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JOURNAL of Cosmetic Dentistry

VOLUME 25 • NUMBER 2
SUMMER 2009

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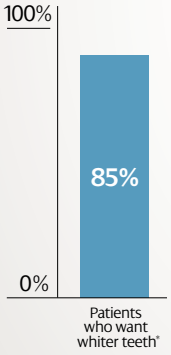

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JOURNAL of Cosmetic Dentistry

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fax 608.222.9540 • info@aacd.com • www.aacd.com

DIRECTOR OF PUBLICATIONS
Tracy Skenandore, tracys@aacd.com

PUBLICATIONS ASSISTANT
Denise Sheriff, denises@aacd.com

EDITORIAL CONSULTANT
Juliette Kurtz, publications@aacd.com

ART DIRECTOR
Lynnette Rogers, lynnetter@aacd.com

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AMERICAN ACADEMY OF COSMETIC DENTISTRY

AACD MISSION STATEMENT

The American Academy of Cosmetic Dentistry is dedicated to advancing excellence in the art and science of cosmetic dentistry and encouraging the highest standards of ethical conduct and responsible patient care.

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Editor's Message

"Pushing Through"

Have you ever asked yourself, *"How did I get here?"* and, more importantly, *"How can I possibly go on?"*

I did a wonderfully foolish thing this past Spring: I competed in my first triathlon. But I didn't start small and work my way up to it…I just went for it. (Well, not the "full Ironman," but the "half Ironman.")

At 6:00am April 4th, I found myself standing in a full wetsuit above the Oceanside Harbor near San Diego. The air temperature was 45 degrees; the ocean water was a balmy 58 degrees! As I stood shaking in my bare feet, marveling at the other 2,299 competitors, I found myself wondering, *"What did I get myself into?"* and seriously thinking that I just didn't belong. I had never raced in the ocean; and, more importantly, had never done an open-water swim. I looked down at my heart-rate monitor, which was blinking at 105 beats per minute! I was so nervous…

To make a long story short, my swim was a disaster. I panicked, and couldn't keep my face in the water, which was cold, murky, choppy, and chaotic. I breast-stroked the entire 1.2 miles, and stopped three times, hanging onto a lifeguard's surfboard to rest. The entire time I was asking myself, *"Is this it? Is this what four months of training has led to?"* I considered quitting the entire swim—and the entire competition. But another, much deeper voice kept resonating in my head: "*Push through, you can do this*." So I did push through, and I did finish the swim, and the whole race. My goal for the entire triathlon was six hours, and I completed it in five hours, 35 minutes.

In all aspects of life we plan, practice, and try our best. Sometimes the best-laid plans go awry. This is so true in the Accreditation process. We try to choose the best cases, treatment plan with care, think of every detail, take great preoperative photographs, and set aside time to treat the patient without interruptions. In other words, we set ourselves up for success! So what could possibly go wrong? Everything!

I can certainly speak to this. In my work toward Accreditation, I have struggled with Case Type I, Six or More Indirect Restorations. Of all the case types, why this one? My Case Type V, Six or More Direct Resin Veneers, in contrast, was a grand slam on the first try. It just goes to show that the best-laid plans sometimes don't turn out… as planned.

My message to everyone working toward Accreditation or Fellowship is to not lose sight of why we attempt the process in the first place; we attempt it to become better clinicians. With that said, we usually learn the most with our toughest cases…and our failures. Failure makes us take a harder, deeper look into what we did; why it failed; and how to do it better next time. Sometimes, however, the seemingly easiest of cases may teach us the most, especially when we struggle with it.

In my pursuit of Accreditation, I have found myself with emotional highs and lows, grand slams, and bottom-of-the-ninth strikeouts. One thing I am certain of is that by pushing through the lows, I know that I have become a much better, more astute, and skilled clinician. So don't be ashamed or too disappointed with a failed case; rather, push through and ask yourself, *"What can be learned from it, and what can I do better next time?"* Enjoy the journey of Accreditation or Fellowship!

In all things, may your expectations be forever exceeded. As I like to say, *"Go big or go home!"*

Michael

Michael J. Koczarski, DDS, Editor

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President's Message

Dreams, Milestones, and Responsibilities

(Adapted from Dr. Sesemann's speech at the 25th Anniversary AACD Scientific Session. To view the speech in its entirety, visit www.aacd.com and click on the live blogging and video coverage button located at the top of the homepage.)

British artist and social critic John Ruskin (1819-1900) wrote: *"It is not what we know… It is not what we think…It is not what we believe…It is what we do that is important."*

My thanks to Dr. John Kois for introducing me to these poignant words in 1996, at my first annual scientific session. I think we can all agree that those words have great significance.

The early members of this organization were pioneers in the true sense of the word; they were determined, driven and, at times, defiant to the traditional "powers that be" in dentistry.

From their hard work were sown the seeds for the survival and growth of this Academy. As the years went by, the members of this organization resolved to establish their belief that cosmetic dentistry should be an integral—*and respected*—part of dental practice.

There never was a guarantee that such a fragile experiment could ever work. Whether a founding creed, initially rooted in *elective* dentistry, could ever survive…whether a dental science based upon restoring someone's self-esteem, or his or her confidence, or appearance, could ever be thought to be legitimate.

Growth and evolution are rarely easy; we found that to be true. Through the years, there would be times of incredible synergy—and, at times, periods of painful polarization. Yet, through it all, there would always be passion and inspiration directed toward the growth of this Academy and an evolution of its ideals.

So here we are, 25 years later, pleased with our accomplishments, and fairly satisfied with the events that have brought us to this point. However, to stay that way—proud and satisfied—not only would be an insult to those who have gone before us, but it would also be a rejection of our inherent responsibility *to always become better*. As Ruskin declared, *"it is what we do that is important."*

I believe that what we *must* do is live the core ideology of this Academy, and commit to the belief that the information we share must accurately reflect the science and knowledge that have been accumulated over the past two-and-a-half decades. Unlike the pioneers, we now have the benefit of long-term research to complement our vast experience in our daily treatment decisions.

