

CAD-CAM Dentistry with Esthetics and Function

"Today and Beyond"

by Pinhas Adar MDT, CDT

Our patients are learning more and more about the role they play in their own dental health thanks to the age of information that we live in that makes it but a click away. And in turn, their wishes and interests are driving the decisions that we as health care professionals make. Within this environment comes the need for information about options, products and the possible implications of dental care decisions. There are many differences in quality that exist in the dental field today.

However, if knowledge were the only requisite for success, virtually everyone would be successful. An action plan also is essential on how to process the relevant information from the anecdotal. Given the onslaught of product introductions from manufacturers vying for the business of the dental market, dental professionals face the ongoing challenge of keeping up with the barrage in order to make informed selections of the best



Pinhas Adar, MDT CDT Master Ceramist Pinhas Adar studied in Tel Aviv, Israel and did his residency with Mr. Willi Geller in Zurich, Switzerland. He has over 35 years of experience in all phases of dental laboratory technology. He is the founder of Adar Dental Network, Inc, a laboratory, educational and research company that is dedicated to setting a new standard in esthetics.

He is an Adjunct Clinical Professor at Tufts University School of Dental Medicine, past President of the Georgia Academy of Cosmetic Dentistry; on the PEC board of the American Academy of Cosmetic Dentistry as program co-chair for 2011, an Accredited member of the American Academy of Cosmetic Dentistry, a Fellow

in the American Academy of Esthetic Dentistry, a board member as well as one of the commencing members of the International Oral Design group. He is also a center for Oral Design International. He is on the advisory board of the Amara Institute as well as on the editorial board of several dental journals.

He is a skilled communicator who has the ability to make the complex simple and to teach and inspire. As a speaker, author, and entrepreneur Pinhas has achieved success in empowering both individuals and organizations. His purpose is "To Live, Teach, and Empower Greatness." He is the creator of educational DVD's, numerous magazine article as well as a contributor to many chapters in dental esthetic publications.

1a



1a: Old crown that did not match the adjacent central

1b: Customizing the internal effects during the patient's appointment

1c: Final single central crown after glaze and polish

1d: Final single central crown after cementation

c



products that not only meet their clinical and esthetic requirements but also patient demands.

The Plan of Action

Dentists and dental ceramists are business owners, and in business, time is money. Yet, rather than just selling a product — a crown, for instance — dental professionals are providing a service that requires considerable skill and time. Instead of asking their patients to purchase a product or procedure, dental professionals are asking for an investment in their expertise and time to exercise these skills and knowledge. Therefore, dental professionals must determine the

types of products and systems to employ in their daily procedures in order to maximize their most valuable commodities — time and service.

Technology is a time saver and can present a rich profit source. However, before investing in any technology, it is important to consider five factors for success. They are as follows:

1. Favorable market trend
2. Product uniqueness (for dental professionals, this translates into their skill levels and how these can be utilized to marketplace advantage)
3. Partnerships with companies with proven longevity, reliability and quality (if dental professionals purchase costly equipment and/or

technology, they want assurance the company and technology will be around if future services and/or upgrades are required)

4. Favorable return on investment (ROI) compensation (if laboratories or dentists invest \$120,000, what can they expect as an ROI for their businesses?)
5. Perfect timing

Dental ceramists and their dentists should embrace technology, but they must not be ruled by it. Patients should feel as if technology is an enhancement — not a replacement — of a dental professional's personal service, as “the personal touch” remains an important element of patient satisfaction and retention. We still need to remember that an informed consumer wants to get what they want – the first time. Communication is one of the key ingredients to achieving this. The topic of communication is one that has many turns and twists and that can become quite complicated particularly with geographical constraints. People use different key words in an attempt to communicate. But what exactly does the patient mean when they use the words “white”, “natural”, “straight”, “big” and “small”? Do these words have the same meaning from patient to patient, dentist to dentist and dental ceramist to dental ceramist? Communication is a complex issue, yet as in the rest of life, an essential part of a satisfactory outcome. Specific tools can be used to assist and support a consistent message traveling between everyone involved, so that the desired outcome can be attained with no surprises for anyone. The first step, no matter what type of enhancement is required, is proper diagnosis and treatment planning.

The assignment that we all have is to create an illusion of reality. And due to the new materials available to us in the market today, it is no longer an impossible task. With the proper ceramic selection and skills of the ceramist, an illusion of reality can be accomplished even with a single anterior crown. The blueprint is already there to copy. **Figure 1-A** is an old crown that did not match the adjacent central to the patient's preference. A new single central crown was fabricated (**figure 1-B**). The blend is much more harmonious with the existing central incisor (**figure 1-C & D**).

