never been stronger; while I do complete most of my single-unit restorations utilizing same-day capabilities and chairside CAD/CAM, my communication and treatment planning includes communication with my laboratory partners, just in a different regard — larger cases, diagnostic wax-ups and combination cases.

My decision in 2008 to get involved with E4D Technologies had to do with more than just the product; it was a sense of a partnership with the company. I felt (and continue to feel) that they are a partner in my success.

I think it is generally acknowledged that when E4D entered the market in 2007, it introduced new innovations and set milestones that have become the goal of the many systems on the market today.

E4D was the first complete chairside system to allow you as a clinician to see exactly what you were capturing (powder-free) and introduced a new format of education (centralized so every owner was learning the same and the basics) and support (S.O.S. — remote Support on Site), allowing clinical and technical experts to log onto your system and see exactly what you were seeing — live.

In 2013, it just got better. With the introduction of NEVO — the Natural EVOlution of digital dentistry — E4D has set another group of milestones for others to match. While keeping the fundamental benefits of centralized education and support along with precision milling, the company has added numerous advantages and practical innovations for capturing data.

_NEVO

I was fortunate to be involved in the initial development of the NEVO scanner when the premise was formed in January 2011. E4D Technologies hosted a group of dental professionals (assistants, dentists and technicians) in a symposium, "Byte to Bite,"™ to outline the future of not only CAD/CAM restorative dentistry but other aspects of digital dentistry, touching on preventive and diagnostic capabilities as well as restorative.

The goal wasn't to define how to make the current system better — through simple cosmetic upgrades of the hardware or software advances that may be used intermittently — but to introduce hardware and software features and benefits that would be used clinically every day.

The end result was NEVO, an intraoral scanner and design software developed to implement the latest technology (Blu-Ray and Windows 8.1) as well as hardware designed for the most efficient daily use and capture of the oral environment.

Taking the lead in the latest innovations, the NEVO scanner offers:

1. Removable tips

NEVO was developed with removable tips for optimal infection control via high level disinfection (HLD;

Fig. 2_Patient presents with bulk fractures of conventional ceramic restorations.

Fig. 3_ Failing restorations removed and teeth re-prepped.

Fig. 4_ Clearance is confirmed with tabs.

Figs. 5, 6_NEVO scan captures the preparations closing dentition and buccal bite.

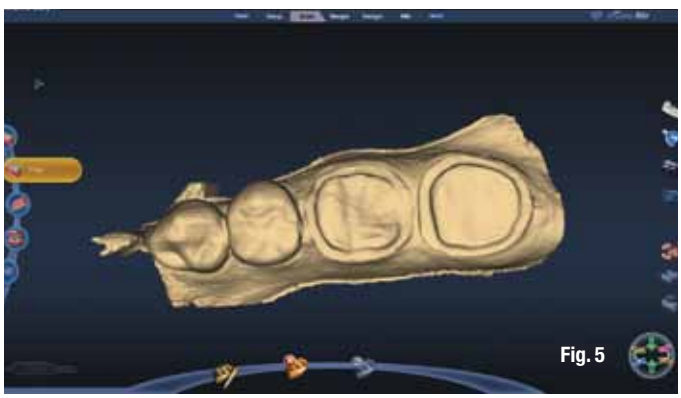
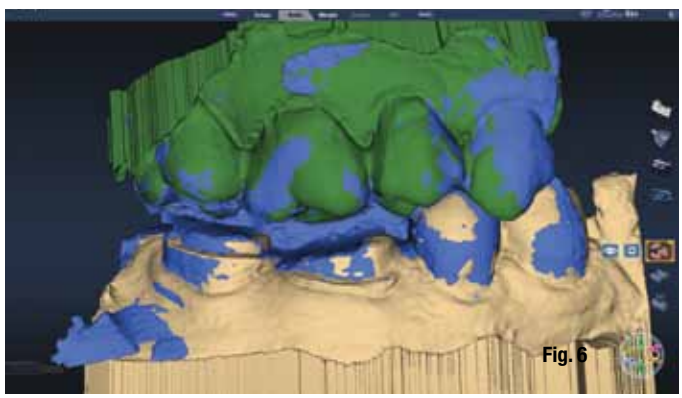


Fig. 5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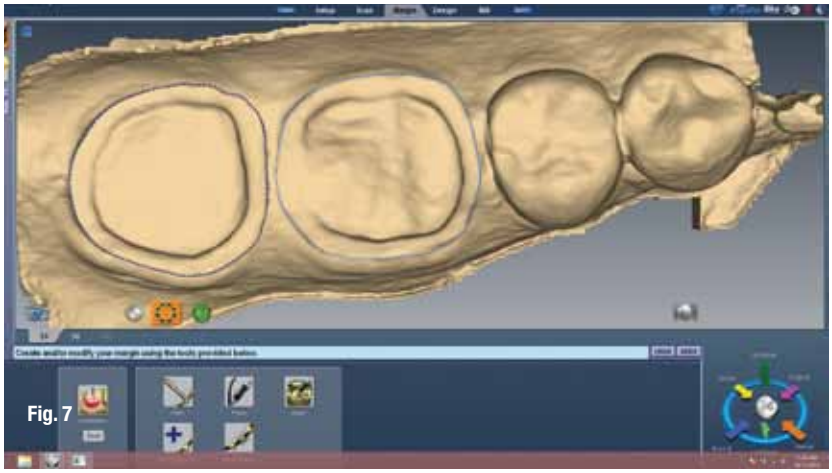
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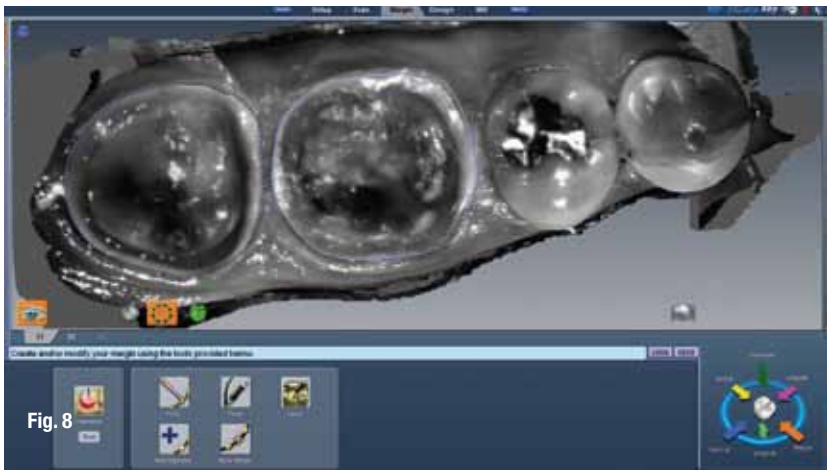
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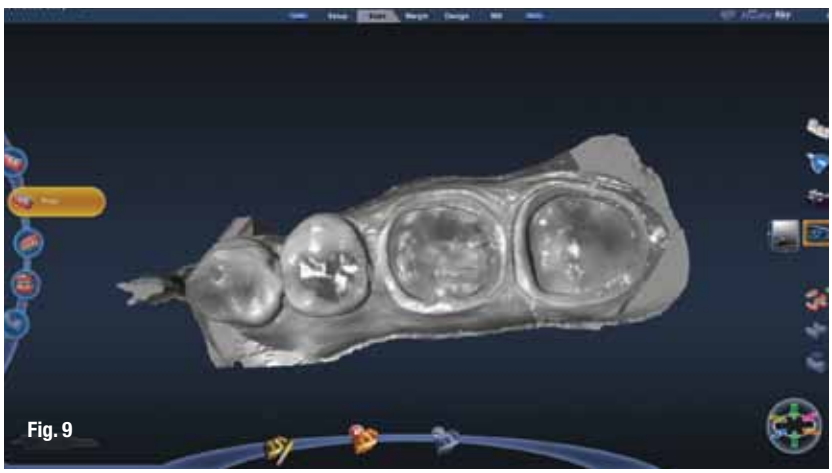


