

## Request for Reconsideration after Final Action

The table below presents the data as entered.

Input Field	Entered
<b>SERIAL NUMBER</b>	85624513
<b>LAW OFFICE ASSIGNED</b>	LAW OFFICE 101
<b>MARK SECTION</b>	
<b>MARK</b>	http://tmng-al.uspto.gov/resting2/api/img/85624513/large
<b>LITERAL ELEMENT</b>	CDE WORLD
<b>STANDARD CHARACTERS</b>	YES
<b>USPTO-GENERATED IMAGE</b>	YES
<b>MARK STATEMENT</b>	The mark consists of standard characters, without claim to any particular font style, size or color.
<b>GOODS AND/OR SERVICES SECTION (009)(current)</b>	
<b>INTERNATIONAL CLASS</b>	009
<b>DESCRIPTION</b>	
Downloadable electronic publications in the nature of journals, newsletters, journal and newsletter supplements, monographs and feature reports in the field of dental continuing education	
<b>FIRST USE ANYWHERE DATE</b>	At least as early as 02/28/2012
<b>FIRST USE IN COMMERCE DATE</b>	At least as early as 02/28/2012
<b>FILING BASIS</b>	Section 1(b)
<b>GOODS AND/OR SERVICES SECTION (009)(proposed)</b>	
<b>INTERNATIONAL CLASS</b>	009
<b>DESCRIPTION</b>	
Downloadable electronic publications in the nature of journals, newsletters, journal and newsletter supplements, monographs and feature reports in the field of dental continuing education	

<b>FIRST USE ANYWHERE DATE</b>	At least as early as 02/28/2012
<b>FIRST USE IN COMMERCE DATE</b>	At least as early as 02/28/2012
<b>STATEMENT TYPE</b>	"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce at least as early as the filing date of the application" [for an application based on Section 1(a), Use in Commerce] OR "The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce prior either to the filing of the Amendment to Allege Use or expiration of the filing deadline for filing a Statement of Use" [for an application based on Section 1(b) Intent-to-Use]. OR "The attached specimen is a true copy of the specimen that was originally submitted with the application, amendment to allege use, or statement of use" [for an illegible specimen].
<b>SPECIMEN FILE NAME(S)</b>	
<b>ORIGINAL PDF FILE</b>	<a href="#">SPU0-21620015371-20150716142159062846 . Specimen 1 - CDE World Cl 9 - June Newsletter.pdf</a>
<b>CONVERTED PDF FILE(S) (3 pages)</b>	<a href="#">\\TICRS\EXPORT16\IMAGEOUT16\856\245\85624513\xml20\RFR0002.JPG</a>
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<b>ORIGINAL PDF FILE</b>	<a href="#">SPU0-21620015371-20150716142159062846 . Specimen 2 - CDE World Cl 9 - July Newsletter.pdf</a>
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	<a href="#">\\TICRS\EXPORT16\IMAGEOUT16\856\245\85624513\xml20\RFR0008.JPG</a>
<b>SPECIMEN DESCRIPTION</b>	Copies of Applicant's June and July 2015 newsletters.
<b>GOODS AND/OR SERVICES SECTION (016)(current)</b>	
<b>INTERNATIONAL CLASS</b>	016
<b>DESCRIPTION</b>	Trade journals in the field of dentistry
<b>FIRST USE ANYWHERE DATE</b>	At least as early as 02/28/2012
<b>FIRST USE IN COMMERCE DATE</b>	At least as early as 02/28/2012

<b>FILING BASIS</b>	Section 1(b)
<b>GOODS AND/OR SERVICES SECTION (016)(proposed)</b>	
<b>INTERNATIONAL CLASS</b>	016
<b>DESCRIPTION</b>	Trade journals in the field of dentistry
<b>FIRST USE ANYWHERE DATE</b>	At least as early as 02/28/2012
<b>FIRST USE IN COMMERCE DATE</b>	At least as early as 02/28/2012
<b>STATEMENT TYPE</b>	"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce at least as early as the filing date of the application"[for an application based on Section 1(a), Use in Commerce] OR "The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce prior either to the filing of the Amendment to Allege Use or expiration of the filing deadline for filing a Statement of Use" [for an application based on Section 1(b) Intent-to-Use]. OR "The attached specimen is a true copy of the specimen that was originally submitted with the application, amendment to allege use, or statement of use" [for an illegible specimen].
<b>SPECIMEN FILE NAME(S)</b>	
<b>ORIGINAL PDF FILE</b>	<a href="#">SPU1-21620015371-20150716142159062846_ . Specimen - CDE World - Class 16.pdf</a>
<b>CONVERTED PDF FILE(S) (1 page)</b>	<a href="#">\\TICRS\EXPORT16\IMAGEOUT16\856\245\85624513\xml20\RFR0009.JPG</a>
<b>ORIGINAL PDF FILE</b>	<a href="#">SPU1-21620015371-20150716142159062846_ . Specimen 1 - CDE World - Class 16.pdf</a>
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<b>SPECIMEN DESCRIPTION</b>	The first specimen shows the Applicant's website where downloadable trade journals (called "eBooks") are available. The second and third specimens are samples of the downloadable trade journals which are available.
<b>GOODS AND/OR SERVICES SECTION (035)(no change)</b>	
<b>GOODS AND/OR SERVICES SECTION (041)(no change)</b>	



SIGNATURE SECTION	
DECLARATION SIGNATURE	/Charles N. Quinn/
SIGNATORY'S NAME	Charles N. Quinn
SIGNATORY'S POSITION	Attorney for Applicant, Member PA Bar
SIGNATORY'S PHONE NUMBER	610-458-4984
DATE SIGNED	07/16/2015
RESPONSE SIGNATURE	/Charles N. Quinn/
SIGNATORY'S NAME	Charles N. Quinn
SIGNATORY'S POSITION	Attorney for Applicant; Member of Pa. Bar #17603
SIGNATORY'S PHONE NUMBER	610-458-4984
DATE SIGNED	07/16/2015
AUTHORIZED SIGNATORY	YES
CONCURRENT APPEAL NOTICE FILED	YES
FILING INFORMATION SECTION	
SUBMIT DATE	Thu Jul 16 15:47:11 EDT 2015
TEAS STAMP	USPTO/RFR-216.200.153.71- 20150716154711811687-8562 4513-5408945deea4b5579609 6c0eab46abfd66c473b1f9824 2a154690e1d274d7180-N/A-N /A-20150716142159062846

## Request for Reconsideration after Final Action To the Commissioner for Trademarks:

Application serial no. **85624513** CDE WORLD(Standard Characters, see <http://tmng-al.uspto.gov/resting2/api/img/85624513/large>) has been amended as follows:

## CLASSIFICATION AND LISTING OF GOODS/SERVICES

**Applicant proposes to amend the following class of goods/services in the application:**

**Current:** Class 009 for Downloadable electronic publications in the nature of journals, newsletters, journal and newsletter supplements, monographs and feature reports in the field of dental continuing education

Original Filing Basis:

**Filing Basis: Section 1(b), Intent to Use: *For a trademark or service mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to use the mark in commerce on or in connection with the identified goods/services in the application. ***For a collective trademark, collective service mark, or collective membership mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to exercise legitimate control over the use of the mark in commerce by members on or in connection with the identified goods/services/collective membership organization. ***For a certification mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to exercise legitimate control over the use of the mark in commerce by authorized users in connection with the identified goods/services, and the applicant will not engage in the production or marketing of the goods/services to which the mark is applied, except to advertise or promote recognition of the certification program or of the goods/services that meet the certification standards of the applicant.

In International Class 009, the mark was first used at least as early as 02/28/2012 and first used in commerce at least as early as 02/28/2012 .

**Proposed:** Class 009 for Downloadable electronic publications in the nature of journals, newsletters, journal and newsletter supplements, monographs and feature reports in the field of dental continuing education

Deleted Filing Basis: 1(b)

In International Class 009, the mark was first used at least as early as 02/28/2012 . and first used in commerce at least as early as 02/28/2012 .

Applicant hereby submits one(or more) specimen(s) for Class 009 . The specimen(s) submitted consists of Copies of Applicant's June and July 2015 newsletters. .

**"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce at least as early as the filing date of the application"** *[for an application based on Section 1(a), Use in Commerce]* OR **"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce prior either to the filing of the Amendment to Allege Use or expiration of the filing deadline for filing a Statement of Use"** *[for an application based on Section 1(b) Intent-to-Use]*. OR **"The attached specimen is a true copy of the specimen that was originally submitted with the application, amendment to allege use, or statement of use"** *[for an illegible specimen]*.

**Original PDF file:**

[SPU0-21620015371-20150716142159062846 . Specimen 1 - CDE World CI 9 - June Newsletter.pdf](#)

**Converted PDF file(s) ( 3 pages)**

[Specimen File1](#)

[Specimen File2](#)

[Specimen File3](#)

**Original PDF file:**

[SPU0-21620015371-20150716142159062846 . Specimen 2 - CDE World CI 9 - July Newsletter.pdf](#)

**Converted PDF file(s)** ( 4 pages)

[Specimen File1](#)

[Specimen File2](#)

[Specimen File3](#)

[Specimen File4](#)

**Applicant proposes to amend the following class of goods/services in the application:**

**Current:** Class 016 for Trade journals in the field of dentistry

Original Filing Basis:

**Filing Basis: Section 1(b), Intent to Use: *For a trademark or service mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to use the mark in commerce on or in connection with the identified goods/services in the application. ***For a collective trademark, collective service mark, or collective membership mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to exercise legitimate control over the use of the mark in commerce by members on or in connection with the identified goods/services/collective membership organization. ***For a certification mark application:*** As of the application filing date, the applicant had a bona fide intention, and was entitled, to exercise legitimate control over the use of the mark in commerce by authorized users in connection with the identified goods/services, and the applicant will not engage in the production or marketing of the goods/services to which the mark is applied, except to advertise or promote recognition of the certification program or of the goods/services that meet the certification standards of the applicant.

In International Class 016, the mark was first used at least as early as 02/28/2012 and first used in commerce at least as early as 02/28/2012 .

**Proposed:** Class 016 for Trade journals in the field of dentistry

Deleted Filing Basis: 1(b)

In International Class 016, the mark was first used at least as early as 02/28/2012 . and first used in commerce at least as early as 02/28/2012 .