We can help those we educate to understand and appreciate the importance of *Responsible Esthetics*, we know the difference. Our experience and knowledge must be counted on to light the way, not create ambiguous standards.

We know that esthetic dentistry should complement the overall general health of the patient…and do no harm.

We know that our treatment plans should utilize interdisciplinary medical and dental treatments to minimize the loss of healthy tooth structure.

We know that we should be using sound clinical judgment to guide our patients to make treatment decisions that benefit their lives, not only in current context, but also for their future.

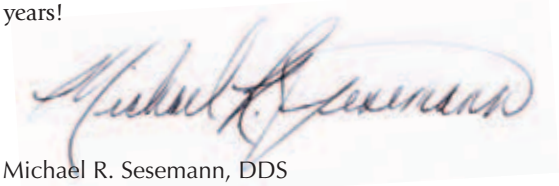
But, I remind you, as Ruskin stated: It is not about what we know, it is about what we *do*, that is important.

You see, our identity can and should be synonymous with the basic tenets of Responsible Esthetics. It is time for us to clarify not only who we are, but also *what we stand for*. With a clear identity and core values distilled through our years of service, we can use a vivid and lucid voice to share our knowledge with all of dentistry, to the benefit of the patients we serve.

Our voice is far-reaching. We now have members in more than 70 countries. We have the opportunity to set an example. We must make it clear that we, as an organization—after 25 years, at this defining moment in our history—are not only willing to exist, but that we are willing *to do more*:

- to educate our membership, and all of dentistry, by providing optimal and innovative learning opportunities
- to be inclusive, to engage all who have a genuine interest and commitment in pushing their abilities to reach his or her maximum potential
- to recognize and appreciate individuality, and celebrate the unique skills and interests that each member of our *entire* dental team brings to our collective mix
- to create community, where the sharing of personal experience and knowledge can be such a powerful ingredient for personal and professional growth.

Let us make the most of this opportunity that lies before us. Let us join together and make this year a pivotal one for our Academy—and a fitting one to embark on for our *next* 25 years!



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About the Cover

by
Jason S. Olitsky, DMD

I first met our patient, model Whitney Thompson, during a 2006 photo shoot. I noticed she had some discolored direct veneers on her front teeth and asked her about her smile. It turned out that she was self-conscious about her teeth and wanted to do something to improve her smile.

Whitney was concerned about the look of the direct composite veneers that had been placed on her four front teeth to cover the scarring that was left on her enamel from braces. The white hypocalcification marks were also evident on the facials of her canines and premolars. She wanted all her upper teeth to be whiter and to match. Whitney, a well-known model in Jacksonville, Florida, wanted to have beautiful teeth to match her personality and success.

An analysis of her smile revealed problems with tooth color, axial inclinations, tooth shapes, and buccal corridor. Her occlusion was good and her temporomandibular joints were healthy. Her treatment plan included whitening, followed by restoration of ##4-13 with indirectly fabricated porcelain veneers.

The smile transformation was accomplished using minimal preparation techniques without breaking contacts. Fortunately, the direct veneers had been fabricated without removing excessive amounts of tooth structure. We were able to utilize conservative techniques, without any crowding and only minor axial inclinations needing to be addressed and corrected. A wax-up was created and a stint was created of the wax-up for the provisional restorations made to our specifications, as well as reduction guides and custom trays. Whitney was allowed to wear the provisionals as a "test drive" for several days to make sure she was comfortable with the new look. A Panadent (Colton, CA) articulator was utilized with a Panadent earless facebow for mounting. Provisionals were fabricated using Luxatemp BL (Zenith/DMG; Englewood, NJ) that closely matched the 030 Empress shade (Ivoclar Vivadent; Amherst, NY). The Empress pressed ceramic veneers were created using E01 ingots by Rob Maatta at Gold Dust Dental Laboratory. He masterfully cut back and layered 1 mm of frosted white translucency and added a halo effect. He also contoured in developmental grooves and notching at the incisal edge, giving the veneers a natural look, replicating and enhancing Whitney's natural beauty.

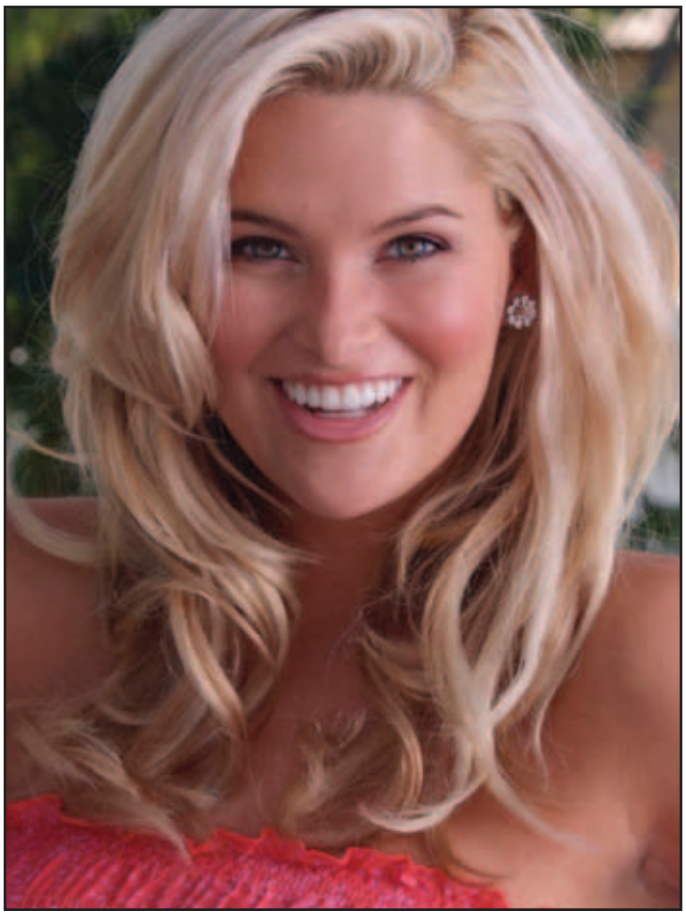
Preoperative.