ZIRCONIA and Lithium Disilicate

Zirconia materials are a practical ceramic option for metal-free restorations. They are ideal for light transmission in certain clinical situations. Studies by the University of Zurich-Haemmerle and the University of Goettingen-Huels have backed up the strength and longevity of restorations using zirconia framework. Fixed partial denture frameworks made from all zirconia can now span up to 14 units on natural teeth and edentulous implant retained restorations (**figure 2-A**).

The fabrication process for an all-ceramic restoration using a zirconia core is similar to the process used for porcelain fused to metal restoration.

Compared to traditional all-ceramic materials, IPS e.max,

composed of 70% needle-like crystals in a glassy matrix, affords optimal strength, durability and esthetics.^{1,2} It has a flexural strength of 360-400 MPa and is up to three times more durable than other glass-ceramic systems.³ IPS e.max incorporates true-to-nature shades while demonstrating a low refractive index, providing optimal optical qualities (e.g., life-like translucency and high light transmission).^{4,5} Cutback-and-layer or stain-and-glaze techniques make it possible to further characterize IPS e.max restorations.^{4,5}

Dental professionals can seat IPS e.max restorations using either conventional cementation or adhesive bonding methods. Dual-curing adhesive luting cements can be used to create a bond between prepared teeth and IPS e.max restorations.^{4,5}

Extremely versatile, IPS e.max is indicated for numerous restoration applications, including veneers, crowns, inlays, onlays and implants. IPS lithium disilicate can be pressed utilizing the hot wax technique (**figure 2-B**). (IPS e.max Press) or milled in the laboratory or chair side using CAD/CAM technology (IPS e.max CAD).^{4,5}

These new technology and materials have certainly made their impact in the dental world. However we need to understand that the human touch still makes the epic difference. All ceramic powders are purchased from the same manufacturers yet each technician ends up with different outcomes.

The challenge with CAD/CAM technology is that the higher strength materials can appear too chalky and not esthetic. Zirconia is the strongest all-ceramic material available in dentistry to date. However, not all Zirconia materials are created equal. For instance, the digitally fabricated Prettau Zirconia material is a more translucent product that can produce full contour single crowns (**figure 3-A & B**) as well as implant-supported, screw-retained restorations. These restorations can be fabricated for any number of implants. As a result, it's a viable treatment option for single units and up to fourteen unit bridges (**figure 3-C**). This final restoration is fabricated using CAD/CAM technology (**figure 3-D**). This includes computer aided design (CAD) and milling of the restoration from a zirconia disk. Once milled, (**figure 4-A**) the “green state” zirconia is much softer making the human touch of contouring and anatomy surface enhancements (**figure 4-B**) as well as multi-shading for improved esthetics an easy possibility (**figure 4-C & D**). After the bridge is sintered at a high temperature for 8-13 hours, a skilled laboratory technician will custom stain the Zirconia and layer pink porcelain (**figure 4-E**) on implant-supported, screw-retained bridges to create the illusion of soft tissue. With many cases involving the mandibular arch, the monolithic option (**figure 4-F**) is common and will need minimal cut back enhancing esthetics by layering on non-functional areas only, as opposed to the upper which usually requires more layering (**figure 4-G**).



2a: Screw retained implant Prettau Zirconia framework after milling

2b: eMax full monolithic crown after glaze



3a-b: Monolithic full contour Zirconia crown process with a natural look



3c: Screw retained implant Prettau Zirconia framework after sintering



3c: Screw retained implant CAD-CAM design



4a: Screw retained implant CAD-CAM after milling

4b: Screw retained implant CAD-CAM after milling and some human touch

4c-d: Prettau Zirconia framework staining with the human touch

By emphasizing the importance and the role of the human touch with CAD/CAM technology digital solution along with unique concepts that create a signature line with more esthetics, consistency and efficiency all at an excellent value, can change the current rule of thumb for full monolithic crowns and bridges.

The process and protocol in fabricating large implant bridges is very important to follow because if any step is missed or done wrong the cost of redo is expensive and very frustrating. For example, if the impressions are not accurate and a verification jig was not provided before cementation (figure 4-H) of the titanium abutment in the lab, the implant bridge will break (figure 4-I), because as strong as Zirconia is, it is still very brittle.

One important thing to remember is that every Prettau Zirconia bridge must have a certificate of authenticity that comes with each Prettau disc – if you do not get one of these (figure 4-J) you have gotten a cheaper material.

Laboratory Protocol

SMILE DESIGNS:

Fabricating entire smile designs are a lot different than doing a couple of crowns. Without adequate communication this could be a difficult procedure with an unpleasant surprise at the end. It is important that we understand the patients' preconceived ideas of what they would like their smile to look like.

One of my favorite quotes is "Beauty is in the eye of the beholder, but so is ugliness." What you or your ceramist might consider beautiful, your patient might consider ugly. That is why it is so important to involve the patient in the process. The patient should always be given options and alternatives so that they can make educated decisions. Make them aware of what the possibilities are.