Applicant hereby submits one(or more) specimen(s) for Class 016 . The specimen(s) submitted consists of The first specimen shows the Applicant's website where downloadable trade journals (called "eBooks") are available. The second and third specimens are samples of the downloadable trade journals which are available. .

**"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce at least as early as the filing date of the application"** [for an application based on Section 1(a), Use in Commerce] OR **"The substitute (or new, or originally submitted, if appropriate) specimen(s) was/were in use in commerce prior either to the filing of the Amendment to Allege Use or expiration of the filing deadline for filing a Statement of Use"** [for an application based on Section 1(b) Intent-to-Use]. OR **"The attached specimen is a true copy of the specimen that was originally submitted with the application, amendment to allege use, or statement of use"** [for an illegible specimen].

**Original PDF file:**

[SPU1-21620015371-20150716142159062846 . Specimen - CDE World - Class 16.pdf](#)

**Converted PDF file(s)** ( 1 page)

[Specimen File1](#)

**Original PDF file:**

[SPU1-21620015371-20150716142159062846 . Specimen 1 - CDE World - Class 16.pdf](#)

**Converted PDF file(s) ( 15 pages)**

[Specimen File1](#)

[Specimen File2](#)

[Specimen File3](#)

[Specimen File4](#)

[Specimen File5](#)

[Specimen File6](#)

[Specimen File7](#)

[Specimen File8](#)

[Specimen File9](#)

[Specimen File10](#)

[Specimen File11](#)

[Specimen File12](#)

[Specimen File13](#)

[Specimen File14](#)

[Specimen File15](#)

**Original PDF file:**

[SPU1-21620015371-20150716142159062846 . Specimen 2 - CDE World - Class 16.pdf](#)

**Converted PDF file(s) ( 17 pages)**

[Specimen File1](#)

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[Specimen File8](#)

[Specimen File9](#)

[Specimen File10](#)

[Specimen File11](#)

[Specimen File12](#)

[Specimen File13](#)

[Specimen File14](#)

[Specimen File15](#)

[Specimen File16](#)

[Specimen File17](#)

**SIGNATURE(S)**

**Declaration Signature**

**DECLARATION:** The signatory being warned that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements and the like may jeopardize the validity of the application or submission or any registration resulting therefrom, declares that, if the applicant submitted the application or allegation of use (AOU) unsigned, all statements in the application or AOU and this submission

**based on the signatory's own knowledge are true, and all statements in the application or AOU and this submission made on information and belief are believed to be true.**

**STATEMENTS FOR UNSIGNED SECTION 1(a) APPLICATION/AOU:** If the applicant filed an unsigned application under 15 U.S.C. §1051(a) or AOU under 15 U.S.C. §1051(c), the signatory additionally believes that: the applicant is the owner of the mark sought to be registered; the mark is in use in commerce and was in use in commerce as of the filing date of the application or AOU on or in connection with the goods/services/collective membership organization in the application or AOU; the original specimen(s), if applicable, shows the mark in use in commerce as of the filing date of the application or AOU on or in connection with the goods/services/collective membership organization in the application or AOU; ***for a collective trademark, collective service mark, collective membership mark application, or certification mark application***, the applicant is exercising legitimate control over the use of the mark in commerce and was exercising legitimate control over the use of the mark in commerce as of the filing date of the application or AOU; ***for a certification mark application***, the applicant is not engaged in the production or marketing of the goods/services to which the mark is applied, except to advertise or promote recognition of the certification program or of the goods/services that meet the certification standards of the applicant. **To the best of the signatory's knowledge and belief, no other persons, except, if applicable, authorized users, members, and/or concurrent users, have the right to use the mark in commerce, either in the identical form or in such near resemblance as to be likely, when used on or in connection with the goods/services/collective membership organization of such other persons, to cause confusion or mistake, or to deceive.**

**STATEMENTS FOR UNSIGNED SECTION 1(b)/SECTION 44 APPLICATION AND FOR SECTION 66(a) COLLECTIVE/CERTIFICATION MARK APPLICATION:** If the applicant filed an unsigned application under 15 U.S.C. §§ 1051(b), 1126(d), and/or 1126(e), or filed a collective/certification mark application under 15 U.S.C. §1141f(a), the signatory additionally believes that: ***for a trademark or service mark application***, the applicant is entitled to use the mark in commerce on or in connection with the goods/services specified in the application; the applicant has a bona fide intention to use the mark in commerce and had a bona fide intention to use the mark in commerce as of the application filing date; ***for a collective trademark, collective service mark, collective membership mark, or certification mark application***, the applicant has a bona fide intention, and is entitled, to exercise legitimate control over the use of the mark in commerce and had a bona fide intention, and was entitled, to exercise legitimate control over the use of the mark in commerce as of the application filing date; the signatory is properly authorized to execute the declaration on behalf of the applicant; ***for a certification mark application***, the applicant will not engage in the production or marketing of the goods/services to which the mark is applied, except to advertise or promote recognition of the certification program or of the goods/services that meet the certification standards of the applicant. **To the best of the signatory's knowledge and belief, no other persons, except, if applicable, authorized users, members, and/or concurrent users, have the right to use the mark in commerce, either in the identical form or in such near resemblance as to be likely, when used on or in connection with the goods/services/collective membership organization of such other persons, to cause confusion or mistake, or to deceive.**

Signature: /Charles N. Quinn/     Date: 07/16/2015

Signatory's Name: Charles N. Quinn

Signatory's Position: Attorney for Applicant, Member PA Bar

Signatory's Phone Number: 610-458-4984

**Request for Reconsideration Signature**

Signature: /Charles N. Quinn/ Date: 07/16/2015

Signatory's Name: Charles N. Quinn

Signatory's Position: Attorney for Applicant; Member of Pa. Bar #17603

Signatory's Phone Number: 610-458-4984

The signatory has confirmed that he/she is an attorney who is a member in good standing of the bar of the highest court of a U.S. state, which includes the District of Columbia, Puerto Rico, and other federal territories and possessions; and he/she is currently the owner's/holder's attorney or an associate thereof; and to the best of his/her knowledge, if prior to his/her appointment another U.S. attorney or a Canadian attorney/agent not currently associated with his/her company/firm previously represented the owner/holder in this matter: (1) the owner/holder has filed or is concurrently filing a signed revocation of or substitute power of attorney with the USPTO; (2) the USPTO has granted the request of the prior representative to withdraw; (3) the owner/holder has filed a power of attorney appointing him/her in this matter; or (4) the owner's/holder's appointed U.S. attorney or Canadian attorney/agent has filed a power of attorney appointing him/her as an associate attorney in this matter.

The applicant is filing a Notice of Appeal in conjunction with this Request for Reconsideration.

Serial Number: 85624513

Internet Transmission Date: Thu Jul 16 15:47:11 EDT 2015

TEAS Stamp: USPTO/RFR-216.200.153.71-201507161547118

11687-85624513-5408945deea4b55796096c0ea

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N/A-N/A-20150716142159062846

**McGregor, Deanna M.**

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**From:** CDEWorld <reply-215892@news.aegispublishations.com>  
**Sent:** Monday, June 01, 2015 6:02 PM  
**To:** McGregor, Deanna M.  
**Subject:** Spring into Summer with New CE Opportunities

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Presenters: Alan Fetner, DMD | Commercial Supporter: *Geistlich Biomaterials*  
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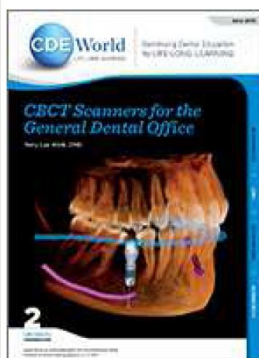
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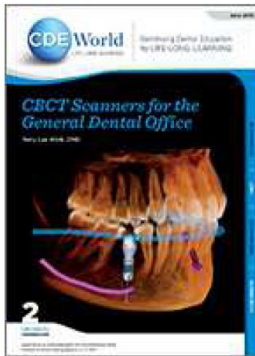
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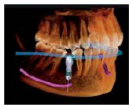


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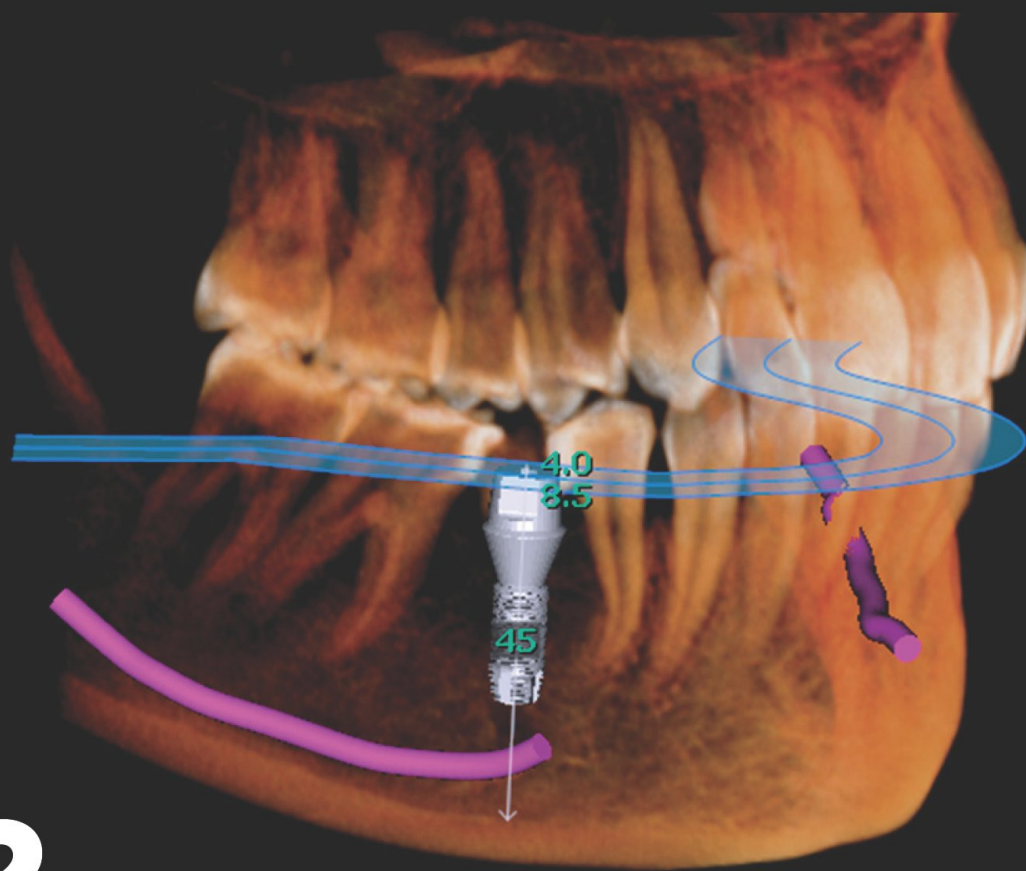




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### DISCLOSURE

Dr. Work reports no conflicts of interest with the material presented in this course

### PUBLISHER

Dental Learning Systems, LLC

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# CBCT Scanners for the General Dental Office

## ABSTRACT

A significant result of advancements in dental radiography is the ability to identify disease and abnormalities—and more precisely plan and execute treatment—in more accurate and predictable ways. Among the radiography innovations increasingly incorporated into dental practice over the past decade are computed tomography (CT) and cone beam computed tomography (CBCT). However, of paramount importance to ensuring diagnostic acuity, use of the most appropriate technology, and minimal patient exposure to radiation is an understanding of the differences between CT and CBCT scanners, as well as their indications for use. This article provides a brief and general overview of CT and CBCT radiography, the capabilities and limitations of each, and illustrations of CBCT applications in general and specialized dental practice.