Postoperative.

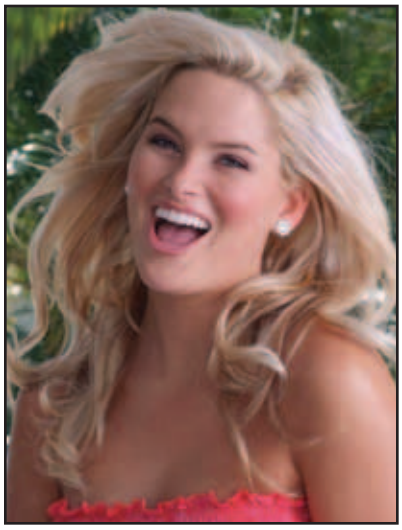
Whitney's response to her new smile was, *"I was always so self-conscious about my smile. I am so happy I decided to get veneers—they look so natural. My new smile is the perfect accessory!"*

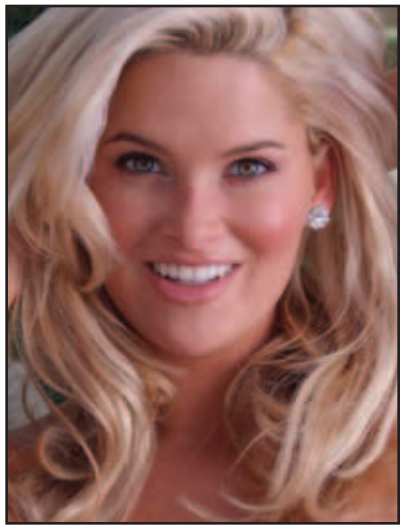
One year after Whitney received her porcelain veneers, she participated in cycle 10 of the hit reality television show, "America's Next Top Model." Since winning the show a year ago, Whitney has become a successful national model and spokesperson. She attributes her new confidence and much of her modeling success to her new smile. For more information about this case, see the Clinical Cover Story on page 62.

Dentistry by Jason S. Olitsky, DMD (Ponte Vedra Beach, FL). Photography by Tiger (Tiger Studios, Atlantic Beach, FL). Ceramic artistry by Rob Maatta (Gold Dust Dental Laboratory, Tempe, AZ).



My new smile is the perfect accessory!





26TH Annual AACD Scientific Session

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Leading the Learning Revolution: Looking Through the Educational Prism with "Team Texas"




by Sandra R. Roth
Brooksville, FL
www.prosynergy.com

Frank J. Milnar, DDS
AACD Accredited Member
(AAACD)
St. Paul, MN
www.milnardds.com

Gary Hult
St. Paul, MN
www.3mespe.com

Gilbert Young, CDT
AACD Accredited Member
(AAACD)
Plano, TX
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Introduction

In assuming the role of 2009-2010 president of the AACD, Dr. Michael Sesemann, FAACD, challenged members to embrace the concept of *Responsible Esthetics* when he gave his inaugural address and outlined his vision for our Academy. It is our obligation as co-chairs of the 26th Annual AACD Scientific Session, which will be held in Grapevine, Texas, to ensure that our educational programming reflects this perspective.

However, Dr. Sesemann took an additional bold step. For the 26th Annual AACD Scientific Session, the Professional Education Committee (PEC) comprises not simply the usual pair of dentists; but rather, four individuals of diverse backgrounds: A dentist, a communications consultant, a corporate representative, and a laboratory technician. With this blending of experience and perspective, "Team Texas" was formed.

Our job focuses on five key responsibilities:

- Revolutionize the way the AACD offers education to our members.
- Target the best and brightest headliners and educators.
- Form the most diverse program the AACD has ever had.
- Make it impossible for people to choose not to come to Grapevine, Texas.
- Make it equally difficult to choose from among the array of amazing offerings when they do come!

As PEC co-chairs, we began the task of planning for 2010 with a comprehensive review of all forms and methods of learning at previous AACD Annual Scientific Sessions, in order to understand what creates lasting learning and gives ongoing benefit to our members and their team members. Such a diligent review would help to ensure that the 26th Annual AACD Scientific Session program content reflects our emphasis on evidence-based, scientifically sound dentistry; and that presenters have demonstrated a high level of expertise in helping people learn and then apply that knowledge.

In particular, attendees at next year's AACD Annual Scientific Session will find that 12 key concepts form the basis for the program's format.

Key Concepts

Concept #1: Headliners

Our headline speakers, Drs. John Kois, Pat Allen, Newton Fahl, and Lorenzo Vanini, will offer evidence-based programs to ensure that our members receive the most scientifically sound information. Their unique presentations will lay the foundation for a virtual smorgasbord of programming and hands-on workshops to guarantee that our members return to their practices with the latest tools in their toolboxes. Both Drs. Kois and Allen will focus on the current literature and scientific information that leads to Responsible Esthetics. As internationally acknowledged leaders in dentistry, these two clinicians will set the stage for everything that follows. Drs. Fahl and Vanini, from Brazil and Italy, respectively, are pre-eminent composite artists, and both have agreed to present general lectures as well as live demonstrations of composite mastery. This combination of theory and practical application will provide our clinicians with a full array of educational options.

Concept #2: More Breadth *and* Depth

Beyond our headline presenters, many of our other highly skilled and superb presenters will offer several programs. As a result, the program can more easily span the needs of those with more introductory interests, as well as others with an eye toward advanced learning. Fewer speakers, several of whom will be delivering more than one presentation on different topics, will ensure that our carefully selected presenters provide significant depth in an array of more narrowly defined subject areas.