Fig. 9

Figs. 7–9_ The proprietary ICE view in NEVO has contrast and brightness sliders that allow optimization of the visual image to assist in margin identification.

60 minutes with Cidex Plus®), providing for patient-to-patient care with no downtime. Three removable tips are included with each NEVO scanner.

2. Heated mirror

A heated mirror in each tip prevents fogging, eliminating the need for suction or airflow across the scanning site.

3. Blue Laser (Blaze™) technology

This is the first time blue laser has been used for chairside dentistry. While several systems use "red lasers" for capture (e.g., classic E4D Dentist, 3Shape, iTero), E4D Technologies is the first to use blue laser (e.g., Blu-ray) technology for more efficient and effective capture.

The benefits are obvious and can relate very well to the evolution of our consumer use of lasers. As consumers, our first step into utilizing laser for capture/reproduction (CDs, DVDs) was red lasers, but many of us have now moved on to blue lasers used in Blu-ray technology, which offers better reproduction, accuracy and speed.[3]

Blue-laser technology in NEVO offers the same advantages — faster capture, better reproduction and accuracy (Fig. 1). And, of course, as with all E4D technology, no powder is required.

4. Solid state technology

While the original E4D Dentist System and current competitive systems incorporate moving parts (e.g., micro-mirrors at 20,000 cycles per second or "physical shutters" for capture), the NEVO scanner has only a single fan that moves to dissipate heat. This provides confidence in durability and long-term use.

5. Laptop-based with Windows 8

Using a special NEVO laptop (loaded with scan-only or scan-and-design software) provides the ability to place the system where you want — on a counter, a tray, on a wall mount or even on medical grade carts (available through Henry Schein). It also allows easier transportation to another office, home or to other operatories.

6. Plug 'n play.

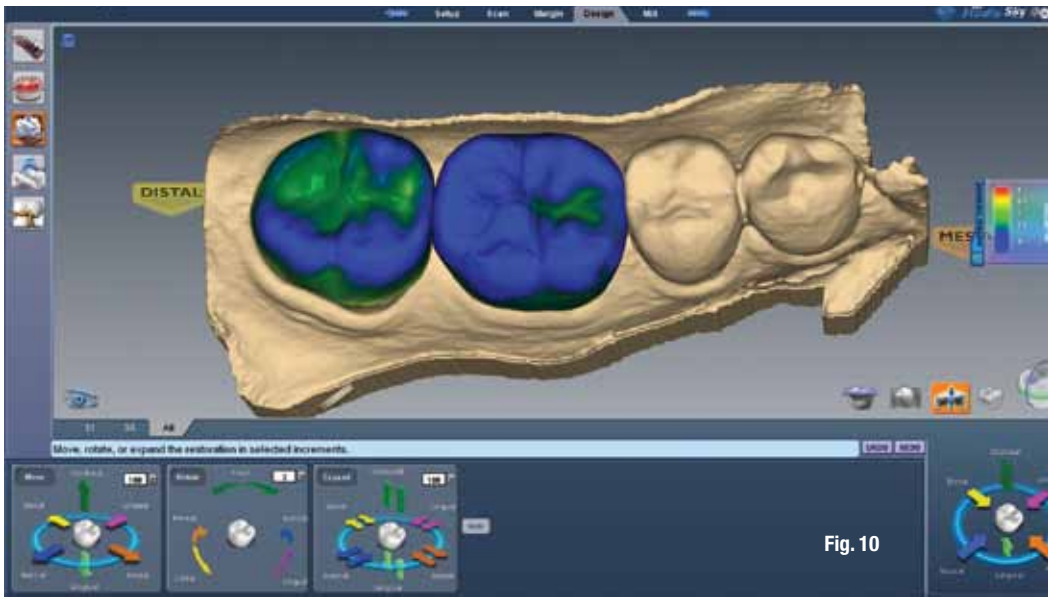
The scanner receives all its power requirements through its Firewire (upgraded cart) and Thunderbolt Connection (laptop), which also provide high-speed data transfer. The plug 'n play ability is significant for practices with multiple operatories — a single scanner can be moved from NEVO laptop to NEVO laptop (or upgraded cart) with no downtime. And for the first time, the scanner no longer needs to be disabled while designing — it can just be moved to scan another patient.