## LEARNING OBJECTIVES

- Describe the differences between radiographs, CT scans, and CBCT scans.
- Discuss the use of CBCT technology in the general and specialty practice.
- Explain the capabilities and limitations of CT and CBCT scanners.
- Identify considerations for choosing between the use of CT or CBCT scanners for acquiring diagnostic images.

Since the first intraoral radiograph was taken in 1896, the use of two-dimensional (2D) x-rays to diagnose dental conditions has continually revolutionized the dental profession.<sup>1</sup> Whereas diagnosis of oral and related diseases had been based on visual and tactile evaluation, the ongoing introduction of imaging technologies (eg, panoramic/cephalometric radiography, visible light, ultrasound, lasers, magnetic fields) has elevated diagnosis, treatment planning, risk assessment, and treatment outcomes to higher levels of thoroughness, accuracy, and predictability.<sup>2</sup> A significant



result of these advancements is the ability to identify disease and abnormalities—and more precisely plan and execute treatment—unlike ever before.

Whether conventional film or digitally based, 2D dental radiographs are generated when a patient is placed between a focused x-ray-generating source and a recording medium (ie, film or digital sensor). The x-rays are impeded to differing degrees, depending on their density, with the resulting image of the object of focus being imposed on the recording medium. Dark image areas represent little resistance to exposure, while light areas represent increased resistance to exposure, a gradation that provides an accurate representation of the hard tissues being evaluated (Figure 1).

Despite this visual acuity, 2D images have inherent limitations, including challenges associated with magnification, distortion, and superimposition,<sup>3</sup> and are really a 1-dimensional picture of a 3-dimensional (3D) object.<sup>2</sup> Images that demonstrate poor spatial accuracy,



**FIGURE 1.** A panoramic radiograph shows the entire mouth and may help to identify an “area of interest” that needs further evaluation.

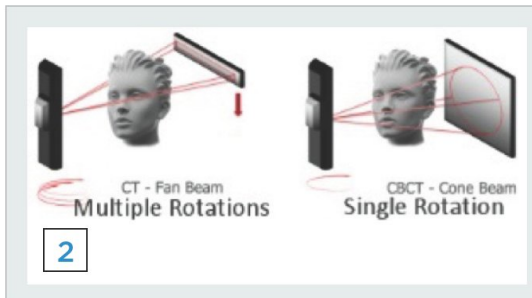
incomplete information, and are static in relation to time and space often result from capturing a 2D representation of 3D structures.<sup>2</sup>

Fortunately, among the evolutionary developments in radiography has been computed tomography (CT) scanning, which uses radiation to generate “slices” of the object of focus to represent the hard tissues. Invented in 1972 by British engineer Godfrey Hounsfield of EMI laboratories and physicist Allan Cormack of Tufts University,<sup>4</sup> CT technology and its imaging scans also require the subject to be

## CBCT technology is increasingly being used in general and specialty dental practices based on the multiple benefits it provides.

positioned between the radiation source and the recording medium. Generally speaking, multi-slice CT scans produce useful clinical information, but often require tube voltage and current adjustments in order to limit radiation exposure while maintaining image quality.<sup>5</sup> Additionally, CT scanning machines are quite large and are usually found in hospitals and imaging centers, with their cost prohibitive for most dental practices. Additionally, the radiation dose is higher than acceptable for diagnostic results.

In recent years, cone beam computed tomography (CBCT) has gained in popularity based on



**FIGURE 2.** The CBCT does not require multiple rotations to acquire the image.

its lower radiation dose (eg, up to 15 times lower than conventional CT scans), easier handling than multi-slice CTs, and reduced cost, among other considerations.<sup>6</sup> These include CBCT's ability to provide sub-millimeter resolution in high-quality diagnostic images, minimally distorted 3D visualization of the maxillofacial skeleton, and shorter scanning times (eg, 10 to 70 seconds).<sup>7</sup> A CBCT scanner is computed tomography that uses a rotating, cone-shaped x-ray beam centered on a 2D detector to evaluate the tissue, with a sensor recording the image data at a higher rate of acquisition. Unlike a conventional CT, a parallel shift of the detector system during rotation—and multiple rotations to acquire the image—are not required, resulting in a more efficient use of the power from the x-ray tube.<sup>5</sup> The sensor evaluates the information, while computer software transforms it into a user-friendly format (Figure 2).<sup>6</sup>

### Differentiating Characteristics of CT and CBCT

#### Image Quality

CBCT images have been shown to present

more detailed information than panoramic or other 2D images. Multi-slice CT scans are considered a better option for analyzing bone density, whereas CBCTs are ideal for situations in which a localized area of radiation exposure (ie, implant placement planning) is required.<sup>6</sup> Specifically, CBCTs facilitate measuring the distance between the alveolar crest and mandibular canal, enable consideration of maxillary aspects (eg, nasopalatine canal, maxillary sinus), allow bone density and quality assessment, and produce less overall radiation exposure.<sup>6</sup> CBCT images have also been shown to demonstrate better image quality of skeletal structures than those produced with multi-slice CTs, lending to its applications in orthodontics.<sup>8</sup>

Among the factors influencing image quality and resolution is the size of CBCT and multi-slice CT voxels (ie, a unit of graphic information). CT and CBCT images are composed of a huge volume of data consisting of millions of 3D voxels. CT voxels are anisotropic; the height of the voxel depends on the CT beam's slice thickness, which limits the accuracy of reconstructed images. With CBCT data, the voxels are isotropic, meaning they are equal in length, height, and depth, which allows for geometrically accurate measurements in any plane. However, despite the 3D accuracy of CBCT images being confirmed in several studies,<sup>9,10</sup> different voxel sizes among CBCT systems have been shown to produce better or worse image resolution of cortical bone surrounding dental implants, which subsequently can

impact the accuracy of bone measurements.<sup>11</sup>

Further, maximizing CBCT use requires in-depth knowledge of the 3D maxillofacial anatomy, in addition to what constitutes variations from the normal anatomy.<sup>11</sup> Judicious use of CBCT imaging is required to ensure that its operation is task-specific relative to the required radiation dose for producing diagnostic image quality given the indication, and how the images are formatted for optimal display.<sup>12-14</sup>

### Radiation Dose

For example, despite generating better quality images with more useful clinical information, CBCTs may still expose patients to higher levels of radiation than multi-slice CTs, depending upon the equipment model and parameter settings used.<sup>8</sup> In fact, in some cases, low-dose multi-slice CT scans may produce images of a quality comparable to CBCTs when contrast-to-noise ratios are examined.<sup>15</sup>

Additionally, research has found a 20-fold range in terms of the effective radiation dose for several CBCT systems, depending on whether small-, medium-, or large-field scanners were

used.<sup>14,15</sup> Therefore, because normal background radiation ranges from 3 mSv to 6 mSv per year among different radiography equipment, depending on altitude, attempts should be made to implement specific protocol in order to minimize radiation exposure to patients and ensure it remains “As Low As Reasonably Possible” (ALARP) (Table 1).<sup>14,16</sup>

In some instances, the use of an external alignment device fitted to a patient’s mouth can be beneficial for reducing radiation dose, particularly when using a small field of view scan.<sup>17</sup> Overall, however, because there is insufficient data regarding the appropriate radiation dose for CBCT imaging, guidelines should be established that are device- and indication-specific.<sup>18</sup>