Concept #3: More Connection and Greater Intimacy Within AACD's Lecture Halls and Social Events

Our venue, the Gaylord Texan Hotel and Convention Center in Grapevine, Texas, is self-contained, and the AACD will occupy nearly 100% of the sleeping, exhibit, and meeting space. For this reason, our members can be assured of easily meeting with their friends and having numerous opportunities to make new ones. Our leadership understands how important it is to help every single member feel at home and invited to participate at every level, and we will offer many opportunities for this to occur. Our New Member Breakfast, International and Affiliate Receptions, and other social events will take place on site to encourage greater mingling and afford more opportunities for connections among our membership. You will not want to miss the Welcome Reception or the Celebration of Excellence Gala, as both will be celebratory and fun.

Concept #4: Skills Day

While the 26th Annual AACD Scientific Session will officially open on Wednesday morning, April 28, with our opening General Session, you will not want to miss our Tuesday Skills Day. Members will be offered a wide array of hands-on, training-oriented skills events focused on non-clinical learning and application. A few of the areas in which specific training and skills development will be offered include developing speaking skills, writing for the *Journal of Cosmetic Dentistry,* and volunteering for the AACD.

Concept #5: Accreditation Track

As many of our members pursue Accreditation in the AACD, our Accreditation Committee and the American Board of Cosmetic Dentistry (ABCD) have established an Accreditation Track that will ensure that candidates are fully supported and trained in the clinical areas in which they must demonstrate competency. Because required courses will be offered more than once, candidates can plan their week to include all of the offerings that will complete their learning requirements.

Concept #6: Fully Vetted Workshops and Lectures

The PEC has proposed innovative standards for all speakers that will be reflected in the invitations and contracts to ensure that they understand that providing quality/relevant content over self- or corporate promotion is the standard to which they will be held. The intent is to offer guidance that will help speakers gear their presentations to our unique group. Presenters must create titles and synopses that accurately reflect the program they will deliver. Presentations must adhere strictly to time limits, and speakers must stay on topic, as well as meet the learning objectives they proposed. Speakers must use respectful and inclusive language, as well as adhere to the AACD's strict ethical standards and conflict of interest policy. They must, where appropriate, plan to engage the audience in the learning experience and provide ample time for questions and com-

ments. With the sole exception of corporate-sponsored lectures, product endorsement or promotion is not acceptable, and discussion of products and services must acknowledge that there are many worthy options in each of those areas.

Concept #7: Digital World

Get ready to visit the AACD's Digital World, where multiple manufacturers will be demonstrating a seemingly endless array of digital technologies available to dentistry today. From digital impressions to cone beam technology, attendees will have the opportunity to investigate all of these innovations in a non-sales environment. Our vendors will, of course, be available in the 26th Annual AACD Scientific Session's exhibit hall to supplement this innovative offering, but Digital World will provide a new dimension for product evaluation.

Concept #8 Complete Team Programming

The PEC understands the major commitment dentists make to bringing team members to AACD's annual scientific sessions. For this reason, they deserve to find a complete array of solid programming specifically for them. Our structure provides a full slate for dental assistants, dental hygienists, business staff, and patient coordinators in clinically oriented, as well as relevant non-clinical, topics. We even provide a Spouse Forum for non-dentist spouses who want to discuss common interests.

Concept #9 Hands-On Workshops

One of the most lauded aspects of our annual scientific sessions has been the inclusion of many hands-on clinical workshops for the single registration fee. In Texas, clinical workshops will be available for dentists, laboratory technicians, dental assistants, and dental hygienists. Other non-clinical hands-on training also will be available to ensure that attendees are provided more practical and application-oriented learning.

Concept #10 Targeted Programming

Initially you will notice several helpful changes in the *AACD Scientific Session Preliminary Guide*, where you will see programs grouped according to professional category (Dentist, Laboratory Technician, Team), learning level (foundational, intermediate, advanced), and focus (clinical, non-clinical, and sub-sets of each). We have ensured that each registrant will be quickly and easily drawn to the programming designed specifically to meet his or her needs.

Concept #11 A Few Surprises

At this point we haven't shared everything, and over the next few issues of the *Journal of Cosmetic Dentistry*, we will reveal much more. Stay tuned for information about our General Sessions, Team Treatment Event, and many more of our speakers. Plans are still underway, and you can count on each event being truly worthwhile.

Concept #12 Create a "Legacy" for AACD Attendees. How can the AACD Change the Face of Dentistry and Influence Our Peers in a Caring and Positive Way?

"Team Texas" is intentionally reaching out to our newer, as well as more experienced, members to revisit the basic components of our technology and curriculums in an evolving, comprehensive, and participatory manner. We will strengthen the entire dentist-auxiliary-laboratory technician team by offering many more valuable and stimulating programs for each participant. We have used a "new form" of math to create an environment in which to improve our members' talents and help them excel: We subtract what does not work, add what was missing, and alter what needs adjusting. Finally, "Team Texas" will multiply the opportunities to interface with your speakers and colleagues in order to make this upcoming meeting the most exceptional one you have ever attended.

We look forward to welcoming each of you to our 26th Annual Scientific Session. Your *AACD Scientific Session Preliminary Guide* will be available soon, and we urge you to register early—and to bring your entire team! This will be an event you definitely will not want to miss, and one we do not want to miss you, either.

AACD Acknowledgment

The American Academy of Cosmetic Dentistry recognizes Dr. Frank J. Milnar as an AACD Accredited Member (AAACD) and Accreditation Examiner, and Mr. Gilbert Young as an AACD Accredited Member (AAACD).

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In This Section:

Reflections of Excellence

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Give Back A Smile Patients Can Need Dentures, Too

by Richard Gangwisch, DDS
MAGD, ABGD
Lilburn, GA
www.gangwischdentalgroup.com

Introduction and Overview

"Annie" (not her real name) was referred to my office by the AACD's Give Back A Smile™ (GBAS) program. She did not have much with which to smile. On the upper, she had only a couple of worthless canines, the anterior teeth having been knocked out by an abusive boyfriend and the posteriors lost due to neglect (Fig 1). I was the third dentist she had seen to help her with her problem; she may not have needed 10 laminates, but certainly we all made at least one denture while we were in school. There is no reason that any one of us shouldn't be able to help her.