The dentist must also be aware of what his laboratory is capable of and what their style is. As with all forms of art, all ceramists have a different style. If a dentist sends a case with the same instructions to several different laboratories he will get extremely different looks. That is because each laboratory interprets the same request with a different vision. The questions that the restorative dentist should ask are: "Which laboratory's outcome will the patient like?" and "What kind of tooth preparation will this desired outcome require?" Each vision has the need for different tooth style preparations for space management.

Now with the CAD-CAM technology we can fabricate several temporary sets for our patient in exact duplicate by using a PMMA block (figure 5-A). So, for example one temporary can be customized with pink composite (figure 5-B) and delivered for the patient to test drive and the second set can be used as

a communication tool to transfer between dentist and the laboratory (figure 5-C). This process is more efficient and cost effective than using conventional methods.

INDIRECT TRIAL SMILE:

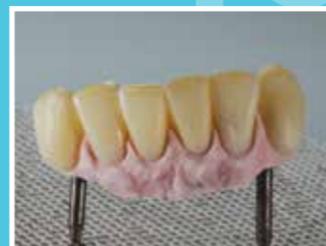
The removable Trial Smile method is an incredible tool for communication. The benefit of the utilization of a trial smile in the pre-treatment stage is to avoid patient disappointment and enhance communication between the entire dental team for a successful outcome. With the "Trial Smile" the patient can see and feel the teeth, as well as the color, in their mouth. The Trial Smile serves as a blueprint to allow the patient to experience all of these things. However, it is important and necessary that the ceramist who will be doing the final ceramics do a diagnostic wax up for the Trial Smile and/or the Trial Smile itself. A lot of detail needs to be put into these restorations.

Figure 6-A is a patient who was unhappy with her smile after orthodontic treatment. She disliked the size and proportion of her teeth as well as the spacing. An impression was taken without tooth preparation and a diagnostic wax up was made. A Trial Smile was fabricated using the cold curing acrylic Outline (AnaxDent). The patient was able to place the removable restoration in her mouth (figure 6-B) and visualize the outcome of the new smile (figure 6-C) prior to tooth preparation.

It is important that the patient make the final decision on the design of their Trial Smile. Esthetics is very subjective and a matter of personal preference, emotional feelings and personal opinion. There is no right or wrong in esthetics, just variations in opinion.

DIRECT MOCK-UP TRIAL SMILE:

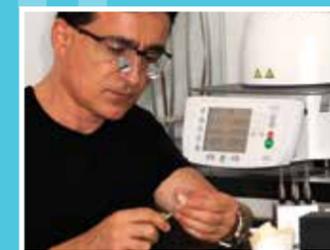
The patient shown in figure 7-A did not like her smile. She felt that the teeth were too short, the soft tissue lacked symmetry and the color was too yellow. The ceramist created a wax up of his vision of what the final outcome of the case should be. This is an extremely important first step to ensure success of the case. The wax was made to overlap the soft tissue to lengthen the teeth cervically, simulating crown lengthening. The dentist made an impression of the wax-up and then created an acrylic mock-up or removable trial smile using DMG Luxatemp® (figure 7-B). The patient then put the mock-up Trial Smile in her mouth (figure 7-C) and could see and feel what her new smile would be like (figure 7-D). This ensures that the patient approves of the ceramist's vision of the final outcome. The patient should always be involved and approve the outcome prior to tooth preparation. Once the wax up/Trial Smile is approved, the periodontist can then use this as a surgical guide and the dentist can prepare the teeth, when ready, minimally to insure the preservation of



4e: Screw retained monolithic implant bridge with pink ceramic application



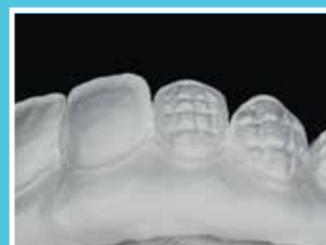
4f: Screw retained monolithic implant bridge after stain and glaze



4g: Minimal cut back on non-functional areas for ceramic application



4h: Cementation with loops to ensure accuracy



4i: Broken full contour Zirconia when not following the process and protocols



4j: Certificate of Prettau Zirconia authenticity

5e



5a: Screw retained implant PMMA framework after milling



5b: Pink composite application with GC gradia

5c: Screw retained implant PMMA bridges after the finish



c

as much enamel as possible maximizing the bonding strength of the porcelain veneers.