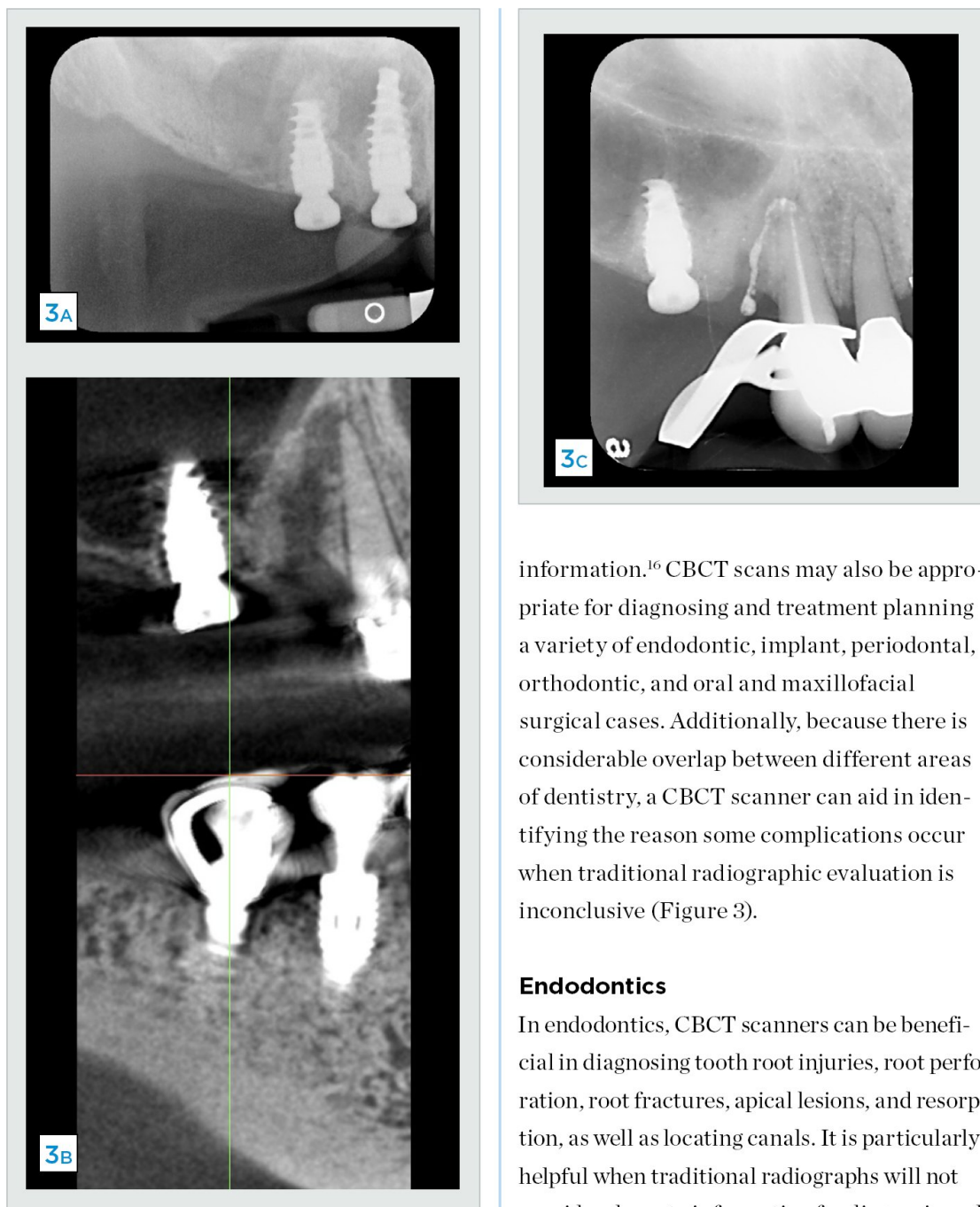
### Diagnostic Indications for CBCT

CBCT technology is increasingly being used in general and specialty dental practices based on the multiple benefits it provides. For general practices, CBCT scanners can contribute to improved care by allowing dentists to begin procedures with more accurate diagnostic

**TABLE 1** Typical Doses for Dental Radiological Procedures<sup>11</sup>

Procedure	Dose in MilliSieverts
Intraoral (F speed, rectangular collimator)	0.001 mSv
Intraoral (E speed, round collimator)	0.004 mSv
Full-mouth set (E speed, round collimator)	0.080 mSv
Lateral cephalometric (F speed, rare-earth screen)	0.002 mSv
Dental panoramic (F speed, rare-earth screen)	0.015 mSv
Cone beam, both jaws	0.068 mSv
Hospital CT, both jaws	0.600 mSv





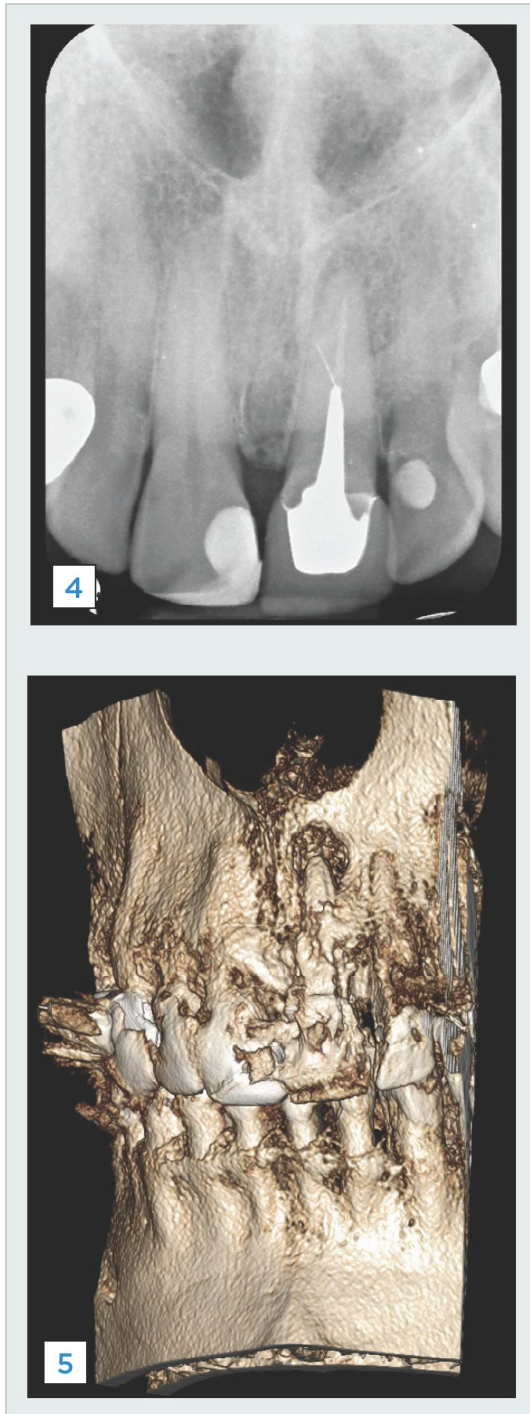
**FIGURE 3.** In the case of an implant lost 3 months after placement, a closely evaluated CBCT scan showed that a periapical lesion on a crowned tooth No. 6 was responsible, because initial endodontic therapy sealer followed the path of infection, thereby compromising the implant. The tooth was re-treated endodontically and allowed to heal.

information.<sup>16</sup> CBCT scans may also be appropriate for diagnosing and treatment planning a variety of endodontic, implant, periodontal, orthodontic, and oral and maxillofacial surgical cases. Additionally, because there is considerable overlap between different areas of dentistry, a CBCT scanner can aid in identifying the reason some complications occur when traditional radiographic evaluation is inconclusive (Figure 3).

### Endodontics

In endodontics, CBCT scanners can be beneficial in diagnosing tooth root injuries, root perforation, root fractures, apical lesions, and resorption, as well as locating canals. It is particularly helpful when traditional radiographs will not provide adequate information for diagnosis and treatment of endodontic disease (Figure 4 and Figure 5).<sup>19-22</sup> For example, although double exposure digital periapical radiographs have





**FIGURE 4 AND FIGURE 5.** The 2D radiograph shows a circular lesion, while the CBCT illustrates the extent of the damage.

been shown to be sufficient for identifying the number of root canals, CBCT scans demonstrate enhanced accuracy for identifying single root canals when the canal anatomy is narrow.<sup>23</sup>

However, when identifying complete and incomplete vertical root fractures, CBCTs have delivered greater diagnostic accuracy when the fractures are complete and greater than 50  $\mu\text{m}$ . Similarly, periapical radiographs have also been shown to be unreliable for identifying incomplete vertical root fractures.<sup>24</sup>

### Periodontics

CBCT scans have been shown to accurately reproduce bone contour surrounding teeth.<sup>25</sup> Prior to the use of CBCT scans, clinicians would have to reflect a flap to ascertain the extent of the defect underneath (Figure 6 through Figure 8). Evaluation by CBCT will also allow the clinician to evaluate the prognosis of a specific treatment prior to the procedure. Patients will have more accurate information in order to ultimately make better decisions about the treatment they choose.

### Maxillofacial Surgeries

An example of the application of CBCT scanners in oral and maxillofacial surgery is the evaluation of third molars prior to removal, which enables dentists to adjust the extraction technique to avoid vital structures. Additionally, because CBCT scans can easily be electronically transferred to specialists (eg, via e-mail), the information presented in the images may prompt general dentists to refer cases to specialists for



**FIGURE 6 THROUGH FIGURE 8.** Although the radiograph taken of a patient who presented with a buccal swelling on tooth No. 3 was not diagnostic, the CBCT scan showed the degree of destruction. Guided tissue regeneration was performed after apical resection of the mesiobuccal root and retrofill.

evaluation and/or treatment.<sup>26-28</sup> Further, size changes in hard tissue lesions can more accurately be evaluated when examined using CBCT scans, because problems such as superimposition and geometric distortion are eliminated.<sup>3</sup>

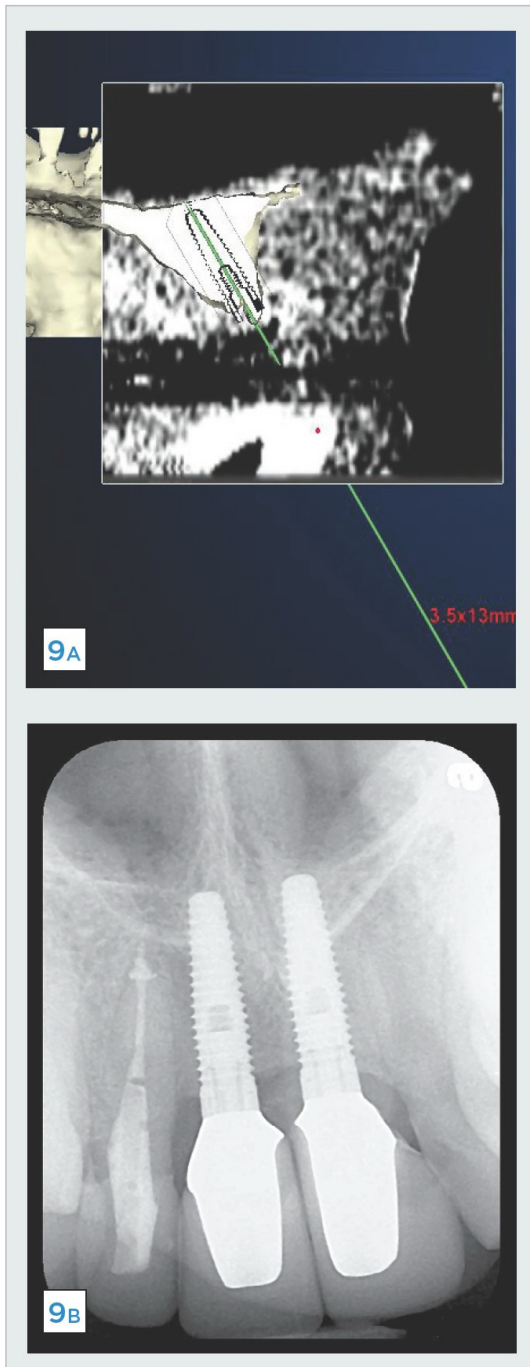
### Orthodontics

The use of CBCT scans in orthodontics spans a range of diagnostic and treatment planning applications. These include measuring available space for tooth movement, facilitating placement of orthodontia used in tooth movement, assessing the proximity of teeth to one another and to vital structures, and planning orthodontic eruption of impacted teeth.<sup>29-30</sup>