The gleam in her eye and the beautiful, ear-to-ear smile were all the payment I needed.

Annie had to be driven across town to our office, which, in Atlanta, is a very long trip both in distance and time. Looking into her sad eyes, I sensed a nice person inside (Fig 2). After she had come such a long way, how could I be the third dentist to reject her?

I do not make many dentures in my practice, either, but felt that this lady was worth going the extra mile, so I got out my denture impression trays and went to work. I enlisted the help of a couple of laboratories; after I explained the situation, both of them generously agreed to do their part of the work pro bono.

After five appointments—one for surgery and four for prosthesis construction—and a number of months (it was difficult for her to find someone to drive her the distance to our office), the day finally came. There wasn't much surgery needed. As Annie entered the room, the corners of her mouth were curling up in anticipation. I inserted the new dentures, and handed her a mirror. That was the golden moment that made all the work worthwhile. The gleam in her eye and the beautiful, ear-to-ear smile were all the payment I needed. When we had her pose for pictures, there was no need to ask her to smile—in fact, we couldn't wipe that grin off her face if we had tried.

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Figure 1: Preoperative, anterior; not much with which to work.

Figure 2: Preoperative, full face; the patient was as melancholy as she looks here.

Patient History

Annie, a 52-year-old female with a medical classification of ASA III, presented to our office for dental reconstruction necessitated by physical assault by her then-boyfriend. Her medical history included insulin-dependent diabetes, kidney and liver problems, mitral valve prolapse, hypertension, and an enlarged heart. Her former boyfriend had punched her in the mouth, breaking off most of her incisors, upper and lower. The social worker's report mentioned that Annie had to be relocated to a "safe house" and that the perpetrator had since been incarcerated.

Clinical Evaluation and Diagnosis

The patient's partially edentulous maxilla contained only canines. These were mobile and poor candidates for abutments for a removable prosthesis. The mandibular arch contained only teeth ##21-23, #27, and #28. Tooth #23 was mobile, but the other remaining teeth were solid enough and in reasonably good periodontal health to be used as abutments.

Treatment Plan

It was decided to extract the upper canines due to their unsuitability as partial denture abutments. Tooth #23 was serving no purpose either functionally or esthetically, so that was also marked for removal. For the lower arch, my recommendation was for a partial denture utilizing the remaining teeth as abutments. For the upper arch, the patient was presented with two options: An immediate denture, or a normal denture with a waiting period for healing. As the patient had been partially edentulous for a while, she opted for a denture constructed after adequate healing had taken place.

Treatment

Preparation

During our first treatment appointment, teeth #6, #11, and #23 were extracted uneventfully under local anesthesia. There was no need for any preprosthetic surgery, as her residual alveolar ridges were in good enough shape to accept dentures. A week later, the remaining mandibular teeth were prepared as partial denture abutments and an impression for the framework was taken with Reprosil vinyl polysiloxane (VPS) impression material (Dentsply Int'l.; York, PA) in a disposable stock tray. We could start this early before healing had completed because an altered cast impression was planned for later.

Final Impressions

After a month of healing time, we made final impressions of both arches. For the maxillary arch, we started with a Coe edentulous stock impression tray (GC America; Alsip, IL). These come in a variety of shapes and sizes with the hope that at least one will closely approximate the patient's edentulous maxilla. The Coe tray was relined with Reprosil, the stiffest VPS putty of which I am aware. The tray, with a plastic spacer sheet covering the unset putty, was placed in the mouth and the putty was aggressively border-molded, allowed to bench set, then knife-trimmed; and, voilà—we had an instant custom tray. A final wash impression was taken using the regular-viscosity Reprosil.

For the lower arch, the laboratory placed acrylic tray saddles on the partial framework so that an altered

Figure 3: Postoperative, smile; a tremendous improvement.

Figure 4: Postoperative, full face; the patient has a visible sparkle in her eyes.

cast impression could be taken. This impression is taken to relate the tissue-bearing surfaces more accurately to the partial framework, and to record the changes in the residual ridge due to further healing of the extraction site. After verifying the proper fit of the framework, an impression was taken of the residual alveolar ridges using Express impression material (3M ESPE; St. Paul MN). Why did I select Express versus Reprosil for that impression? Color was the only factor, not any difference in handling characteristics. Because my laboratory uses a blue-colored acrylic for the altered cast tray and Reprosil is blue, it would make it difficult to see any pressure spots. The purple color of the Express would easily contrast with any show-through of the acrylic tray, indicating a pressure spot.

Although an extra appointment with occlusal rims would have provided a more accurate fit, because Annie had to come from quite a distance, to save an appointment a preliminary bite was taken on the same day as the impression appointment. After marks were placed on Annie's nose and chin, the vertical dimension was determined by having her swallow and relax multiple times, then measuring with calipers. She was instructed to open and close her jaw until she was able to reproduce the movement with her condyles seated in a physiologically optimum position. The preliminary bite was then taken utilizing three to four sheets of baseplate wax heated to 140° in a hot water bath until very pliable. It was molded to approximate Annie's arch form, and then placed onto the maxillary arch. She was then instructed to close slowly in centric relation until the calipers measured the proper vertical dimension. Once in proper position, the wax was molded for proper lip support and border-molded to the point of underextension so that it would fit the models without distorting (this wax is used only for bite registration, not for a baseplate). Then, smile lip lines, midline, and interpupillary lines were carved into the wax to give the laboratory a good starting point. Needless to say, we did not try to test phonetics at this step. The main objective with this technique is to be close enough so that the laboratory can do a reasonably good preliminary set-up that can be fine-tuned at the try-in appointment.