COMMUNICATION TOOLS:

There are critical communication tools that need to be used between the dentist and the laboratory technician to maximize success:

1. Preoperative study models of upper and lower arches
2. Preoperative clinical digital images – smile and retracted view with a shade tab of the natural color shown with it
3. Digital image of the unprepared teeth with the existing color shade tab next to it
4. Digital image of desired shade tab next to the prepped teeth. It is incredibly important for the technician to know the shade of the prepared teeth so that the correct ceramic system can be chosen.
5. Digital image of provisional restoration if used – smile and retracted view
6. Digital image of patient's face
7. Three or more accurate impressions. The reason for 3 impressions is that certain distortions are very smooth and unrecognizable, but it would be very difficult to have the same type of distortion in 3 impressions. So the technician can check the restorations in all 3 models for accuracy, thus allowing for the best fit of the restoration.
8. List of the desired expectations of the patient and the dentist

Synergy between all the key players, the patient, periodontist, general dentist, prosthodontist, orthodontist and the ceramist should be a priority for treatment. This will integrate communication that will ultimately lead to success.

Understanding each restorative option is the key to achieving patient expectations. Clinical mastery depends mainly on the expertise of the dental team as well as the restorative materials chosen (**figure 8-A**). Esthetics is not about a particular product but about using the product with the same degree of success whether you have a case that is a single crown, multiple crowns or a combination case of veneers and crowns or implant (**figure 8-B**). To achieve success all members of the restorative team must work together using the same set of guidelines and protocols. In an ideal situation, the entire dental team, consisting of the restorative dentist, the specialist and the dental technician (**figure 8-C**) should be able to evaluate the patient during the treatment-planning phase. This can be done either in person or by video conferencing. However if this is not possible a very detailed protocol for communication is the next best thing (**figure 8-D**).

There is not one single product on the market today that can solve every restorative case. That is why material selection is so critical to reach success. You must consider the type of foundation that is used to have the optimal end result. As re-

storative materials continue to progress, technicians will be able to create improved harmony which will directly increase overall patient satisfaction with a definitive end result.

Summary

In summary let me quote what many people have heard me often say: "No man is an island." We all need each other to pull off the ultimate in dentistry. No aspect of dentistry can survive this "CAD-CAM-ESTHETIC" rush if we think we can do it on our own. With digital solutions today we can create a signature line with more consistency and efficiency as well as pleasing esthetics and all at an excellent value, allowing us to serve more dentists and their patients. The importance is to understand that the human touch still makes the epic difference!! We must learn to communicate better and most of all, to respect the profession and our colleagues. ■

Dentistry by:

Figures 1-A –1-B - Dr. Cathy Schwartz, private practice, Atlanta, Ga
 Figures 4-A – 4-D – Dr. Nancy Ray, private practice, Chicago, IL
 Figures 8-A – 8-D – Dr. Aldo Leopardi, private practice, Greenwood Village, CO

Special THANKS to the Zirkon Zahn TEAM!! Alessandro Cucchiari, LienHuynh, Admir Hujdur, Ashley Wayne Michalec and Hai Nguyen for their generosity and assistance with the screw retained implant Prettau Zirconia !!

References

1. McLaren EA, Phong TC. Ceramics in dentistry: classes of materials. *Inside Dent* 2009; 5(9):94-103.
2. Reynolds JA, Roberts M. Lithium-disilicate pressed veneers for diastema closure. *Inside Dent* 2010; 6(5):46-52.
3. Ivoclar Vivadent. IPS e.max lithium disilicate: this changes everything. Amherst, NY: Ivoclar Vivadent; 2009:1-6.
4. Culp L, McLare EA. Lithium disilicate: the restorative material of multiple options. *Compend Contin Educ Dent* 2010; 31(9):716-20,722,724-5.
5. Ivoclar Vivadent. Ips e.max lithium disilicate: the future of all-ceramic dentistry-material science, practical applications, keys to success. Amherst, NY: Ivoclar Vivadent; 2009: 1-15.
6. Kahng LS. Patient-dentist-technician communication within the dental team: using a colored treatment plan wax-up. *J Esthet Restor Dent*. 2006;18(4):185-93; discussion 194-5.
7. *Journal of Esthetic Dentistry*, Volume 9, number 6, Adar – Avoiding Patient Disappointment with Trial Veneer Utilization
8. Nanchoff-Glatt M. Clinician-patient communication to enhance health outcomes. *J Dent Hyg*. 2009;83(4):179.
9. Terry D.A. *Aesthetic & Restorative Dentistry Material Selection & Technique*. Everest Publishing Media. 2009:152-3.



6a: Patient who was unhappy with her smile after orthodontic treatment



6b: Patient placing the removable Trial Smile restoration in her mouth



6c: Smile with Trial Smile in the mouth



7a: Pre-operative smile



7b: Mock up fabricated from a wax up



7c: Patient smile with mock up



7d: Smile with mock up full-face picture has more impact on the patient



8a: Pre-operative smile



8b: The process of cementation with MO1 Multilink implant resin based



8c: Delivery of the screw retained implant bridges in the articulator



8d: Final smile with the screw retained Prettau Zirconia implant bridges