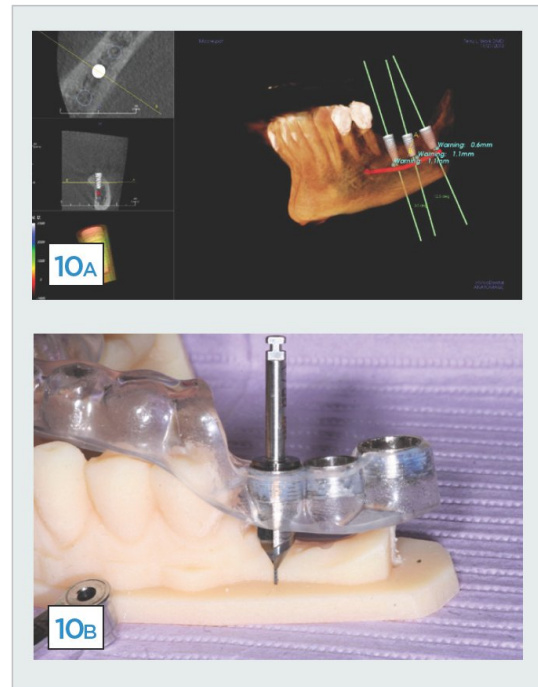
CBCT images and the measurements obtained from them have been found to be reliable compared to actual anatomy. Additionally, they have shown significantly greater reliability than lateral cephalometric, posteroanterior, and submentovertex cephalograms, which varied considerably from the actual anatomy.<sup>31</sup> Other studies have shown that CBCT images may only be more accurate than lateral cephalometric images for some linear measurements in the sagittal plane.<sup>32</sup> However, CBCT scans have provided greater reliability and enhance accuracy than corrected angular linear tomography and temporomandibular joint panoramic radiography when identifying condylar cortical erosion.<sup>33</sup>

### Implants

Today, many implant manufacturers require adherence to special surgical protocols that rely on accurate hard-tissue evaluation.<sup>34</sup>



**FIGURE 9 AND FIGURE 10.** This CBCT allowed the placement of implants just into the nasal floor without disrupting the nasal area. A guide was used to ensure the inferior alveolar nerve was not damaged.



CBCT scanners have made these procedures possible, including guided implant placement that ultimately enables dentists to have a final prosthesis manufactured prior to surgery. CBCT technology has allowed for very precise implant placement, a decrease in surgical time, and higher implant restoration success rates (Figure 9 and Figure 10).<sup>35</sup>

Because bone quality classification impacts the long-term stability and success of dental implants, the accuracy of radiographic gray density values indicative of bone quality are important. Research has shown that the gray density values of CBCT scans can help predict bone quality and, ultimately, primary implant stability.<sup>36</sup> However, when used to plan stereolithographic surgical guides, both angular and



linear deviations between planned and placed implants were observed for CBCT scans, as well as CT scans.<sup>37</sup> A calibration procedure can be beneficial in resolving issues associated with digitizing a CBCT-based surgical template and, therefore, helping to ensure an accurate fit of the surgical guide on a patient's teeth and/or soft tissues and subsequently, accurate implant placement.<sup>38</sup> Additionally, if peri-implant defects do arise, CBCT images have been shown to be reliable and accurate for identifying buccal marginal alveolar defects, with depth, width, and volume measurements correlating highly to actual physical measurements.<sup>39</sup>

## Conclusion

The dental profession has a long history of using the most current technology to provide improved care to patients. The CBCT scanner is becoming the standard of care for many procedures, and CBCT manufacturers continue to make great advances toward expanding the applicability of this technology to dental practices. The newer CBCT scanners feature settings for bitewing radiographs, as well as dual-sensor setups for either CBCT or panoramic radiographs. Current CBCT devices enable temporomandibular joint lateral or axial views, as well as a variety of settings for different areas of interest, thereby limiting radiation exposure to a small area. However, it is ultimately the responsibility of the clinician to use CBCT technology responsibly, supporting its application based on an evaluation of reasonable degree of risk versus reward. Through education and a commitment

to excellence, CBCT scanners can improve clinicians' ability to diagnose and treat many dental conditions across most of the specialties.

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CBCT

## CBCT Scanners for the General Dental Office

*Terry Lee Work, DMD*

TO TAKE THE QUIZ, VISIT:

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- Generating a dental radiographic image requires which of the following?**
  - Focused x-ray source
  - Recording medium
  - Imposition of the object of focus
  - All of the above
- When 3-dimensional structures are represented 2-dimensionally, which of the following can result?**
  - Poor spacial accuracy
  - Representation of incomplete information
  - A and B
  - None of the above
- What does CT stand for?**
  - Connective tissue
  - Computed tomography
  - Collated topography
  - Computer telepathy
- Which of the following statements is true?**
  - A CT scan has less radiation dose than traditional radiographs.
  - A CBCT scan makes multiple revolutions to generate an image.
  - A CBCT scan uses individual slices to generate an image.
  - A CBCT scan requires less radiation dose than a CT scan.
- Among the benefits of CBCT scanners are:**
  - shorter scanning times to acquire the desired image.
  - facilitation of patient home-care preparation.
  - accurate measurement of probing scores.
  - being able to clearly show soft tissue.
- Diagnostic image quality of CBCTs are affected by which of the following?**
  - Voxel size
  - Radiation dose
  - Computer formatting of image display
  - All of the above
- Multi-slice CT scans are a better option than CBCT images for which of the following?**
  - Measuring the distance between the alveolar crest and mandibular canal
  - Analyzing bone density
  - Identifying incomplete vertical root fractures
  - Reproducing bone contour surrounding teeth
- CBCT scans are more helpful than conventional radiographs in diagnosing periapical lesions because they:**
  - use less radiation.
  - produce a 3D image.
  - create slices.
  - take less time to generate.
- When placing implants, CBCT scans are preferable over conventional radiographs because they:**
  - have less distortion.
  - can be manipulated in three dimensions.
  - can more accurately depict anatomical features.
  - All of the above
- How can CBCT technology help treatment plan periodontal procedures?**
  - CBCT scanners can accurately measure probing scores.
  - CBCT scanners can accurately represent bone contours around teeth, allowing clinicians to better prepare for surgical procedures.
  - CBCT scans very clearly show soft tissue.
  - CBCT scans facilitate patient home-care preparation.

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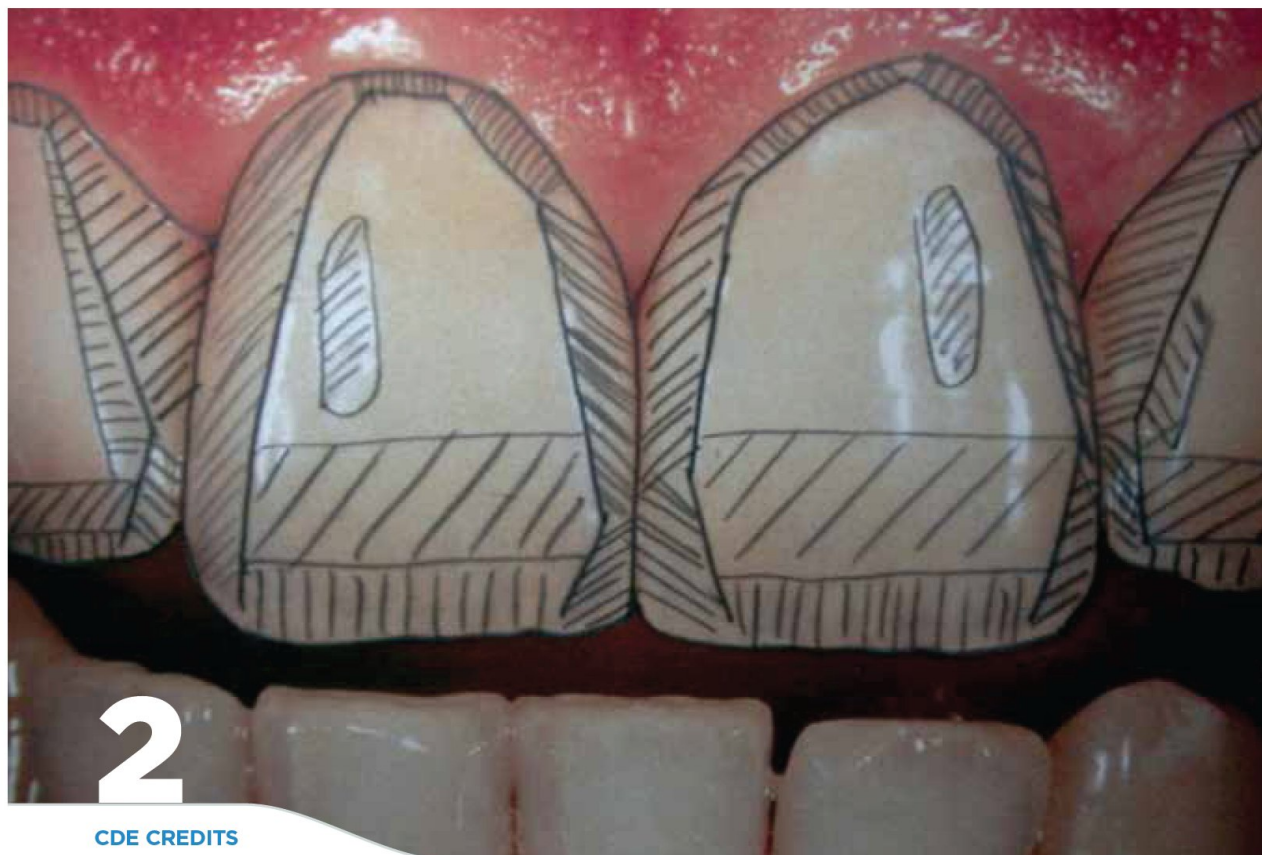
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# *Anterior Esthetics: Managing Difficult Challenges*

Gregg A. Helvey, DDS, MAGD



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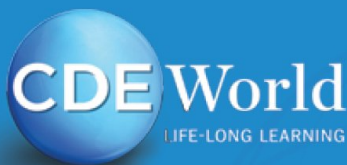
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# Anterior Esthetics: Managing Difficult Challenges

Gregg A. Helvey, DDS, MAGD



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Dr. Gregg Helvey attended Georgetown University School of Dentistry and maintains a private practice in Middleburg, VA, emphasizing restorative and aesthetic dentistry. He received his Mastership in the Academy of General Dentistry in 1997. Dr. Helvey

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# Anterior Esthetics: Managing Difficult Challenges

**ABSTRACT** As the case presented demonstrates, meeting the challenge of managing anterior esthetics starts with applying a proven approach to clarifying patients' expectations, choosing a treatment that fits their esthetic and functional needs, then taking a "cookbook approach" to fine-tuning the planned treatment and executing it smoothly and efficiently.