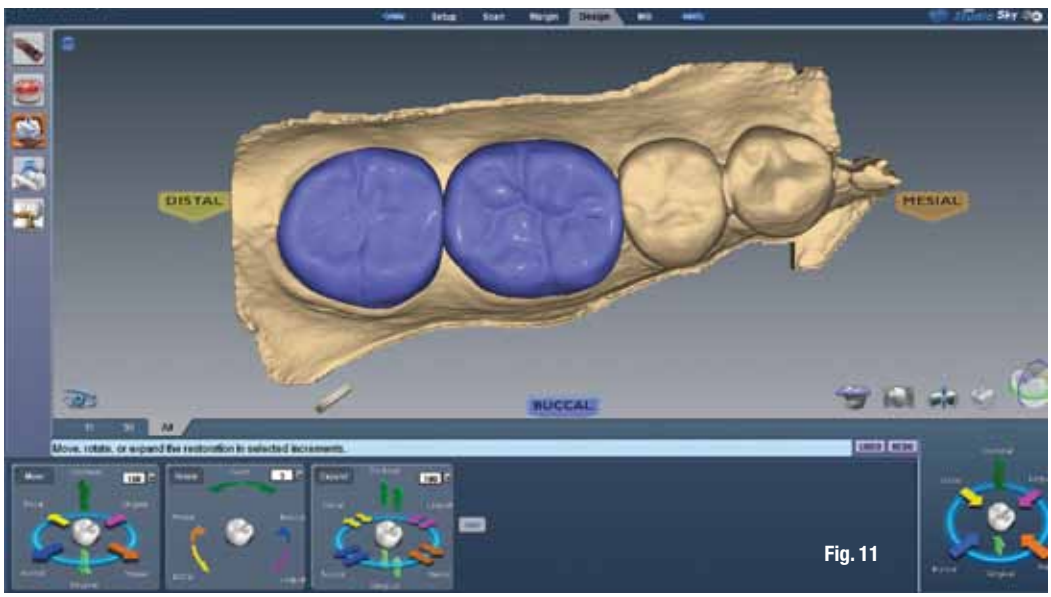
These are just a few of the advancements that have been implemented in the design to maximize productivity, efficiency and efficacy.

_Case report

Patient presented with bulk fractures of conventional ceramic restorations (Fig. 2).

Treatment plan was to minimize tooth preparation while placing reinforced lithium disilicate





Figs. 10, 11_Autogenesis automatically proposes an anatomically correct ideal restorative solution, including color-coded representations of contacts and material thickness.

milled restorations (IPS e.max CAD, Ivoclar Vivadent, Amherst, N.Y.) using E4D NEVO in one appointment.

An advantage of the previous restorations was minimal preparation, which could also be tied to the failure mode; however, it also meant the final preparation could maintain supragivngival margins and conserve a ring of enamel around each preparation.

Shoulders were prepared slightly below the axial wall to maintain the biorim[4] of the tooth and provide additional resistance form while ensuring proper clearance. The basic preparation guidelines were followed for all ceramic restorations – adequate clearance of 1.5–2.0, rounded internal angles and taper, shoulder preparations and supragingival margins where possible (Fig. 3).

Clearance was confirmed with tabs (Fig. 4).

After the preparation was completed, the NEVO scanner was used to capture the preparations, opposing dentition and buccal bite for occlusion.

The DentaLogic Software was then used to mark margins using the ICE (I See Everything) view (Figs. 5, 6).

The proprietary ICE view in NEVO also has contrast and brightness sliders that allow optimization of the visual image to assist in margin identification (Figs. 7–9).

The system then proposes the ideal restorative solution using Autogenesis™. Autogenesis presents an anatomically correct solution by evaluating the neighboring form of contour and marginal ridges, as well as the proximal and occlusal contacts per the clinician's selected settings.

Once the proposal is provided, numerous intuitive tools allow complete control and analysis of the restorative plan. These include color-coded

Fig. 12_ Restorations in their intermediate crystallization stage can be tried in.

Fig. 13_The final restorations.

representations of contacts and material thickness, confirming the proper utilization of the materials and predicted longevity.

After the designs are finalized (Figs. 10, 11), the restorations are sent wirelessly to the precision mill. For this case, mill times were 11 and 13 minutes respectively (teeth #18 and #19).

One of the advantages of milling IPS e.max CAD chairside is the ability to try in the restorations in their intermediate crystallization stage (blue/violet – as milled) to confirm occlusion and fit (Fig. 12).

Once confirmed, characterization and speed firing with the Programat CS1 (Ivoclar Vivadent, Amherst, N.Y.) provide the finished restorations.

Following proper preparation and restoration conditioning (Multilink A&B on preparation and HF etch for 20 seconds, Monobond-S on the intaglio surfaces of the restorations), according to the instructions of manufacturer Ivoclar Vivadent, the restorations were seated with Multilink Translucent and polymerized.

The final restorations (Fig. 13) provided form, function and esthetics in a one-appointment solution using the NEVO scanner and design center and the E4D precision mill.

The new NEVO scanner and design center, along with E4D, provide a portable, precise, in-office restorative solution without any clinical or esthetic compromises. This latest development by E4D Technologies just confirms my decision back in 2008 to implement chairside CAD/CAM in my practice._

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_about the author CAD/CAM

Bryan Couch, DDS, has been in private practice for 28 years in Coppell, Texas. He primarily practices family, cosmetic and restorative dentistry. In the past five years, he has added multiple services, such as same-day dentistry with E4D, implant dentistry, laser therapy, clear aligner therapy and sleep apnea dentistry. He continues to present in the areas of CAD/CAM dentistry and implementation of the digital dentistry practice. His training has involved TMD, restorative, orthodontics, cosmetic and occlusion training — all the necessary dental educational tools to develop a high-quality complete dentistry practice and complete smiles. Contact him at (972) 393-0708.

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An efficient milling material for efficient CAD/CAM practices

Author_Chad C. Duplantis, DDS

_Efficiency is, of course, one of the top considerations for any dentist with an E4D System. If you're like me, you made your purchase with a goal of doing great dentistry in a time-efficient way that works for both you and your patients.

After about one year of using the E4D System, I can say it has changed my practice, and I am certainly meeting that goal. Not only has my lab bill greatly decreased, but patients love that they can get an indirect restoration on the same day.

After having used a different chairside milling system in the past, I have an especially great appreciation for the principles of affordability and efficiency with chairside milling. The good news is that just as technology is improving in scanning, design and milling systems, material options are getting better as well, enabling outstanding efficiency for in-office systems.

