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# ESTHETIC INTEGRATION OF DIGITAL-CERAMIC RESTORATIONS

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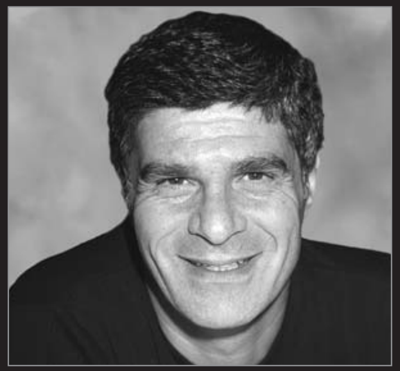

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# PREFACE

The ultimate goal of this collaboration is to provide our colleagues with guidelines for achieving esthetic integration of dental restorations. Consequently, this reference is not simply another book on technology, and it is not a comprehensive guide on the CAD/CAM process. Actually, CAD/CAM technology is simply a **tool** that the authors use to successfully treat their patients and to achieve esthetic integration. This high technology provides the implant surgeon and prosthodontist with a proven means of integrating implants, abutments, crowns, veneers, and bridges within the oral environment in an inconspicuous way that ensures they look and function just as natural teeth.

Integration is our objective, psychologically as well as physically, mechanically, and—especially—biologically. Therefore, we have chosen to develop an atlas from our restorative cases, illustrating clinical situations that we encounter routinely and defining the part that CAD/CAM plays in their resolution. Since implant therapy is presently biologically driven, we have also outlined the importance of tissue preservation and/or development and the understanding of biological parameters in order to limit tissue remodeling around implants.

The format of this reference may differ from the traditional "textbook" but follows the example set by our subject—for books, too, have evolved in the age of the Internet. While it is possible to use the World Wide Web for research, the act of searching, condensing, and applying these results can be difficult due to the inherent expansiveness of the Internet. Thus, a reference such as this plays a different role—it synthesizes the applicable information and structures it for easier consideration and understanding. Times continue to change, and in our minds a clinical manual ought to be easy to read, fast to capture a message that is simple to remember and, of course, visual, since an image is worth a thousand words.

Because teamwork is essential to achieving successful restorations, our book has been prepared in close collaboration with a laboratory technician—a master ceramist—who shares his insights and techniques as well. Obviously, high-strength ceramics and digital-ceramic restorations are materials and techniques that presently represent the first choice when it comes to integration to the soft tissues, even making metal-based restorations obsolete. They will be the ingredients of our book.

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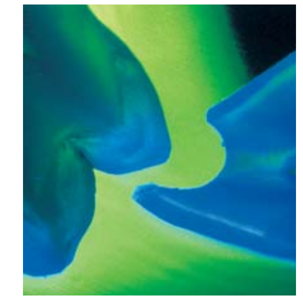
CHAPTER 1



# THE CAD/CAM PERSPECTIVE

Historically, modern ceramic materials are generally regarded as originating at the end of the 19th century, when the first ceramic crowns were fabricated by Land of feldspathic porcelain baked on platinum foil. Another significant milestone in ceramic technology occurred in the early 1960s, when Weinstein and Kuwata created the first metal-ceramic crowns. In the following decades, several attempts were made to fabricate metal-free ceramic crowns with tougher cores. Focusing on the development of an aluminous porcelain material, MacLean was one of these pioneers. Sadoun soon expanded on this line of research with his work on the aluminum oxide core and the slip-casting technique.