## LEARNING OBJECTIVES

- **Describe different approaches to determining patient expectations**
- **Know how to place and evaluate provisional restorations**
- **List information that should be gathered and sent to the laboratory for the preparation appointment**
- **Be aware of the difference in optical value between pressable and millable crowns**

**B**ecause dentists and their patients may have different perspectives on esthetics, meeting patients' expectations should start with a meeting of the minds.

## Get on the Same Page

The first step in dealing with anterior cases is to

determine the patient's expectations. Dentists may view anterior teeth differently than their patients, so it is important to get an idea of what they have in mind through discussion and visual information such as photographs, magazine pictures, etc. Perhaps the best starting point for creating a restoration that will meet the patient's needs and expectations is to place a mock-up that simulates the shade and contour of the planned restoration. Patients must be happy with the appearance of their restorations, and at the same time, be able to function comfortably and speak without a lisp or difficulty in pronouncing different syllables.

## A Cookbook Approach

Whether it's just a couple of teeth or a full set of veneers, the author recommends a "cookbook"

approach—ie, using a protocol for anterior cases that can be followed successfully for predictable results.

### Sign-off Sheet

This starts with creating a “sign-off sheet” that tracks each step of the protocol and specifies related materials and documentation, including clinical photographs, cosmetic imaging, radiographs, impressions, mock-ups, provisionals, laboratory instructions, and, importantly, a signed patient informed consent that is witnessed by a staff member.

### Pretreatment Clinical Photographs

Clinical photographs should be taken while positioning the flash at different angles. This allows

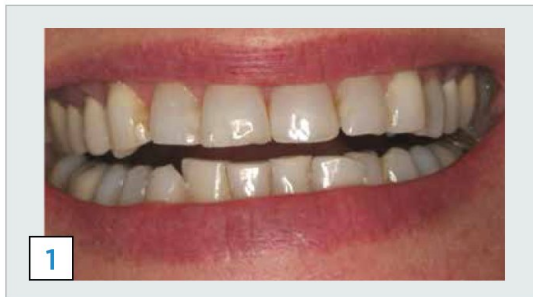


FIG 1. Pretreatment clinical photograph of the frontal smile.

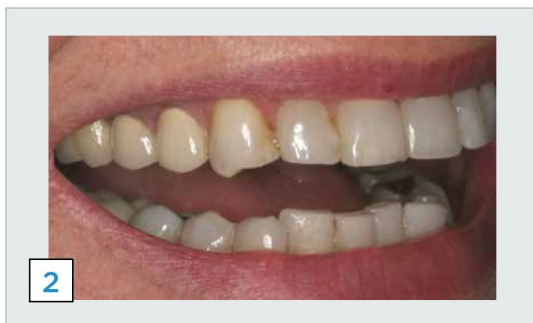


FIG 2. Pretreatment clinical photograph of the lateral view.

the facial texture of the tooth surface to be viewed more easily, as the light from the flash bounces back at different angles. The photographic views should include a frontal smile taken while the patient holds an “E” sound that demonstrates the mobility of the upper lip (Figure 1); having them say and hold the letter E will usually elevate the lip to show the gingival areas. There should also be separation of the maxillary and mandibular teeth. In addition, there should be a lateral view taken at a 45° angle, plus retracted frontal and lateral views (Figure 2).

### Impression(s)

Throughout the case, several impressions may be taken. The author favors the double-pour method using one model to create the provisional restoration or “mock-up” and the other as an unaltered permanent record.

### Cosmetic Imaging

There are a number of commercial dental cosmetic imaging software programs available that generally use a “cut and paste” technique that simulates an entire smile. These specific imaging programs are usually expensive compared to photographic enhancing programs such as Adobe Photoshop Elements, which can be used by the clinician or a staff member to modify a patient’s smile cosmetically. Using a variety of tools within the software program, each individual tooth can be lengthened, shortened, rotated, or even aligned correctly. Diastemas can be closed and gingival contours and margins can also be modified. Then, after the structural





**FIG 3.** Altered frontal view images showing treatment variations.



**FIG 4.** Altered lateral view images showing treatment variations.

changes are completed, the shade of the teeth can be changed.

There are potential problems that can arise from the “cut and paste” approach; for example, anatomical or structural issues may preclude the dentist and/or laboratory from delivering the simulated enhancement. This can lead to a patient’s dissatisfaction with the treatment based on expectations gained from the enhanced photograph. For that reason, the tooth-by-tooth approach is much more predictable in terms of meeting the patient’s expectations.

The cosmetic imaging can show the patient variations of treatment. For example, the patient can see the differences in treating the six anterior teeth versus including the first bicuspids or the first and second bicuspids (six, eight, or 10 veneers). The cosmetic imaging should be done from a frontal and lateral view. It should be pointed out to the patient when showing the lateral view that this view is what other people see versus what the patient sees in the mirror (frontal view).

After the consultation, the patient should be sent home with 8 x 10 prints (one can be digital) showing the different variations, so the proposed treatment plan can be shared with friends and family members if desired. Several studies show a 50% increase in treatment acceptance among patients who can see before and after pictures of their own teeth.<sup>1,2</sup>

### Conducting the Consultation Appointment

During the consultation appointment, the dentist can first show the patient any occlusal concerns (if present) on the original models and the necessary treatment to correct it. The patient must understand that if the cause of their dental problem is not addressed, the longevity of the cosmetic treatment will be compromised.

During this appointment, the patient can view a variety of treatment plans using different before-and-after images. For example, the frontal view is what the patient usually sees in the mirror. Using altered frontal images, patients can see what their teeth would look like with different treatment variations (six, eight, or 10 veneers) (Figure 3).

Using the same approach but from a lateral view, patients can also see variations of the treatment from an angle they do not see in the mirror but can be seen by others (Figure 4).

### Obtaining Informed Consent

After the details of the treatment plan are finalized, it is important that a written informed consent form is presented to the patient before treatment commences. This document should include the agreed-upon treatment plan and possible complications, risks, and benefits. It should be signed by the patient and witnessed and signed by a staff member.

### Create and Evaluate Mock-up

The mock-up is created in the laboratory on one of the models using old composite that will simulate the proposed treatment. A vacuum-formed stent is fabricated and cut out following the gingival contour of the teeth involved in the treatment and filled with a composite material. The shade selected is a starting point but may not necessarily be the final shade. Using the composite-filled stent, a copy of this mock-up or provisional restoration is bonded on the involved teeth using a total-etch system (etching the entire facial surface, not spot-etching) to simulate the final restorations. The patient wears the provisional restoration for several days or weeks during which he or she is able to evaluate its esthetics, phonetics, and function. This enables the patient to “test drive” the new restorations which should also be photographed for further evaluation by the clinician (Figure 5).

WIDTH OF THE CENTRALS



INCISAL EMBRASURES



WIDTH OF THE LATERALS



5

FIG 5. Photographs of mock-ups for evaluation.



6

FIG 6. Visualization of lines used to assess mock-ups.

An assessment of the mock-up can be brought down to a visualization of lines in evaluating contours of the teeth (Figure 6).

For the clinician, photography is a useful medium to evaluate the mock-up. Any corrections can be easily made during the “test drive” by adding or subtracting to the provisional material. Once the patient is satisfied, a new impression and model can be made.

### The Provisional Restoration

The provisional restoration based on the first impression and model—which may itself be modified during mock-up creation and evaluation—offers the clinician and patient the opportunity to evaluate the planned restoration and make needed modifications prior to fabrication and seating of the final permanent restorations.

#### Provisional Restoration Placement

After informed consent is secured, the provisional restorations are placed using a local anesthetic. To create the provisional, a vacuum-form stent made from the mock-up model is filled with a soft composite of the shade of the proposed restorations. Depending on the composite used, the flow can be increased by either softening in warm water or placing the composite in a microwave oven.

The overhead chair light is turned off. After etching the entire facial surface of all teeth involved, a bonding agent is applied, and the vacuum-form stent is completely seated. Depending on the flow of the composite, it may take a little more time to completely seat the stent.

During the fabrication of the stent on the model, the edge of the stent was trimmed to the gingival margin around the involved teeth. During the seating of the stent, the excess material can easily be removed around the gingival margin. With the stent in place, the composite is light-cured. The stent is then removed and the provisional restorations are trimmed and polished. The occlusion is then checked in centric and eccentric positions.

#### Provisional Restoration Evaluation

The patient wears the provisional for a period of time—usually several days—which provides the opportunity to “test drive” the planned restorations. The patient can “try out” the restorations and evaluate the esthetics, phonetics, and function. These are the restorative criteria that must be satisfied before the treatment can go forward. The esthetic evaluation is based on the shade, the shape, and the contour of the provisional restorations. Composite material can be added or subtracted to maximize the appearance. The phonetic evaluation is based on whether or not the patient has difficulty with certain syllables or “F” and “V” sounds, for example, “55.” If the incisal edge encroaches on the lower lip during these sounds, the length needs to be shortened. Finally, during the functional evaluation, the patient actually chews food and reports back to the clinician any difficulty encountered while eating a meal. Adjustments are subsequently made until the patient is satisfied with the provisional restorations. A new impression is then made before the teeth are prepared for laboratory purposes.