A great example of this is 3M™ ESPE™ Lava™ Ultimate Restorative. This milling material was originally

Fig. 1_Failed composite restoration with a compromised distolingual cusp following caries removal (tooth #14). (Photos/Provided by Chad C. Duplantis, DDS)

Fig. 2_The prepped tooth.

introduced for E4D (E4D Technologies, Richardson, Texas) and CEREC systems (Sirona Dental, Long Island City, N.Y.) and can now also be ordered through the lab. Its unique properties help explain why it is so useful for either in-office restorations or laboratory fabricated cases.

Lava Ultimate restorative is a new class of material: resin nano ceramic. What does this mean? In terms of the block's makeup, it is composed of a blend of approximately 80 percent nanoceramic particles embedded in a highly cured resin matrix. In terms of performance, "resin nano ceramic" means that the material mills and polishes quickly, provides durability and shock absorption in the mouth, and can be easily adjusted and repaired with composite.

All of these qualities contribute to in-office efficiency and long-lasting results for patients.

_Fast milling

For chairside CAD/CAM systems, the block's milling qualities are especially notable. It is less brittle than other materials, which helps it mill quickly and easily, with excellent edge quality. Once milled, restorations need no post-firing. Dentists can pick from eight shades and two translucencies, allowing plenty of options for strong esthetics.

In addition, I have found that for cases in which I'd like to add more characterization, 3M™ ESPE™ Sinfony™ Indirect Lab Composite Lab Composite thinned with a little adhesive works well.

_Strong and resilient

Lava Ultimate restorative's less brittle nature is due to the fact that the material has an elastic modulus that is similar to dentin and is significantly lower than glass ceramic materials or veneering porcelains for PFMs. The benefit for patients is that restorations are resilient and can absorb chewing forces. However, the material still maintains high flexural strength of 220 MPa.

This combination of strength and resiliency helps explain the material's 10-year warranty.

_Easy to adjust

The unique makeup of Lava Ultimate restorative also allows for it to be easily adjusted and repolished. Occlusion can be adjusted with both additive and subtractive techniques, with no need to send the crown out or to spend valuable time on recharacterization and repolishing. For implant cases, access holes can be cut into the crowns and resealed with composite.

_Case illustration

The case photos shown here illustrate the simple use of the material and its esthetic results. As seen in Figure 1, the patient had an existing composite resin restoration with recurrent decay on #14, in which the distolingual cusp was compromised.

Fig. 3_Final result milled from Lava Ultimate restorative

After the composite and decay were removed and the walls of the prep were refined (Fig. 2), the 3M™ True Definition Scanner was used to capture a digital impression. The scanner's smooth interface with E4D enabled almost instantaneous transfer of the data, and the restoration was then designed with the E4D software.

The case was next sent to the E4D milling center, where a Lava Ultimate block was milled. The prep was treated with 3M™ ESPE™ Scotchbond™ Universal Adhesive, and 3M™ ESPE™ RelyX™ Ultimate Cement was then applied to the restoration and seated. (This combination of adhesive, cement and restorative material is designed to work together; the cement includes an integrated dark cure activator for the adhesive.)

Final polishing was then performed, and the case was completed (Fig. 3).

From start to finish, this case took approximately 75 minutes, a great illustration of the efficiency made possible with E4D and Lava Ultimate restorative.

_Conclusion

Today, I estimate that I use my E4D in more than 20 cases per month, making it a great investment for my practice. Combined with an affordable and accurate digital scanning system and a milling material designed for efficiency, the E4D provides dentists with an outstanding, practical gateway to in-office milling._

_about the author CAD/CAM

Chad C. Duplantis received his DDS from the University of Texas Health Science Center at San Antonio Dental School in 1999. In 2000, he received a certificate in advanced education in general dentistry from Baylor College of Dentistry. He has been in practice for the past 11 years. Duplantis takes several hours of continuing education each year to improve his clinical skills. Most recently, Duplantis completed both the advanced and masters series at the Center for Aesthetic Restorative Dentistry in Dallas. He also served as teaching faculty for the course for the past year. He has professional affiliations with the American Dental Association, the Texas Dental Association, the Fort Worth District Dental Society, the Academy of General Dentistry and the Fort Worth Academy of General Dentistry, among others. Contact Duplantis at his practice at (817) 306-7474.

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Adjust and polish new restorative ceramics for miles of smiles

Authors_James DiMarino, DMD, MSEd, & Lance Panarello, DMD

_One of the best things about being a dentist is the patient's smile after completion of an esthetic restoration. The emergency patient who presents with a large cusp fracture and leaves with a single-visit E4D ceramic restoration and ear-to-ear grin, makes the difficult days worth it!

A challenging aspect of dentistry is keeping up with the technology as our restorative materials constantly evolve. While new materials don't necessarily require new bur shapes or techniques, they do require rotary cutting and polishing instruments that are fast and effective.

Fig. 1_E4D Mill (Photos/Provided by Premier Dental)

As all-ceramic restorations become stronger, more esthetic and more popular, dentists must adapt in order to work efficiently with these advanced materials. Premier® Dental offers some unique products that help dentists adjust and polish the new generation of tough ceramic materials while streamlining the workflow.

Let's look at adjusting ceramics. The newest Two Striper® diamond was based on the same technology used to make the E4D milling diamonds (Fig. 1). TS ZTech™ diamonds feature the innovative combination of a select grade of proprietary diamond grit combined with the P.B.S.® brazing process for crystal attachment. They are designed to provide faster and cooler cutting with less trauma and no sparking as well as a useful service life.

These friction grip diamonds come in five shapes, and three are available with slightly longer shanks. There are also two HP lab diamond shapes (Fig. 2).

When adjusting an all-ceramic restoration, it is important to have a diamond that does not cut too aggressively, because the resulting deep scratches in the restoration will require more time to polish. The smaller diamond particle size used in the TS ZTech diamonds provides enough grit to gently adjust the occlusal contacts while limiting surface roughness.