At present, ceramic materials can be classified according to their material composition as either **silica-based** or **non–silica-based** (Table 1-1). The former can be further divided into 1) conventional feldspathic porcelains, which are generally fabricated on refractory dies, and 2) reinforced, pressed ceramics. In non–silica-based groups, the subgroups consist of 1) sintered and infiltrated ceramics that are created according to the slip-cast technique, and 2) densely sintered, high-purity aluminum and zirconium oxides ceramics that are fabricated through **the CAD/CAM technique**.[1-3]

**TABLE 1-1. Classification of Ceramic Materials**

- Silica-based materials
  - Conventional feldspathic ceramics
    - Amorphous phase and crystalline phase (ie, feldspar, quartz)
  - Reinforced pressed ceramics
    - Vitreous phase and increased crystalline phase
- Non-silica-based materials
  - Sintered and infiltrated aluminum oxide
    - Alumina core and glass
  - Densely sintered, high-purity aluminum or zirconium oxide
    - CAD/CAM-generated, milled copings, abutments, and bridge infrastructures

**TABLE 1-2. Representative Sample of CAD/CAM Systems**

| SYSTEM | MANUFACTURER |
|---|---|
| Procera | Nobel Biocare (Yorba Linda, CA) |
| Lava | 3M Espe (St. Paul, MN) |
| Cercon | Dentsply Ceramco (York, PA) |
| Cerec In-Lab | Sirona Dental Systems (Charlotte, NC) |
| Everest | KaVo (Lake Zurich, IL) |
| DentaCAD | DentaCAD, Inc (Buford, GA) |
| Cynovad Pro50 | Cynovad (Saint Laurent, Quebec) |
| Wol-Ceram | Wol-Ceram (Ludwigshafen, Germany) |





More recently, Duret introduced the CAD/CAM process to dentistry and was followed by Andersson and Öden, who applied it to the fabrication of all-ceramic crowns. Due to their mechanical and esthetic qualities as well as their biocompatibility, CAD/CAM-generated restorations have rapidly gained acceptance in the restorative community. These metal-free restorations are the result of the digital age and represent the integration of high technology in dentistry (Figures 1-1 through 1-6). Combining CAD/CAM technology and metal-free dental materials, these restorations may thus be classified as "**digital-ceramic restorations**." Consequently, these restorations have established the new standard for restorative dentistry, providing natural esthetics and vitality as well as proven biocompatibility. Using minimally invasive preparation designs and adhesive or conventional cementation procedures, digital-ceramic restorations present dental professionals with a rapid and effective process for providing optimal care for their patients.

At this time, there are multiple CAD/CAM systems available in the market (Table 1-2).[4,5] Of these options, the authors have selected **the Procera system for multiple reasons that include its long-term performance, mechanical properties, and esthetic capabilities**, each of which has been well-documented in the literature. The versatility of Procera, which provides restorative solutions for veneers, crowns, abutments, and fixed partial dentures, gives the authors the confidence to use these restorations to predictably treat a broad range of clinical conditions (Figures 1-7 to 1-43).[6]

### History of CAD/CAM Technology and Digital Communication

For decades, dental laboratories have depended on the experience and manual craftsmanship of human workers in order to fabricate esthetic restorations.[7] The dental industry has continued to evolve from this dynamic because of CAD/CAM technology. This process introduces the digital age to the conceptualization and fabrication of dental prostheses and involves the effective communication of case information among the restorative team members.[8]

With CAD/CAM technology, electronic computer files generated by the dental laboratories are used to partially or entirely replace the traditional sequences of

1-1. Procera CAD/CAM copings can be fabricated in A2 shade in Alumina or white in Zirconia in order to mask the biological substructure. The 0.4mm Alumina copings can be W (white) or T (translucent).

1-2. With a thickness of 0.4mm, 0.6mm, and 0.7mm for alumina and zirconia copings, respectively, Procera enables seamless esthetic integration.

1-3. Initial presentation of two fractured all-ceramic crowns (fabricated of pressed ceramics) on the two central incisors.

1-4. Preparations with hybrid layer.

1-5 and 1-6. Harmonious outcome and natural tissue integration of the two full-coverage, digital-ceramic crowns (Procera Alumina).

prosthesis fabrication. CAD/CAM systems can be used to create **the entire restoration, from the intaglio to the occlusal surface (ie, Cerec In-Lab or Cerec 3D), or just a part of the restoration (ie, a coping or a framework)**. This last option is the approach used by Procera and the one favored by the authors in daily practice. By using CAD/CAM to fabricate only the substructure of a given restoration, they are able to combine innovative technology and conventional steps, mixing the reliability and reproducibility of industrial digital manufacturing with the artistic skills of dental technicians responsible for the ceramic stratification.