## Preparation Appointment

At the preparation appointment, all materials and information needed by the laboratory to create the final restorations—as described below—are gathered, evaluated, and sent to the laboratory.

### 1. Photographs

To ensure the correct choice of color, the author recommends close-up photography, using the ring flash as a point flash by removing it from the camera and pointing it at different angles. This allows color and texture to be easily seen. A teleconverter lens can be attached to the dental close-up lens to capture greater detail. The manufacturer's shade tab—showing its name—should be visible in the picture next to the teeth, as should the stump shade, so the laboratory can use the correct composite die material and shade to exactly reproduce what the patient is expecting.

### 2. Impression(s)

Two final impressions of the prepared teeth should be taken. The reasoning behind taking a second impression is that if the first impression has a questionable area that cannot be seen in the second impression, there is a discrepancy. If that questionable area is seen in both impressions, it is part of the preparation. The time and expense required to take a second impression is minimal compared to the inconvenience to the patient of having to return for an unexpected appointment.

### 3. Opposing Model and Bite Registration

An opposing model is necessary. The bite

registration included should be made of a polyvinyl material that covers only the prepared teeth. After it is set, it should be removed and trimmed of excess material on the occlusal, buccal, and lingual sides. All undercuts and interproximal “fins” must also be removed as they would prevent a passive seating onto the models. Avoid sending “mushbites” registrations that cover all of the prepared and unprepared teeth. These are too difficult to properly seat on the working models in the laboratory.

### 4. Articulation Tools: Facebow, Bitestick, or laboratory Provisional

While the best articulator is the patient, the laboratory needs to duplicate the patient's horizontal, frontal, and sagittal planes onto an articulator. The purpose of a facebow is to do just that. There are several methods that can convey that information. However, an earbow, which is used frequently because of its simplicity, should be avoided. Most patients' ear canals are not at the same level and therefore create an incorrect horizontal plane on the articulator, resulting in restorations with a canted midline plane. The frontal and horizontal planes are duplicated if the lingual and facial aspect of the provisional restorations are reproduced in the laboratory. The remaining sagittal plane (facial midline), which is at a 90° angle to the esthetic or horizontal plane, can be transferred using a Kois Dento-Facial Analyzer, a cross stick, or laboratory provisional that includes at least two anterior teeth.

### 5. Model of the Approved Provisionals

It is the model of the approved provisional restorations that is used to make the final restoration through a duplication technique using the “wax injection method” described below.

### 6. Laboratory Prescription

In addition to images, the laboratory prescription should include a color map with measurements, and references to the close-up photographs for saturation (chroma) level and facial characteristics of the teeth. The shade of the prepared teeth should also be included. A photograph of the prepared teeth with the inclusion of a stump shade guide tab will provide the technician the color of the prepared tooth. This allows the technician to compensate for any “bleed through” of the underlying color that may affect the final shade of the restoration.

### Case Study

The case described below demonstrates the “cookbook approach,” illustrating its use up to and after the laboratory receives materials and instructions pertinent to final restoration fabrication.

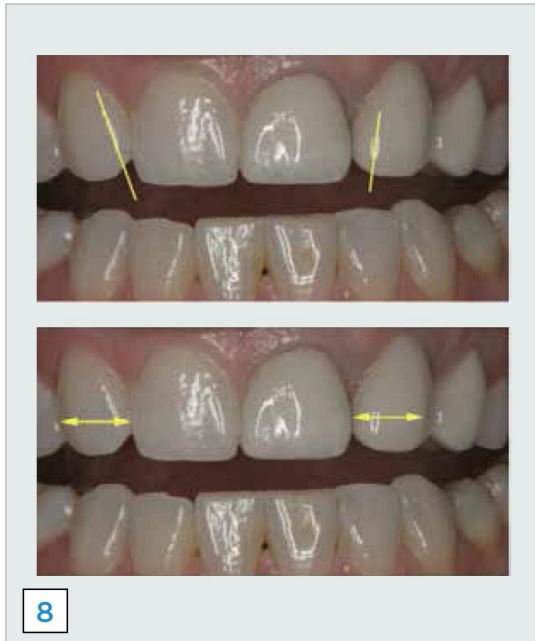
This patient wanted to replace her existing crowns on teeth Nos. 9, 10, and 11. This case involved matching the contralateral central incisor, a lateral incisor, and a canine tooth. She presented to the author’s practice wearing temporarily cemented permanent crowns; she had been dissatisfied with the appearance of these crowns during several attempts by another dentist to replace them over an 18-month period.

### Evaluation of Existing Restorations

The first thing the author did when the patient presented was to evaluate the existing restorations, noting the following: In examining the central incisors, tooth No. 9 was shorter in length than No. 8 (Figure 7), the mesial contour ridge of No. 9 did not line up with No. 8, and the mesial-distal width of the two centrals did not match (Figure 8); likewise, the incisal embrasures did not match up (Figure 9). In the lateral incisor position (because of canine substitution, they were really canine teeth in this case), the mesial contour ridge of this tooth and the contralateral tooth were evaluated for symmetry as well as the medial-distal width (Figure 10).

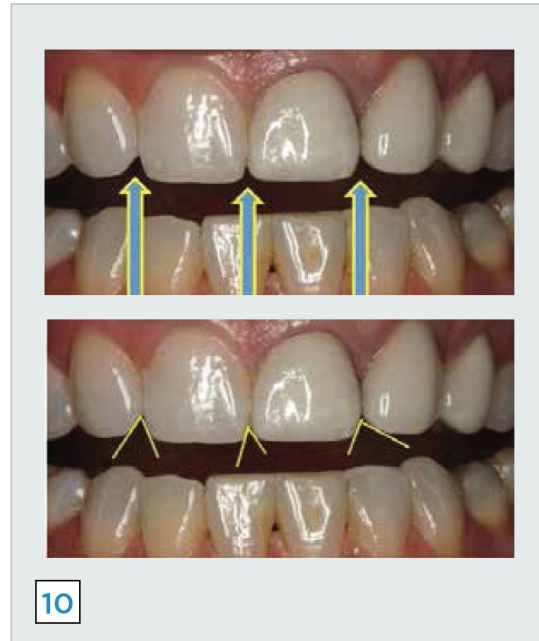


**FIG 7.** Evaluation of existing restoration length.



8

FIG. 8. Evaluation of mesial contour ridge and mesial-distal width of central incisors.



10

FIG. 10. Evaluation of lateral incisor position (canine substitution).



9

FIG. 9. Evaluation of incisal embrasures.



11

FIG. 11. Mock-up fabricated and evaluated with photography, positioning the flash at different angles.



### Mock-up Fabrication and Evaluation with Photography

The mock-up was fabricated, placed, and evaluated with photography, positioning the flash at different angles, as described above (Figure 11). Based on the patient's feedback, adjustments were made until the patient was satisfied. A new alginate impression and model were made and prepared for the laboratory, which was sent all appropriate information, as described above.

### Provisional Duplication

The laboratory received the above materials and duplicated the provisionals using the wax injection technique. Using a wax injection unit (used by jewelers to duplicate wax patterns while making jewelry), melted wax was injected onto a solid, working through a silicone stent that was made from the model of the provisional restorations. This method allows the technician to duplicate the shape, length, and contour of the provisional restorations.<sup>3-5</sup>

In this case, a silicone index was made from the existing mock-up model, and holes were placed around the prepared teeth, Nos. 9 and 11 (Figure 12). The wax was melted to 180° in the injection unit, which was pressurized to 5 psi. A removable die spacer was applied to the prepared teeth on the solid working model (Figure 13), and the melted wax was injected through one of the holes (Figure 14); when the melted wax came out the other hole, everything was filled. After the wax cooled, the silicone index was removed (Figure 15).

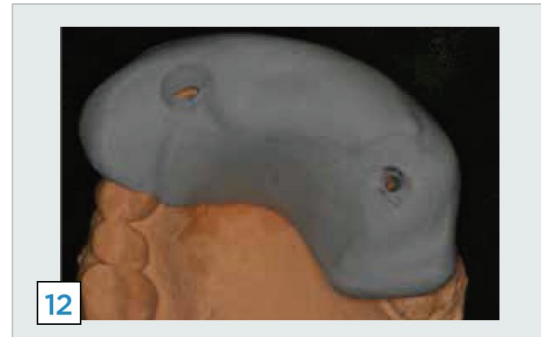


FIG 12. Two holes were placed in silicone index.



FIG 13. A removable die spacer placed on the prepared teeth on the solid working model.



FIG 14. Melted wax being injected through one of the holes.



FIG 15. After the wax cooled, the silicone index was removed.



**FIG 16.** Excess material was removed.

This method yields an exact copy of the provisionals the patient was wearing. After excess material was removed (Figure 16), each unit was separated and transferred to the multiple-die working model to refine the margins.

In every case the author makes two working models—one solid and one multiple-die model. The individual restorations are sprued and invested and then placed in a burnout oven. The investment ring is placed in a pressing oven and pressed using lithium-disilicate (IPS e.max®; Ivoclar Vivadent; [www.ivoclarvivadent.us](http://www.ivoclarvivadent.us)) ingots. Crowns are divested and separated from the sprue. After the fit is checked on the individual dies, the incisal portion is cut back and then layered with the appropriate incisal porcelains.

In another case, a patient had lost the veneer on No. 8. All the anterior teeth were previously veneered with the pressed lithium disilicate (e.max) version. However, the author used his chairside CAD/CAM system (CEREC®; Sirona; [www.sironadental.com](http://www.sironadental.com)) to fabricate the restoration. The CEREC system, like other chairside CAD/CAM systems, uses the millable version of the lithium disilicate (e.max). The result was that the milled version had a higher value

than the pressed version and did not match the adjacent restorations. The hue and chroma were correct, but the value was different.

### **Difference between Pressable Ingots and Millable Blocks**

Clinicians should be aware that there is difference in flexural strength between the pressable lithium-disilicate ingots used in the laboratory and the millable blocks (referred to as “blue blocks”) used with the CAD/CAM milling machines, even though they are made from the same batch of material. There is also an optical difference between the two versions. The manufacturing process for the pressable ingots and millable blocks starts from the same batch of material. The pressable ingots undergo complete sintering at the factory, resulting in a tooth-shaded lithium-disilicate ingot that can be hot-pressed to fabricate a restoration.