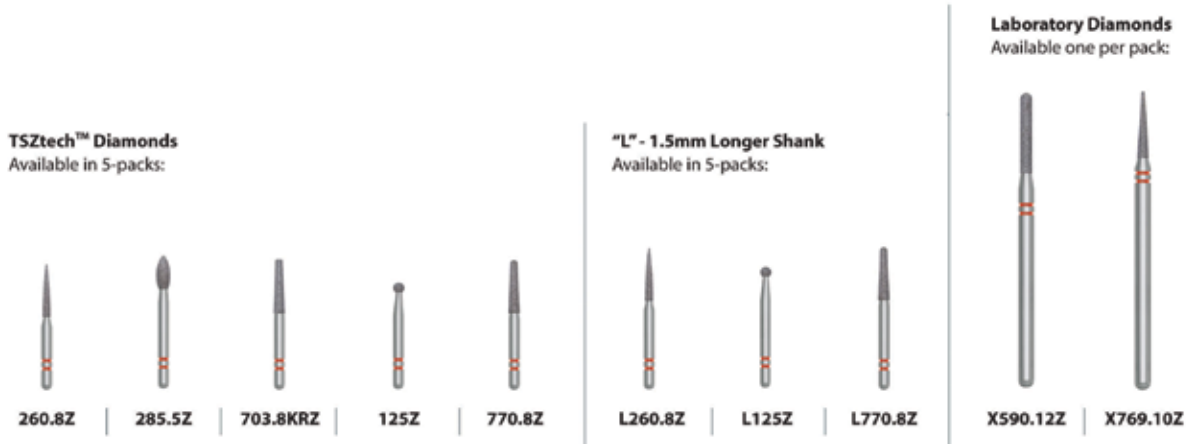

Fig. 2

Fig. 2_ TS ZTech diamonds

Fig. 3_ Diamond Twist SCO

After permanently seating and adjusting the restoration, Premier's Diamond Twist SCO™ intraoral polishing kit provides an easy one-step system to swiftly polish the adjusted area to a final high-gloss finish using the supercharged polishing paste and included microcloth disks (Fig. 3). You can also use the flat or taper polishing brushes in the kit for posterior occlusal surfaces.

_Dr. Lance Panarello, an E4D dentist, shares his observations

Let's talk about delivering an IPS e.max® crown. The material, in my opinion, has finally made full-mouth ceramics a legitimate, viable option.

So now we have a very strong, dense lithium disilicate material that is ultra-durable. But wait – there is a problem. What do we use to adjust this material? How do we do it? When you have too smooth a diamond, you will adjust forever; too rough, and you have to use a second or third finer diamond to smooth the scratches and then polish.

Multiple steps waste time, cost money and fail to meet patient expectations. The TS ZTech diamond provides the perfect blend of cutting efficiency with minimal scratching (Fig. 4). Premier's polishing system is so effective that it can lead to more revenue. I had a patient present for an adjustment of a delivered veneer case. I used the combination of TS ZTech and Diamond Twist SCO to adjust and polish the veneer.

She loved the look and feel after polishing so much that she asked me to polish every veneer in her mouth! Keep in mind, these were all glazed with no rotary adjustments. Some people can really tell the difference and appreciate it.

_Extraoral polishing

Premier also offers an extraoral polishing system, the Diamond Twist SCL™ polishing kit. If you prefer, you can polish extraorally. This glaze-like, multi-surface polishing system features advanced open-weave fibra pre-polishers and 100 percent wool paste applicators for a supercharged mirror polish.

Pre-polish with Fibra Points (barrel, wheel or taper), whose open-weave design generates significantly less heat. Final polish with Diamond Twist Super-Charged Polishing Paste applied with felt barrel, wheel or point for a glaze-like polish (Fig. 5).

As dentists, we want to do the best for our patients while staying current with the advancements in dentistry. It is a relief when you come across a system that works and is easy to use and implement.

The key to optimal use of TS ZTech diamonds is copious amounts of water spray, followed by a final high-gloss polish with Diamond Twist SCO. Because these unique diamonds cut so efficiently through all-ceramics, they can also be used for other procedures such as atraumatic all-ceramic crown removal.


Fig. 4


Fig. 5

Fig. 4_ The TS ZTech diamond in action. (Clinical photos/Provided by Dr. Lance Panarello)

Fig. 5_ IPS e.max CAD

The fine diamond particle grit effectively cuts through zirconium, according to REALITY's 2013 report — 4 stars, and first place ranking.

Another indication is creating endodontic access through all-ceramic restorations. The fine diamond particle grit of the TS ZTech diamonds allows for easy access with minimal microfracturing according to the 2012 CR Foundation report, which rated these diamonds as "Excellent."

Premier Dental has been providing new technologies to dentists for more than a century. The company's dedication to quality and easy-to-use products that work is clearly reflected in the TS ZTech diamond and Diamond Twist SCO/SCL polishing systems.

It is one thing to complete the perfect preparation, capture the perfect impression and present the perfect restoration, but being able to efficiently polish away adjustments so the look and feel of the restoration is natural is truly what keeps our patients and us smiling._

_about the authors

James DiMarino, DMD, MSEd, is a graduate of the University of Pennsylvania School of Dental Medicine and the University of Pennsylvania Graduate School of Education. He completed his general practice residency and opened a solo general dentistry office while researching and implementing advanced dental technologies and procedures. He has been busy obtaining U.S. patents, inventing, training dental professionals, publishing and lecturing. DiMarino has been working with Premier Dental Products as the manager of clinical product development and the director of clinical affairs. You can reach DiMarino by email at *DiMarino@adamember.net*.

Lance Panarello, DMD, is a 1997 graduate of Temple University School of Dentistry. He is currently a partner in private practice at Dental Health Care Associates (the first green dental building in the United States). He is a member of the Academy of General Dentistry, American Dental Association and American Academy of Facial Esthetics. He is a speaker on efficiency, technology, productivity and building green. He is the co-owner of The Elite Dental Institute, a consulting company for efficiency, excellence and experience. You may contact Panarello at *meangreenmachine4@yahoo.com*.

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The business of CAD/CAM dentistry

Author_Mike Moroni, DDS

_As with anything in business, it is critical to always step back and figure out what it takes to run your business. Review your overhead, fixed costs and variable costs. Ask yourself: What can I invest in to make my patient's experience better, increase my new patient volume and, therefore, produce and collect more money to sustain the expenditures within the office?

This last point is key because many things are on the shoulders of dentists: salaries, pay raises, costs of supplies, costs of charitable donations, staff bonuses, 401(k) contributions ... the list goes on.

Oftentimes, we make the decision based on gut feelings, rather than looking at the numbers and evaluating what a purchase will actually end up costing the practice.

How much will it cost? Will the practice pay for it in cash or take a loan out? What is the monthly payment? What is the break-even point?