CAD/CAM offers various other clinical advantages. This technology enables dental professionals to produce two or more absolutely identical restorations. For example, one electronic file can be used to generate two implant abutments (ie, for provisional and final restorations) initially and then, should it be necessary in the future, to be recalled from an archive so that an exact duplicate abutment or coping can be fabricated. **This CAD/CAM process represents not an evolution but a revolution in esthetic dentistry**, the consequences of which investigators are only beginning to assess. Combined with high-strength ceramics, CAD/CAM is responsible for significant changes in dentistry.[9,10]

The foundations for the development of CAD/CAM technology originated with the work of Duret in the early 1980s. Although Duret's work began with the search to mill gold alloys with industrial processes, the technique evolved rapidly when other pioneers such as Mormann, Rekow, Andersson, and Oden applied them to various ceramic materials. Sandvik, one of the early manufacturers involved in the industrial development and fabrication of the restorations via CAM, was acquired by Nobel Biocare in 2003 in an effort to further streamline the production process and improve service to laboratory technicians as well as clinicians.

These CAD/CAM techniques are now applied to **highly pure and densely sintered** aluminum oxide, zirconium oxide, and titanium materials. In this manner, industry manufacturers have expanded the capabilities of CAD/CAM restorations, instilling them with fit, strength, and esthetics in a single restorative solution that can be used to treat a variety of clinical indications.

**Convergent Growth of Digital Communications**

Key developments in CAD/CAM restorations and digital communications occurred along similar time frames. Throughout treatment, dental professionals now use the Internet to enhance and expand communications related to patient consultation and care. Thus, e-mailed patient records, clinical photographs, and related patient data can be used to connect practitioners over vast geographic regions. Digital communications shared in this manner thus represent striking improvements over previous methods of communication that depend on the mailing of physical patient records. This evolution has reached other aspects of the dental practice as clinicians have adopted practice management software and related technologies to automate their practices and improve their efficiencies.

Digital communications have grown more prevalent in dental education as well. As technology proliferates in the form of satellites, fiber optic cables, and the Internet, clinicians have better access to information that permits lifelong learning in dentistry. Delivered via the Internet, webcast lectures have become increasingly popular among dentists, technicians, and training centers. Webcast lectures enable practitioners to log on to the Internet at their own convenience and access either live or archived presentations delivered by the industry's leading authorities in esthetic dentistry. The authors routinely participate in such weblectures and venues (eg, Global Institute for Dental Education).

Most of the restorations shown in this book result from the long-distance digital communication of esthetic information—without the ceramist ever seeing the patient in his laboratory. By using digital communication and CAD/CAM techniques, dental professionals are able to treat a wide range of clinical indications and satisfy multiple requisites for crown restorations:





- **Minimally invasive preparation;**
- **Esthetic, metal-free post and cores;**
- **Hybridized tooth surface;**
- **Nonmetallic substructure;**
- **Biocompatible restorative material (high-strength ceramics);**
- **Natural brightness and translucency;**
- **Esthetic palatal (or lingual) aspect;**
- **Adhesive and esthetic cement;**
- **Bonded margins;**
- **Radiolucency; and**
- **Fast digital communication for predictable outcome.**

In terms of dental implants, CAD/CAM technology can be used for the fabrication of metallic abutments, metal-ceramic abutments, and all-ceramic abutments—all with virtually unparalleled customization or "stock" prefabricated versions. More recent advances in the involved scanning technology allow the creation of porcelain laminate veneers as well as bridges. The latter can be used in three-unit restorations (ie, two abutments and one pontic) for the anterior and posterior regions; further research will be needed to determine the reliability of fixed partial dentures of greater length (ie, four units or more). While early findings with all-ceramic bridges appear promising, additional long-term studies are needed to gather evidence on their success rates as well as to determine the parameters for ideal connectors according to various occlusal loads and especially in the case of parafunctional habits.