TRY-IN APPOINTMENT

The laboratory got the esthetic part right the first time. The bite was only slightly off. A remount was performed, and the bite was verified in all excursions. The esthetics were verified one last time along with phonetics. Finally, the mirror was handed to Annie. I have to admit that my vision was a bit blurred from the tears welling up in my eyes. She was so happy with the set-up. She was also very disappointed that she couldn't take them home with her that day.

SEATING APPOINTMENT

Three months after we began, the big day had arrived. With all of the preliminary work that was done, the dentures were fitted with minimal adjustment. As I handed Annie the mirror, her face lit up brighter than the Las Vegas Strip (Figs 3 & 4). The entire staff dropped what they were doing and rushed in to be part of the moment. In an instant, Annie was transformed from a gloomy, depressed woman to one with a brilliant smile that radiated her inner beauty (Figs 4 & 5).

Figure 5: Happy patient with happy author.

Discussion

The patient's transformation from start to finish was amazing (Figs 2 & 4). We didn't tell her that we would be taking pictures on seating day, yet she showed up wearing makeup, a new hairdo, and nice clothes—all signs of a new self-esteem, and all because of a new smile!

I have worked at a charity clinic for a number of years, but have never felt the profound sense of accomplishment that I did with this GBAS patient. This experience was extremely rewarding. When asked if I would accept another GBAS case, my answer was an emphatic "*Yes!*" I urge all members of the Academy to join in to help the GBAS program. You'll be glad that you did.

Acknowledgments

The author thanks Eclipse Dental Laboratory (Lexington, KY) for construction of the partial denture framework, and Hammond Dental Services (Dahlonega, GA) for all of the acrylic work. Both laboratories graciously donated their labor and materials for the case discussed in this article.

AACD Acknowledgment

The American Academy of Cosmetic Dentistry gratefully recognizes Dr. Richard Gangwisch as a Give Back A Smile™ (GBAS) volunteer who has restored one GBAS survivor's smile.

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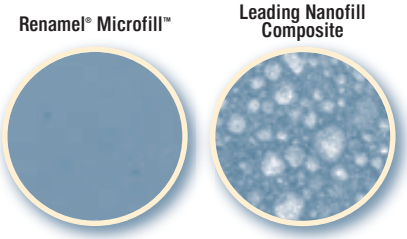

The SEM image of Renamel Microfill (left) and a leading nanofill (right), ***both at the same 1,000x surface magnification***, show Renamel Microfill attains a remarkably smooth polish.

Surface roughness of nano and microfill resin-based composites. A. Catelan, P.H. dos Santos, A.K.B. Bedran-Russo. J Dent Res 88 (spec issue B): 592, 2009. (www.dentalresearch.org)

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Students' Questions

In This Section:

Questions From Senior Dental Students

by Simona Cuevas, DDS
San Antonio, TX
simona.dds@gmail.com

Question

Can seventh-generation bonding agents meet all our modern clinical needs? Please give us an update and compare with the other bonding generations of adhesive systems.

Answer

Current bonding agents available on the market are being classified according to five generations. These are primarily characterized by the type of etching used (i.e., etch and rinse, total rinse, and self etch), as well as by the number of separate steps required for application.

The current bonding agents can be characterized by generation type (fourth, fifth, sixth—Type I, sixth—Type II, and seventh) and the clinical application. Type, components, smear layer, and availability of dual-cure activation then further separate these generations.

This means the following:

Fourth-Generation Bonding Agents:

- are an etch-and-rinse multiple bottle system
- have three (separate bottle) components (etch, primer, adhesive)
- remove the smear layer

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- contain dual-cure activators
- can be used for direct light-cured restorations
- can be used for indirect post restorations (if system has dual-cure catalysts)
- can be used for core buildups (with self-cure composites if dual-cure catalysts available)
- can be used for thin or thick ceramic veneers.

Fifth-Generation Bonding Agents:

- are an etch-and-rinse single bottle system
- have two (separate bottle) components (etch and primer/adhesive)
- remove the smear layer
- only some of them contain dual-cured activators
- can be used for indirect post restorations (if system has dual-cure catalysts)
- can be used for core buildups (with self-cure composites if dual-cure catalysts available)
- can be used for thin or thick ceramic veneers.

Sixth-Generation Type I Bonding Agents:

- are a self-etch, two-step application system
- have two (separate bottle) components (acidic primer and adhesive)
- have a modified smear layer
- only some of them contain dual-cured activators
- can be used for indirect post restorations (if system has dual-cure catalysts)
- can be used for core buildups
- can be used for thin or thick ceramic veneers (after etching or pumicing of the enamel).

Sixth-Generation Type II Bonding Agents:

- are a self-etch, one-step application system
- have single bottle components (acidic primer/adhesive)
- have a modified smear layer
- only some of them contain dual-cured activators
- can be used for indirect post restorations (if system has dual-cure catalysts)
- can be used for core buildups (with self-cure composites if dual-cure catalysts available)
- can be used for thin ceramic veneers (after etching or pumicing of the enamel) or thick ones (after etching or pumicing of the enamel or with dual-cured catalyst).

Seventh-generation bonding agents use the smear layer as a bonding substrate. The acidic primer demineralizes the smear layer and the top layer of the underlying dentin surface. The acidic primer also infiltrates the exposed collagen along with the hydrophilic monomers, which then co-polymerize. Because the etched surface is not rinsed, the demineralized smear layer is incorporated into the hybrid layer. The hybrid layer ranges in thickness from 0.5 µm to 5 µm. The acidic primer and adhesive monomers also infiltrate collagen fibers as the primer decalcifies the inorganic component in dentin to the same depth, which should minimize voids and potentially leakage and postoperative sensitivity.

Bond strengths of seventh-generation bonding agents were measured in several studies.[1] They revealed bond strengths to enamel ranging from 19 to 32 MPA and to dentin from 18 to 28 MPA. These bond strengths are very comparable to other currently used generations of bonding agents.