Unfortunately, dental school does not provide dentists the formal training on how to actually run a business. We just want to practice dentistry. So I had to ask myself and do the research: Do I really want to get into CAD/CAM dentistry? I did not want to purchase it and have it sitting in the corner like many pieces of equipment we purchase (or like the treadmill I have at home that has clothes hanging from it)!

I narrowed my search down to three major components:

1) How would I manage my appointment book efficiently?

2) How would I pay for it?

3) How could I be the best at it?

When I decided to purchase my E4D for my office, the first thing I did was gather information. How was this purchase going to help the office?

I originally purchased a CEREC CAD/CAM system four years ago. It is a good system, but I was tired of all the additional costs for upgrades. These costs, in my opinion, became cost prohibitive to continue with that system. My specialists (referrals) also all had to be using Sirona products, as it is a closed and proprietary system.

With the E4D system, I found that the latest upgrade was a fraction of the cost. I also liked the open platform and the flexibility, which allows me to use any system on the market that utilizes a Dicom file format. I can integrate my E4D system with any other open system and send files back and forth.

_Managing your new technology

The first hurdle is managing your office and setting the bar high for optimal efficiency and imple-

Fig. 1a

Fig. 1b

mentation of the new technology. Notice that I said *you* manage your office, not the other way around. Yes, the procedure for a crown will take slightly longer, but you will be making the entire restoration from start to finish, and you and the team are learning. So you have to build time into your daily schedule to accommodate that time extension.

For me, I scheduled three hours when I first started doing CAD/CAM restorations. Crazy amount of time, huh?! Most times I did not need that duration, but there were some cases where I did need it.

As I became more proficient with the software and performing these restorations, I tailored my appointment book around my speed with designing, milling and crystallizing (for e.max) restorations. My office manager and I have honed in on tweaking the schedule to accommodate CAD/CAM dentistry into my office.

We now overlap and perform quadrant dentistry on a regular basis.

If I have a crown on #30, I will perform #31 MO and #29 DO, as well as any restorations that are needed on the opposing arch, while the crown is milling. This makes for high production and time efficiency, and patients love that I do not waste their time.

There are many little extras that can help your patients' visits be more enjoyable and make the time pass. I show movies in my office so my patients can watch a movie while they wait. My patients can connect to free WiFi and perform work tasks on their individual devices they bring in, and there is a play area for their children during the appointment time.

I can usually perform a crown in an hour and a half, start to finish. This includes the time to do the additional restorations in that quadrant.

The owners of E4D Systems are excited about the release of the E4D NEVO. This newest innovation from E4D allows for faster scanning that is accurate and easy. The scanner is amazing – what you see on the screen is recorded as images, and those images are stitched together. It usually takes me about three minutes to scan in the mouth now, but with the NEVO, it is 20 to 30 seconds. Period. Fast, easy and accurate.

_How to pay for it

I received a lease set up through Henry Schein. My monthly payment is around $2,200 for the CAD/CAM unit, milling machine and oven.

Fig. 1a_Pre-op tooth #19. Tooth is fractured and decay is present under old amalgam filling. (Photos/Provided by Mike Moroni, DDS)

Fig. 1b_Post-op tooth #19 shows e.max crown final restoration.

Now, here is the really neat part: You cannot afford to *not* buy it! Let me demonstrate.

The unit costs $2,200 per month, plus the cost for blocks and other consumables. The average monthly cost is about $3,000. By comparison, the average bill for my local crown lab was $10,000 a month. I just saved $7,000 on my lab bill alone! Hello!

Then the intangibles come into play – intangibles to us, but huge issues for many patients these days, such as taking time off of work. Or coming back because a temporary came off, or to re-impress because the crown does not fit, or there is no contact, etc., etc. This causes a huge drain on your practice productivity and chair-time. If a patient is in my chair, I want to be making money, not losing it.

My lab technician came by my office a month ago. It had been about four years since I used him. Since I started CAD/CAM dentistry, my goal was to do everything I could with it, if possible, using the materials we have and considering the individual patient needs. I basically send out only the removable (prosthetic) cases to the lab. Everything else I do in the office. This gives me more control over the quality of the restorations that I place in my patients.

The lab does not see what is in the patients' mouths, but we do! If the patient requires a broader contact on a crown, I can provide that when I design the crown. If the contact also needs to be placed closer to the gingiva because of food impaction, I can easily do that as well. It's all easy to do chairside with the E4D System.

Fig. 2a

Fig. 2b

Fig. 2a_Pre-op view of teeth #18, #19 and #20.

Fig. 2b_Final view of #18 MO Resin, tooth #19 MODL e.max onlay and tooth #20 MODL e.max onlay.


Fig. 3a


Fig. 3b


Fig. 3c

I advised my lab tech who came into my office to get into CAD/CAM dentistry and told him it was the way everything is going. The restorations are the same, if not better, than a lab can create. That was my one huge criterion before I went into this area of dentistry – the end product had to be the best. This leads to my next subject. ...

_How to be the best

You cannot be the best unless you invest in yourself, and your team, and get training on the system. If you buy the unit and think that is all it takes, you are incorrect. You also can't take just one course and call yourself good. Yes, you will know the basics, but there is so much more to learn. The more educated you become with the product, the better dentistry you will do, the faster you become and the more you will produce.

I have taken basic courses, which give you an idea of how the system works. Advanced courses go way beyond what basics do, but unfortunately, most dentists don't invest in them.

I have taken advanced courses, and I can now produce a veneer smile design case better than the lab I used to use. I can do it by myself, using the advanced training, in my office with my machine. I don't have to send it out and get a $2,500 to $3,000 lab bill for a cosmetic case. I can do it myself for about $500. That sounds pretty straightforward to me.

But it is not merely about the money. It is about the quality of the restoration. My restoration is perfect, or I make it again. Same day, while the patient is there.

There is nothing that gives the patient more respect for you and your team if you stop what you are doing, explain that you are not satisfied with how the margin is on a crown and re-take pictures, re-design and re-mill while the patient is still waiting.

Did it take longer to do? You bet. But the patient is not going to go anywhere else after that experience.

The patient knows your office is the place to be, because you do it right. The patient knows it and spreads the word about you, your office team and the wonderful machine that makes crowns in a day. Many patients actually ask for or inquire about the E4D when they make the appointment. That is the best free word-of-mouth marketing in the world.