**Interdisciplinary Communication**

Many factors influence the clinician's ability to achieve esthetics in prosthetic dentistry.[11,12] Since there are many restorative alternatives and dental materials available, clinical and laboratory steps depend on a proper esthetic diagnosis and accurate transmission of information among the members of the treatment team. Laboratory work can be developed nicely by an experienced laboratory technician, but it will not necessarily fit the patient's overall facial esthetics and fulfill his or her expectations without proper

## CASE STUDY: REPLACEMENT OF UNAESTHETIC PFM RESTORATIONS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1-7. Preoperative view of patient who requires treatment of eight maxillary and eight mandibular restorations. The patient presented with four defective PFMs on anterior teeth as well as inflammation, crowding, and poor hygiene on the mandibular dentition.

1-8. View of maxillary preparations on the model. Note that the majority of the teeth are vital.

1-9. Mandibular preparations on the model. When endodontic treatment is involved, the authors use zirconia posts with pressed ceramic cores.

1-10. Facial view of definitive mandibular all-ceramic crowns upon seating and cementation.

1-11. Postoperative view immediately following cementation with resin-modified glass-ionomer cement.

1-12. One-year postoperative view shows the integration and biocompatibility of the Procera crowns within the maxilla.

### Workflow for Fabrication of Procera Restorations

- In the operatory, preparations and impressions are completed conventionally by the dentist.
- In the laboratory, dies are conventionally poured and ditched (ideally under a microscope). Dies are then scanned in a CADDesign program and the resulting electronic file, which three-dimensionally reproduces the die (30,000 to 50,000 points for each 3D image), is sent via modem to a Procera production center (New Jersey, USA; Stockholm, Sweden).
- In the production facility, copings, abutments, and bridge infrastructures are pressed, sintered, milled, and express-delivered to the laboratory.
- In the laboratory, porcelain is built up over the substructure, and the completed restorations are sent to the dentist for placement.

### About the Scanning

This scanner features a mechanical palper sapphire at the end of a probe, with a pressure of 17g and data capture of 360 dots per rotation. The probe tip moves 200μm after each rotation and results in 30,000 to 50,000 points in just 3 minutes. Due to the light pressure exerted, waxups can be scanned with this process.

clinical information. Challenging cases are better conducted when both professionals—the clinician and the technician—are involved from the early phases of treatment. Even with experienced professionals, lack of communication between professionals can compromise the final esthetics.[13]

Prior to the adoption of the CAD/CAM process, **digital photography improved interdisciplinary communication and shortened distances, allowing data transmission among professionals placed in different geographic regions**. It is important to point out that data communication is not restricted to shade communication. Many different aspects of a given case can be transmitted among clinicians, laboratory technicians, and other specialists, and various protocols have been developed to meet this need.

**Considering long-distance communication for prosthetic purposes, the first requirement is that the clinician clearly understands the patient's needs and/or complaints in such a way that he or she can translate the patient's expectations to the laboratory technician**. Any misinterpretation will result in failures and delays during the treatment. This is presumably one of the reasons that technicians often find it desirable to see and talk personally to the patient. A good clinical examination and patient history, however, can show former failures and patient desires; this should be transmitted to the laboratory technician during the treatment planning phase and reinforced by the esthetic try-in sessions.

### Initial Documentation

In addition to the first esthetic evaluation, the initial appointment should also yield diagnostic models, radiographs, and digital photography. It is advisable to keep these records for legal reasons. While simple documentation is sufficient for single-crown replacement, more complex cases can benefit from additional records (eg, a face-bow for mounting models, CT scans, MRIs).

According to the case, digital photographs taken at this stage can register the extraoral frontal and profile aspects (ie, at rest, while smiling), intraoral occlusion (ie, frontal and lateral

## CASE STUDY: FULL MAXILLARY ARCH REHABILITATION WITH ZIRCONIA-BASED DIGITAL CERAMIC CROWNS AND BRIDGE


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1-13. Female patient of approximately 57 years presented with heavy abrasion and abfractions.