The ideal recommended uses for seventh-generation bonding agents are as follows:

Light-cured seventh-generation bonding agents are primarily recommended for bonding of light-cured direct composite resins (because of their acidic monomers they are not recommended for use with self-cure materials), due to the fact that the acidity can deactivate the catalysts in self-cure materials and therefore inhibit polymerization.

The seventh-generation bonding agents can be used with dual-cure materials only if they themselves are also dual-cured bonding agents.

Wetness sensitivity with seventh-generation bonding agents is not very critical because they have water as a solvent (rather than ethanol or acetone).

Should heavy contamination occur, the recommendation is to rinse the affected area with water and to reapply the bonding agents.

It is important to also remember that on unground enamel the recommendation stands to use phosphoric acid before the application of the bonding agents, or even just polish the affected enamel with pumice.

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Accreditation Essentials

In This Section:

Introduction to Accreditation Essentials

by Edward Lowe, DMD
AACD Accredited Member (AAACD)
Vancouver, BC, Canada
www.mysmilemakeover.com

"Success is a journey, not a destination. The doing is often more important than the outcome."—Arthur Ashe

The path to earning Accreditation in the AACD is not without detours and roadblocks. This section of the *Journal of Cosmetic Dentistry* (*JCD*) not only celebrates successful cases; it also enables us to discover the journeys of our peers who chose not only to acquire knowledge, but also to take action and use it to enhance their skills and enrich their patients' lives.

I recall attending a two-hour lecture one evening, during which a colleague spoke about his experiences in cosmetic dentistry. All of the dentistry was performed at a fairly high level. The majority of his clinical presentation consisted of several intraoral preoperative and postoperative photographs, along with glamour headshots and a story about the patient in each case. If one were to consider only the lecturer's speaking style, stage presence, entertainment value, and polish, the presentation was flawless.

At the conclusion of the seminar, I spoke with several of the attendees, who raved about the quality of the dentistry. When I inquired about what they got out of the program, their reactions included the following statements: *"I didn't learn much"*; *"He talked about, but didn't reveal, his techniques"*; *"He never showed his mistakes"*; *"I wish he shared his diagnostic thought processes"*; and, *"I would have loved to see a step-by-step of the procedures."* Nevertheless, the majority of the audience thought the speaker was hilarious!

I had two epiphanies that evening. First, it is possible to be a captivating and entertaining speaker simply by developing a keen sense of comedic timing and a talent for telling great stories. Second, dentists are naturally curious about how things are accomplished. We yearn to see *how* the successes are achieved in order to give us something to aspire to and be passionate about. We want to see how failures occur so as to learn from them and use them as springboards toward greater success. In fact, I decided that if I ever presented, I would show more failures than successes because that is how we learn.

"Accreditation Essentials" is about learning why a well-selected case looks great, and understanding the thought processes of the clinician presenting the dentistry. This is meant to enhance our own skills and to enrich our repertoire of diagnostic and treatment decisions. In some instances in which a clinician presents a more demanding case, we are guided through the detours and roadblocks along the journey and how they were overcome.

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It is not easy to open our "closet doors" and have our colleagues peek in and look at our collection of "skeletons." We are always appreciative of the people in the AACD Accreditation process who are willing to take the time to share their voyage with us in the *JCD*. It is just one of the reasons why this peer-reviewed journal is a first-class resource for cosmetic dentistry.

In this issue, we share the experiences and successful AACD Accreditation cases of two talented dentists. Dr. Nick Addario features his Case Type V, Six or More Direct Resin Veneers; and Dr. Steve Gorman showcases his Case Type II, One or Two Indirect Restorations.

Successful completion of Case Type V tests the clinician's capacity to handle resin, as well as all principles of smile design, function, and dental anatomy. It is a skill that every accomplished cosmetic dentist should possess. Dr. Addario takes a challenging case selection and demonstrates his ability to enhance the patient's appearance with a judicious use of resin.

The challenge with Case Type II is that it assesses the clinician's ability to match the surrounding natural dentition. It involves one or two indirect restorations in the maxillary anterior region treating incisors; the adjacent teeth cannot have existing indirect restorations. Smile design is of lesser weight in these cases. However, it is essential for the clinician to deliver an esthetic result that fits with the pre-existing natural condition. Dr. Gorman presents a demanding case of two discolored central incisors that were enhanced with porcelain veneers to match the adjacent natural lateral incisors and return his patient's smile to a natural state.

Dr. Rebecca Pitts shares the examiners' perspective on each case with us. The examiners' feedback allows us to admire what key elements contributed to a successful case and to learn from the faults incurred that invariably can be present. This willingness to share and grow is what makes this section of the *Journal of Cosmetic Dentistry* an invaluable resource for constant and never-ending improvement.

Congratulations to Dr. Addario and Dr. Gorman on their success in the AACD Accreditation process. We are grateful for the privilege of peering into your closets!

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Accreditation Clinical Case Report, Case Type V: Six or More Direct Resin Veneers

by Nick A. Addario, DDS
Chula Vista, CA
www.sunbowdentistry.com

Introduction

Treatment planning in cosmetic dentistry is a process that requires the dentist to visualize the final outcome with treatment options that meet the specific needs of the patient. A successful outcome is dependent not only on the cosmetic result, but also on weighing the costs to achieve the desired result. This philosophy is especially relevant when treating young patients.

Direct composite veneers can be some of the most challenging restorations that can be offered to a patient.

The case described here is that of a young girl who desperately wanted to improve her smile. During her treatment planning, we wanted to achieve a natural-looking smile with conservative treatment. Preservation of tooth structure was paramount because, no matter which type of restorative material we chose, it would have to be redone more than once in her lifetime. Direct composite veneers can be some of the most challenging restorations that can be offered to a patient. Young patients can be excellent candidates for direct bonding, especially if preservation of tooth structure is a high priority. In this case, the use of composite resin veneers in conjunction with orthodontic treatment proved to be a very conservative cosmetic option that yielded great patient satisfaction (Fig 1).