If I lose contact because of my design, we can quickly add contact on the E4D or add porcelain before we fire the restoration in the oven. No more re-cementing the temporary and sending the patient away or asking them to take more time off work. I can do it in my office, same day, in about 15 minutes.

I don't remember the last time I received a call from a patient during the weekend because they lost or broke their temporary. I rarely make temporaries anymore. And that is another cost savings!

Fig. 3a_Pre-op tooth #30 with DOF onlay.

Fig. 3b_Prep of tooth #30.

Fig. 3c_Tooth #30 with DOL LAVA ULTIMATE onlay seated and final restoration.


Fig. 4a


Fig. 4b


Fig. 4c


Fig. 4d


Fig. 4e

Fig. 4a_Tooth #21 pre-op.

Fig. 4b_Tooth #21 with e.max try-in.

Fig. 4c_Tooth #21 seated (buccal view).

Fig. 4d_Occlusal view of prepared tooth #21.

Fig. 4e_Occlusal view of tooth #21 seated.

_In closing

I have been practicing dentistry for 16 years. I love what I do. I love CAD/CAM dentistry, and I am a better dentist for practicing this way. I feel like my restorations are the same, if not better, than any laboratory can make them.

It is a huge economic advantage to have an E4D in my office. It is a great time-saver for my patients and also for my entire team. We could not even fathom not having it at this point.

Please feel free to contact me at anytime if you would like to discuss venturing into this area of dentistry.

I am not a sales person; I have nothing to gain by you purchasing this type of equipment. I have owned both CAD/CAM systems, and I can give you honest feedback that can give you the information to make an educated decision on your purchase._

_about the author

Dr. Mike Moroni was raised in Northern California. He attended California State University at Hayward where he received his BS in biology. In 1997, he graduated with his doctorate in dentistry from Case Western Reserve University in Cleveland. He completed his dental residency at the Cleveland Clinic, with emphasis in the treatment of HIV/AIDS and Alzheimer's patients. In 1999, he moved to Colorado where he opened his private practice. Moroni is committed to quality care and has taken more than 200 hours of continuing education yearly with emphasis in cosmetic dentistry. His professional memberships include American Academy of Cosmetic Dentistry, American Dental Association, Colorado Dental Association and Metropolitan Denver Dental Society.

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If you are planning to invest in such equipment or technology as an E4D System, doing so before the end of the year may be more affordable than you think. (Photo/Provided by E4D)

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Author_Keith Drayer, vice president, Henry Schein Financial Services

_Imagine the benefit to your patients, your dental team and to you by increasing your practice's esthetic appeal, efficiency and effectiveness. Think of the incremental profitability when you are able to focus on delivering an even higher level of quality care to your patient base.

If you are a health-care professional who is thinking of starting, growing, going digital or remodeling an office, you may be able to do so more affordably in 2013 than ever before (see Table A).

What makes this a highly desirable environment?

- Higher tax rates than prior years make all deductions more valuable.
- Record high dollar level of Section 179 benefit.
- Ability to quickly and conveniently secure attractive fixed-rate financing.
- Specialty lenders are offering 100 percent financing as well as long-term deferrals for equipment or technology (so your practice can benefit before any payments are required).

_Section 179 fundamentals

It is never too late or too early to do business tax planning. The best time to tackle tax planning is mid-year, because you still have time to put strategies into action. It is suggested that your tax planning goal is

	Top Federal Tax Bracket Rate	Section 179 Deduction Benefit
2013	39.6 percent	$500,000
2012	35 percent	$139,000

Table A

Section 179	2013	2012
Equipment/technology Software	$300,000	$3000,000
Section 179 benefit	$300,000	$300,000
50 percent bonus depreciation	Available	$30,500
Total first year deduction	$300,000	$169,500
Potential tax bracket	39.6 percent	35 percent
Cash savings	**$118,800**	**$59,325**

Table B

to (a) minimize income, (b) maximize expenses and (c) take advantage of tax credits (Perez, 2011).

There are many ways to conduct tax planning, and the best time to do tax planning is now. The Section 179 tax deduction is a federal IRS tax code rule that allows businesses to deduct all or part of the purchase price of certain qualifying business purchases (equipment, technology and off-the-shelf software are usually qualified property). The 2013 Section 179 deduction benefit of $500,000 has never been higher. Bonus deduction applies up to $2 million (see Table B). (There are individual circumstances applicable to your situation. Please check with your own advisors as we do not offer tax advice).

As more and more practitioners embrace equipment and technology, such as the purchase of an E4D or other CAD/CAM related products, the Section 179 benefit can be applied to lower the office's taxable income, making a practice more efficient, productive and profitable. But don't wait too long to acquire technology or upgrade your office. Although it is true that you can have equipment placed in service until Dec. 31, waiting too far into the year may mean you will settle on your selections because of diminished quantities.

You owe it to your practice and yourself to evaluate your opportunities. Now may be the best opportunity to utilize the winning combination._

_about the author CAD/CAM

Keith Drayer is vice president, Henry Schein Financial Services. Henry Schein Financial Services provides equipment, technology, practice start-up and acquisition financing services nationwide. Henry Schein Financial Services can be reached at (800) 853-9493 or *hsfs@henryschein.com*. Please consult your tax advisor regarding your individual circumstances.

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Section 179 Tax deduction is a Federal IRS tax code rule that allows businesses to deduct all or part of the purchase price of certain qualifying business purchases (equipment, technology, and off the shelf software). The 2013 Section 179 deduction is $500,000 with a bonus deduction that applies up to $2,000,000.

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IPS e.max CAD: A clinically proven solution for CAD/CAM needs

Author_Ivoclar Vivadent Staff

_CAD/CAM and digital technology present a wonderful opportunity to the dental profession because of the array of possibilities they offer. IPS e.max CAD from Ivoclar Vivadent is an innovative lithium disilicate glass-ceramic (LS2) for CAD/CAM applications that has been used by E4D Dentist System users since 2008.

The metal-free IPS e.max CAD material combines high esthetic qualities with exceptional user-friendliness. Unlike other CAD/CAM materials, IPS e.max CAD is suitable for a comprehensive range of indications, and its wide spectrum of translucency levels, shades, and block sizes provides great flexibility.

Unlike materials of the past – many of which required a minimum thickness of 2 mm to reduce the likelihood of ceramic fracture – IPS e.max CAD allows for conservative preparation with a material that is stronger than traditional porcelains.