1-14 through 1-17. Single-unit preparations were performed for maxillary execpt for teeth #11(23) through #13(25), which were prepared for a fixed partial denture.

1-18 and 1-19. Bisque bake as ready for try-in and on the first laboratory model.

1-20. The bisque bake was stabilized with a disclosing medium (ie, Fit Checker, GC America, Alsip, IL) during try-in.

1-21. A pickup impression of the bisque bake try-in was made for the fabrication of the second laboratory cast.




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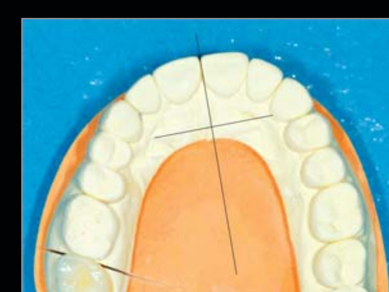
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1-22. Intaglio surface of the zirconia-based restorations (single units and the three-unit bridge).

1-23. Posterior restoration as seated on the second laboratory model.

1-24 through 1-26. Final restorative outcome demonstrates new vertical dimensions of occlusion and incisal guidance.

1-27. Lingual view of the patient's maxillary arch.

1-28. Postoperative view of the restored maxilla. Treatment was complicated due to the asymmetry of the patient's arch.

## CASE STUDY: REPLACEMENT OF CANINES WITH ALUMINA ON ZIRCONIA BRIDGES


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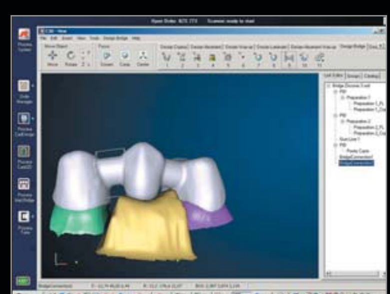
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1-29. Preoperative buccal view of patient who presents for restoration of the maxilla.

1-30. Left buccal view of missing tooth #11(23) that will be replaced with Procera AllCeram bridge.

1-31. Facial view of the patient prior to treatment demonstrates the esthetic compromise that will be addressed with the fabrication of two all-ceramic bridges.

1-32. Model demonstrates the lack of space that does not allow for implant placement.

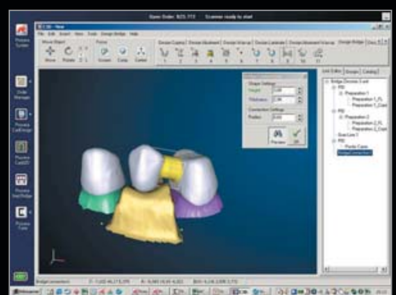
1-33. View of the completed preparation on the abutment teeth #5(14) and #7(12).

1-34. Preparations are completed for the abutment teeth on the left side as well.

1-35. In the laboratory, the prostheses will be fabricated with the Procera CAD/CAM solution.

1-36. The anticipated all-ceramic bridge is designed in the computer prior to being milled and sintered in the Procera production facility.

## CASE STUDY: REPLACEMENT OF CANINES WITH ALUMINA ON ZIRCONIA BRIDGES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1-37. The laboratory technician is able to customize the bridge connectors to ensure optimal support is given to the final restoration.

1-38. The all-ceramic framework is returned to the laboratory for conventional buildup.

1-39. View of the completed Procera AllCeram bridges prior to their try-in.

1-40. Occlusal view of the seated Procera bridge on teeth #7 through #5.

1-41. View of the maxillary arch demonstrates the natural integration of the all-ceramic bridges.

1-42. Buccal view of the seated FPD shows natural adaptation of the bridge to the gingival tissues with ovate pontics.

1-43. Postoperative view of the Procera AllCeram bridge evidences the enhanced esthetic appearance of the patient's dentition.