The sintering process for the millable block is stopped when the material is in the lithium metasilicate form, which is blue in color. In this form, the block is easier to mill. Once the milling process has been completed, the restoration is placed into a two-stage oven, which completes the sintering process, increasing the flexural strength (not as high as the pressed version) and changing the blue color to the correct tooth shade. This sintering—also referred to as crystallization—transforms the lithium metasilicate into the lithium disilicate form.

This interruption of the sintering process creates a difference in the grain size between the two material versions. The millable blocks

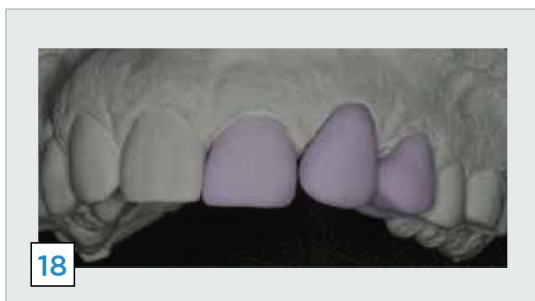


actually have a smaller grain size, which has an effect on the optics of the ceramic. The millable form has a slightly higher value than the pressed form, while the hue and chroma remain the same.

In this case study, the author had made a second set of crowns with the millable version of lithium-disilicate. The CEREC system was used in the replication mode to copy teeth Nos. 6, 7, and 9 (Figure 17). After the milling process was completed, the three crowns were placed on the model and adjusted before the sintering (crystallization) was completed (Figure 18). They were then placed back on the model, where the incisal portions were cut back and layered in the same manner as the pressed version (Figure 19). The contours were then finalized before staining (Figure 20).



**FIG 17.** The three restorations were fabricated using the CAD/CAM replication mode.



**FIG 18.** The lithium-metasilicate crown was adjusted before completing the sintering process (crystallization).

### Laboratory Prescription

The laboratory prescription included a color map with measurements. It is helpful for the laboratory to see the characterization that is present and areas of different chroma levels (saturation) in the adjacent teeth through close-up photography (Figure 21). In addition, because the patient had a band of hypocalcification 4 mm from the incisal edge, that measurement was recorded on the laboratory prescription.

### Laboratory Provisional

A laboratory provisional, created as described below, can be used to duplicate the facial and dental midline and the existing cant of the patient's pre-maxilla.



**FIG 19.** The now-sintered crowns were cut back and layered with the appropriate porcelains.



**FIG 20.** The contours were finalized before staining.

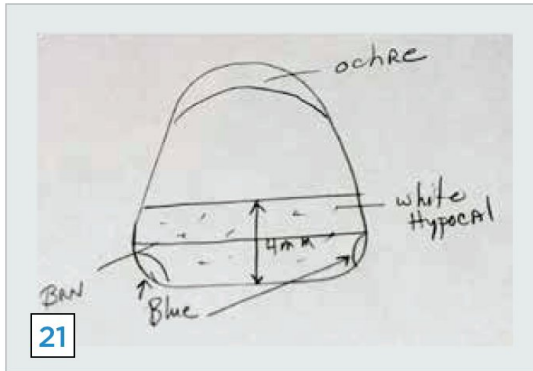


FIG. 21. Detailing the characterization of the restoration.

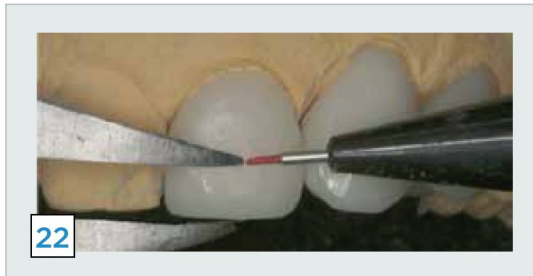


FIG. 22. Using a Boley gauge, 4 mm from the incisal edge was marked with a wax margin liner pencil.



FIG. 23. The red wax line was at the same level as tooth No. 8.



FIG. 24. The color map was created using the wax margin liner pencil.



FIG. 25. The different stains were applied in the designated areas.

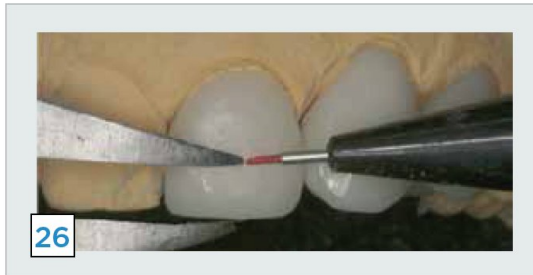
- Fill the vacuum-form stent with a dual-cure temporary material.
- Remove and replace the stent several times as the material begins to set to eliminate any undercuts.
- Once the material sets, remove the laboratory provisional from the stent.
- Using a pencil, mark the dental midline coincident with the facial midline.
- Send to the laboratory.

#### *Once in the laboratory:*

- The provisional is placed on a solid working model supported by "silly putty" so it is stable enough to hold models in place on the articulator.
- The midline (pencil mark) is aligned with a straight edge placed on the bench, so the sagittal plane is aligned with what exists on the patient.
- The maxillary is mounted on the articulator and allowed to set; then the lower model is mounted and verified with the straight edge.

### Staining Process

In preparation for the staining procedure, a red



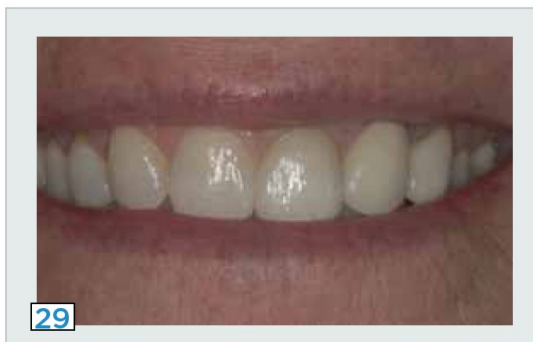
**FIG. 26.** The pressed version of all three crowns. Tooth No. 9 had a lower value than tooth No. 8.



**FIG. 27.** The higher-value milled version of tooth No. 9 replaced the pressed version, which the patient then approved.



**FIG. 28.** The pretreatment view.



**FIG. 29.** The posttreatment view.

wax margin liner pencil was used to mark 4 mm from the incisal edge (Figure 22). A red line was drawn to indicate the height of the white hypocalcifications present in tooth No. 8 (Figure 23). There were some bluish areas in the distal and mesial incisal corners of tooth No. 8. The wax margin liner pencil was used to create areas where the stains would be applied. The wax on the ceramic surface keeps the stains from bleeding together (Figure 24) and burns off during the heating cycle, leaving no residue. White, blue, brown, and ochre stains were then applied (Figure 25) based on the close-up photograph of tooth No. 8.

### Insertion Appointment

During the insertion appointment, the temporaries were removed and the prepared teeth were cleaned prior to the try-in. The pressed versions were tried in first for the patient's evaluation. She was satisfied with the shape of all three crowns, but felt the color of No. 9 was too dark. Therefore, the pressed version of tooth No. 9 (Figure 26) was removed and replaced with the higher-value milled version (Figure 27), which she approved. The final combination of milled and pressed lithium-disilicate crowns achieved the patient's expectations.

The crowns were etched with hydrofluoric acid for 20 seconds, rinsed, and dried. Silane was then applied. A dual-cure bonding adhesive was applied, air-thinned, and then light-cured. Using a dual-cure cement, the three restorations were inserted.

Photographs taken before (Figure 28) and after treatment (Figure 29) depict a satisfactory result for this discerning patient.

## Conclusion

In the case presented, a discerning patient was fully apprised of the esthetic possibilities of presented treatments. The author used a “cookbook” approach that established her esthetic goals and the steps involved in achieving them methodically and predictably. By creating two versions of each of the three crowns—one version that was pressed and the other that was milled, the author was able to deliver a restoration that met the patient’s functional and esthetic needs.

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DISCLOSURE:

The author received an honorarium for his work on this course.

## Notes

[illegible]



# CDE Quiz

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ESTHETICS

## Anterior Esthetics: Managing Difficult Challenges

Gregg A. Helvey, DDS, MAGD

TO TAKE THE QUIZ, VISIT:

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- The steps to the author's "cookbook approach," in order, are:**
  - obtaining informed consent; pretreatment clinical photographs; sign-off sheet; cosmetic imaging; impression(s); conducting the consultation appointment; create and evaluate mock-up; and provisional restoration evaluation.
  - pretreatment clinical photographs; impression(s); cosmetic imaging; sign-off sheet; obtaining informed consent; conducting the consultation appointment; create and evaluate mock-up; and provisional restoration evaluation.
  - sign-off sheet; pretreatment clinical photographs; impression(s); cosmetic imaging; conducting the consultation appointment; obtaining informed consent; create and evaluate mock-up; and provisional restoration evaluation.
  - impression(s); cosmetic imaging; pretreatment clinical photographs; sign-off sheet; conducting the consultation appointment; obtaining informed consent; create and evaluate mock-up; and provisional restoration evaluation.
- The photographic views should include a frontal smile taken while the patient holds what sound that demonstrates the mobility of the upper lip?**
  - "E"
  - "F"
  - "S"
  - "V"
- Several studies show how much of an increase in treatment acceptance among patients who can see before-and-after pictures of their own teeth?**
  - 10%
  - 25%
  - 50%
  - 75%
- The restorative criteria that must be satisfied before the treatment can go forward are:**
  - esthetics.
  - phonetics.
  - function.
  - All of the above
- According to the author, how many final impressions of the prepared teeth should be taken?**
  - One
  - Two
  - Three
  - Four
- After the bite registration is set, it should be removed and trimmed of excess material on which of the following sides?**
  - Occlusal
  - Buccal
  - Lingual
  - All of the above
- The frontal and horizontal planes are duplicated if which aspects of the provisional restorations are reproduced in the laboratory?**
  - Lingual and facial
  - Facial and occlusal
  - Occlusal and labial
  - Lingual and occlusal
- The remaining sagittal plane is at what angle to the esthetic or horizontal plane?**
  - 45°
  - 90°
  - 75°
  - 120°
- In addition to images, the laboratory prescription should include:**
  - a color map with measurements.
  - references to the close-up photographs for saturation (chroma) level.
  - facial characteristics of the teeth.
  - All of the above
- The sintering process for the millable block is stopped when the material is in the lithium-metasilicate form, which is what color?**
  - Yellow
  - Green
  - Blue
  - Red

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