_High strength

IPS e.max CAD is indicated for inlays, onlays, veneers, partial crowns, anterior and posterior crowns, telescope primary crowns and implant superstructures.

For a posterior crown fabricated to full contour using CAD methods, the material demonstrates 360 MPa of strength through the entire restoration. As a result, restorations demonstrate a "monolithic" strength, unlike other metal-free restorations.

IPS e.max CAD is milled in a "soft" intermediate state, during which the material exhibits its characteristic bluish color. The microstructure of partially crystallized IPS e.max CAD lithium disilicate consists of 40 percent platelet-shaped lithium metasilicate crystals embedded in a glassy phase. These crystals range in length from 0.2 to 1.0 um.

In a swift crystallization process, IPS e.max CAD subsequently obtains its final high strength of 360 MPa and achieves the desired esthetic properties, such as tooth color, excellent translucency and brightness. Post-crystallization microstructure of IPS e.max CAD lithium disilicate material consists of 70 percent fine-grain lithium disilicate crystals embedded in a glassy matrix.

_Esthetic options

IPS e.max CAD satisfies high esthetic demands with its three different levels of translucency throughout the A–D shades. Special Bleach and Impulse shades also are available. Additionally, individual characteristics can be added using the staining or cut-back technique.

IPS e.max CAD blocks are colored using coloring ions. However, the coloring elements demonstrate a different oxidation state during the crystalline intermediate phase than in the fully crystallized state. As a result, the blocks exhibit a blue color. The material achieves its desired tooth color and opacity when

IPS e.max CAD is a lithium disilicate glass-ceramic (LS2) for CAD/CAM applications. (Photo/Provided by Ivolcar Vivadent)

the lithium metasilicate is transformed into lithium disilicate during the post-milling firing process.

The IPS e.max CAD shade line has been extended to include IPS e.max CAD Impulse. These blocks include three value shades (value 1, 2, 3) and two opal shades (opal 1, 2).

The value blocks – which provide intermediate translucency for the B1–BL3 shade range – are ideal for crown, partial crown and veneer indications. The value of these Impulse blocks increase from 1 to 3.

The opal blocks combine lifelike opalescence and strength for enamel replacement and are ideal for minimal preparation restorations, including thin veneers. The translucency of these Impulse blocks decreases from 1 to 2.

_Placement flexibility

IPS e.max CAD lithium disilicate glass ceramic restorations can be traditionally cemented or bonded adhesively. Therefore, any restrictions that may be presented because of placement or location within the mouth are eliminated, whether in the anterior or posterior areas.

Strong and durable, the all-ceramic material is highly resistant to the forces of mastication over the long term, so it's ideal for use in the posterior region.

IPS e.max CAD restorations also demonstrate lifelike optical properties, such as a relatively low refractive index that provides excellent optical characteristics, including optimal light transmission and lifelike translucency for natural-looking and highly esthetic restorations in the anterior region.

_Monolithic versatility

IPS e.max CAD Monolithic Solutions streamline the fabrication of full-contour restorations that demonstrate high strength, durability and proven clinical properties. Monolithic restorations that can be fabricated to full contour with IPS e.max CAD include thin veneers (0.4 mm), veneers, occlusal veneers, inlays/onlays and crowns.

_Summary

IPS e.max CAD lithium disilicate provides opportunities for esthetically, efficiently and predictably restoring a broad spectrum of cases. When combined with CAD/CAM technology – whether in the dental practice or the dental laboratory – IPS e.max CAD enables dentistry to provide patients with state-of-the-art treatments that satisfy their multiple demands._

Next-generation Multilink Automix: A strong bond for all cementation cases

Author_Ivoclar Vivadent Staff

_Multilink Automix has been known as an innovative, multipurpose adhesive cement because it creates a reliable and long-lasting bond regardless of the restorative material of choice, even in the posterior segment.

Multilink Automix has been used successfully to place more than 10 million indirect restorations and has achieved excellent results in numerous clinical investigations, including long-term studies. The survival rate of restorations in terms of adhesion was 99 percent in nine studies that examined more than 291 restorations. It is the recommended cement for IPS e.max restorations and for the cementation of all IPS Empress restorations, in addition to all other types of restorative materials.

The next generation of Multilink Automix is now available. The formula of the cement has been further enhanced, allowing for much easier cleanup of excess material. Further developments to the system include a new shade, try-in pastes and the convenience of room-temperature storage.

This self-curing luting composite with light-curing option is indicated for indirect restorations (inlays, onlays, crowns, bridges) and posts fabricated from such materials as lithium disilicate, zirconia, metal and metal ceramics, oxide ceramics, fiber-reinforced composites and precious alloys.

Featuring patented hydrolytically stable acidic monomers, the Multilink self-etch, self-curing primer produces high immediate bond strengths to tooth structure. The primer ensures durable adhesion and long-term bonds within 10 minutes of placement. Multilink Automix includes a one-step primer that self-etches, self-cures and seals the dentin in 15 seconds, providing excellent marginal adaptation and minimal postoperative sensitivity.

The Air Block Liquid Strip enables users to protect the cement line from oxygen exposure during the curing process. This prevents the formation of an inhibition layer and lays the foundation for achieving esthetic restorations with impeccable margins.

Multilink Automix.
(Photo/Provided by Ivolcar Vivadent)

Multilink Automix has been clinically proven in various independent and manufacturer studies to offer a simplified procedure through sound chemistry. Designed for fast and easy application, the Multilink Automix system uses an innovative mixing tip that dispenses exact dosing with less waste and consistent mixes and requires no hand mixing, no capsule activation and no additional application tools or devices.

The formula of Multilink Automix has been optimized to further facilitate the cleanup of excess material using the quarter cleanup technique. Excess material may be pre-cured for one to two seconds per quarter surface (mesio-oral, disto-oral, mesio-buccal, distobuccal), transforming the material into a gel-like consistency for simpler and more efficient removal with a scaler, probe or floss.

The shade range has been expanded to include a white shade with medium translucency. Water-soluble, glycerine-based try-in pastes are now available to simulate and check the shade effect of the restoration in relation to the chosen Multilink Automix shade.

In addition, the entire Multilink Automix system pack can now be stored at room temperature because of the optimization of the Multilink Automix formula._

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