Teeth-in-an-Hour®

The Teeth-in-an-Hour® treatment concept uses implant therapy to provide patients with immediate function and a completed prosthetic restoration in a single hour of treatment. By combining an expedited treatment planning phase, in which **a CT scan is used and a surgical template is developed**, the clinician is able to use a flapless technique for implant placement. The implants are then positioned in the osseous structures and a fixed partial denture (FPD) is immediately secured.

In order to ensure an optimal result, the majority of the clinical data captured and transmitted to the prosthetic manufacturer is communicated electronically. Patient registration, treatment planning (ie, CT scanning), two-dimensional CT data communication (DICOM), and a three-dimensional planning program are key components to the initial treatment stages. This is followed by determination of the implant's positioning as well as the fabrication of a CAD/CAM restoration using computerized systems.

**This revolutionary treatment** solution is intended for use in edentulous patients where sufficient jaw bone exists, the quality of the osseous structures is adequate for immediate loading, 50mm of space is available, and the patient's health is not compromised. A minimal distance is required between neighboring implants at the level of the abutment mount (ie, 7mm at the jawbone crest) to ensure proper drilling using a drill guide. Once positioned, care must be taken to ensure that the cap above the abutment is completely submerged in the prosthesis. This will allow the development of an esthetic result following placement of the definitive screw-retained abutments in the FPD.



views), occlusal views of the maxilla and mandible, the six anterior teeth (with and without a black background), and initial shade. By documenting the entire case in this manner, the clinician will be able to retrieve the details required for subsequent appointments.

**These pictures should transmit information to the laboratory technician as if he or she was directly facing the patient**. One of the most common aspects of preoperative imaging is that patients with esthetic concerns often smile in a different way. Some reduce the height of the smile, while others conceal features such as "gummy" smiles when they are photographed. This should be mentioned to the patient during initial documentation, explaining that it is crucial for him or her to smile in a way that registers as much accurate information as possible and thus ensures better results.

### Shade Registration

When performing shade registration, the clinician must take certain precautions. The teeth should not be hydrated, and the position of the shade tab should be as parallel as possible to the surface to be registered. If many shades can be distinguished, different shade tabs should be positioned in the various areas. It is also very helpful for one to take photographs of the adjacent and opposing teeth, which will help the ceramist to achieve the proper characterization for the teeth.

Digital photography has evolved considerably since its early phases. Depending on the purpose, the clinician can have a cost-effective camera available to suit his or her needs. Digital cameras can be ultra-compact (eg, Canon Digital Elph), compact (eg, Canon G6), "bridge" (eg, Epson 3.3 MPx), and reflex (eg, Nikon D70, Nikon D100, Canon 20D, Fuji S3 Pro).

It is usually more difficult to reproduce some dental features (eg, characterizations, textures) with traditional ring flashes. To accommodate this need, special types of ring flashes (eg, Nikon SB 29) have been developed whereby one can adjust light intensity to the left and right side of the ring, which allows more realistic images and facilitates the laboratory technician's ability to visualize and to reproduce these details.

Information Transmission

To begin the laboratory fabrication process, the ceramist needs a detailed patient history, dental models, and series of photographs in order to fabricate a diagnostic waxup.[14] The fabrication of provisional restorations also depends on such information. Once the waxup and provisional restorations have been completed, they will be used in the clinical phase to permit intraoral seating and verification of additional details that provide a more comprehensive idea of the esthetic and functional changes during the treatment phases:

**Digital Diagnostic Waxup Protocol for Long-Distance Communication**

- Initial extra- and intraoral photographs
- Initial shade (including adjacent and opposing teeth)
- Close-up photographs to show characterizations and surface textures
- Prepared teeth (particularly for discolorations and cores)
- After provisional crowns (extra- and intraoral photos)
- At bisque-bake try-in (extra- and intraoral photos)
- Final extra- and intraoral photographs

- **The length of the maxillary central incisors should be no more than 3mm in a rest position, and their edges should touch the lower lip of a smiling female or young adult patient;**
- **The mandibular central incisors' length should be displayed more frequently in males but should not exceed the lower lip line by 3mm;**
- **Changes in the vertical dimension of occlusion (VDO) for oral rehabilitations;**
- **Soft tissue support (ie, the distance of the upper and lower lip to a plane from nose tip to chin);**
- **The relationship of the maxillary midline to facial midline; and**
- **The relationship of the incisal plane and central incisors' border to the sagittal plane.**





Provisional restorations should ideally contain as many details as possible in such a way that their reproduction in another model could provide additional information to the laboratory technician. The combination of digital imaging and the intermediate casts will provide the technician with the information needed to perform an accurate laboratory work, including the sex, personality, and age factors. Once the provisional restorations are seated, the clinician should capture several additional images:

- **Full face and smile (from both the front and the profile view);**
- **Provisional restorations in place, with and without lip retractors; and**
- **Prepared teeth, which will show all types of color changes in the substrate, and the presence of cores and discolorations.**

Some digital cameras can also register brief movements, allowing transmission of phonetics (eg, "F" or "V" sounds) and functional problems during early phases or try-in sessions. This, in conjunction with the usual phonetic tests, will help achieve the best central incisor length and incisal plane.

Ceramic will then be fired, and the bisque bake can be tried in during the following clinical session. This try-in session will be visually documented in a similar manner, and the required corrections should be noted with digital photography. During this try-in session, the pickup impression should be made for full-crown restorations and bridges (the procedure not being suitable for veneers), which will allow the establishment of the final emergence profile of the restorations because gingival tissues will not be displaced.

Imaging Management

Depending on the equipment used, it may be necessary to adjust and edit the images before sending them to one's colleagues. To transfer these images to the computer, it is possible to connect the camera cable to the USB port. One can also choose to introduce the camera's memory card to the computer in a card reader and save them to the hard drive accordingly. Most images transfer from a camera in a large-format file (ie, TIFF) that contains the maximum possible data about the image. While this ensures the highest level of quality, TIFF files must be reduced in size for use in digital communications. **The JPG format is significantly smaller and easier to use for e-mailing**. While the conversion of image from TIFF to JPG format diminishes the quality of the file, there are some acceptable ranges for handling them. A JPG file of 72dpi or 90dpi can be used for e-mail purposes; **JPGs must be approximately 300dpi in size for printing**.

Various computer software (eg, Adobe Photoshop, Microsoft Image Editor) can be utilized for resizing, cropping, and rotating these images. Digital photographs can be converted from color to gray scale and thus help clinicians to assess **the proper value of teeth—one of the most important details in shade determination**. After all the necessary image handling is performed, these image files can be immediately e-mailed to the laboratory technician.

Digital photography is now mandatory for remote multidisciplinary communication, and with the laboratory technician in particular. When the laboratory is located in the same facility as the practice, digital photography and communication are still indispensable for recording esthetics, color information, and oral health status prior to and following prosthetic treatment. Digital photography is also necessary:

- **At the outset of the case to help the esthetic diagnosis and to facilitate patient communication;**
- **In the presence of different substrata or discolorations;**
- **To document prepared teeth;**
- **After the cementation of the provisional restorations to refine the final esthetic project and to communicate all the changes performed during the clinical work;**
- **During the bisque-bake try-in session to finalize the value and help with all form and emergence profile alterations; and**
- **Upon completion of the case to document the prosthetic restoration.**





### Summary

The clinical applications of CAD/CAM technology and digital communication continue to grow at an unprecedented rate. The Procera system used by the authors, for example, now enables the scanning, design, and fabrication of all-ceramic crowns, bridges, implant abutments, and porcelain laminate veneers. At present, the system cannot be used in the fabrication of dowels and cores due to technical limitations involved in the scanning of these components, but this too may be solved at some point in the foreseeable future. While additional research is necessary to confirm the performance of the newer applications (eg, long-span, all-ceramic bridges) of CAD/CAM technology, **the clinical experiences of the authors have been extremely favorable to date**.