Patient History

The patient was a 15-year-old female in excellent physical health. She had had several restorations placed due to a relatively high caries rate. Tooth #29 was congenitally missing (second premolars and lateral incisors are the most commonly missing permanent tooth).[1] Tooth T was retained. Her oral hygiene was fair. Her chief complaint was that her teeth appeared stained and discolored (Figs 2-4).

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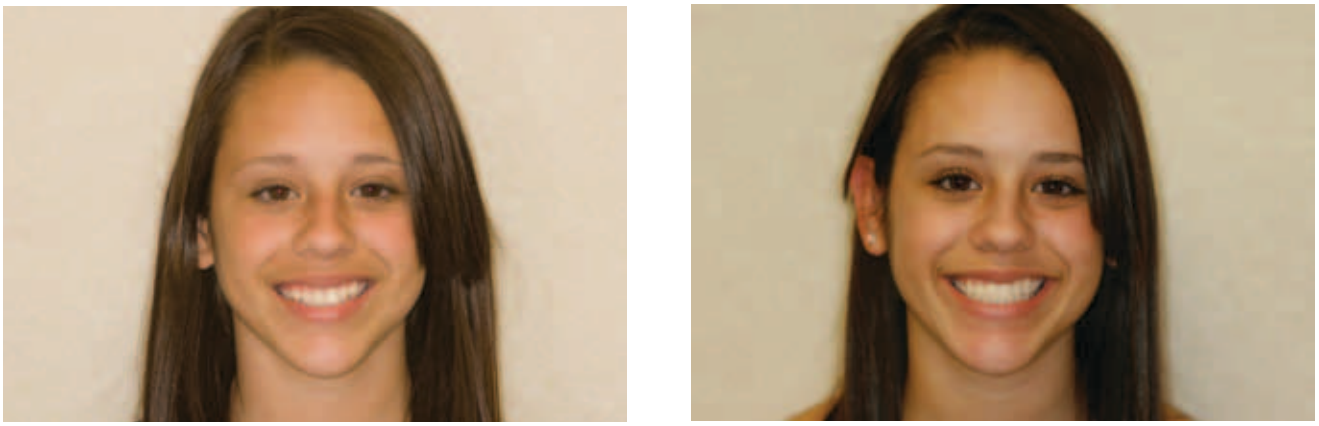

Figure 1: Preoperative; significant cant is visible in the patient's smile. Postoperative; mild improvement in the appearance of the cant, although there is more gingival display on the right side.

Figure 2: Preoperative; smile is dark and discolored. Postoperative; teeth are brighter with natural tooth color characteristics.

Diagnosis

A comprehensive examination was done and a full-mouth series of radiographs was taken. She had no dental decay, but generalized gingivitis was evident. Her temporomandibular joint was asymptomatic, with no audible sounds and a normal range of motion. She had a Class I occlusion and mild crowding of her maxillary and mandibular anterior teeth.

Her tooth discoloration was caused by *amelogenesis imperfecta*, a relatively rare genetic disorder characterized by abnormal enamel formation. The term "amelogenesis imperfecta" is reserved for developmental alterations in the structure of enamel that are not associated with a systemic disorder.[2]

Esthetic Considerations

Canted Maxilla

The patient had a slight cant to her maxilla. There was also supraeruption of the premolars on the right side because of the lower occlusal plane in the area of the retained deciduous tooth. Since there was gingival reveal when she smiled, these factors could not be resolved with restorative dentistry alone. An interdisciplinary approach would be prudent, considering such options as implant placement to replace the deciduous tooth and orthodontics to improve the plane of occlusion.

Gingival Height and Tooth Length Discrepancies

There were discrepancies with tooth length and gingival height. The patient's periodontal pockets ranged from 2 mm to 4 mm throughout the anterior segment. Crown lengthening with osseous recontouring was an option to balance gingival display. Since the patient

Figure 3: Preoperative and postoperative 1:2 right smile.

Figure 4: Preoperative and postoperative 1:2 left smile.

Figure 5: Preoperative; note the gingival inflammation and the uneven gingival contours. Postperative; the gingival health and appearance are improved. Although the tooth length discrepancies are better, #9 is still longer than #8.

Figure 6: Preoperative and postoperative 1:2 right retracted view.

Figure 7: Preoperative and postoperative 1:2 left retracted view.

was only 15 and still growing, there was a possibility of future changes to her gingival display and smile. We also had to take into account that this would not be an option should we alter her plane of occlusion as mentioned previously. Due to her age and financial constraints, we felt that this could be an option when she is older.

Since there was some periodontal tissue that could be removed without encroaching on the biologic width,[3] plans were made to gain some balance with conservatively contouring the soft tissue and altering the tooth length with restorative material (Figs 5-7).

Functional Considerations

The patient had a Class I occlusion and mild crowding of her maxillary and mandibular anterior teeth. She presented with bilateral canine guidance, although it was short-lived in excursions as her maxillary canines were rotated significantly (Fig 8).

Treatment Planning

The treatment-planning decisions emphasized conserving tooth structure and minimizing financial costs. Since the patient's teeth seemed sufficiently mineralized, I thought that she would be an excellent direct bonding case; I could minimize the amount of tooth structure removed and still mask the color discrepancies within the tooth structure. Additional layers would create internal effects and, in the end, an improved texture and finish.

Prior to restorative treatment, I believed that orthodontic treatment would be essential to achieve our goals. First, it would put the teeth in proper arch form, allowing for conservative preparation designs and

Figure 8: Preoperative and postoperative occlusal view. Note that the canines' rotation is improved in the arch form.

Figure 9: The hypocalcified enamel was completely removed from #9.

Figure 10: Bulk composite on #8 and #9. Note the magnitude of superficial hypocalcification on the other maxillary teeth, as they are dehydrated.

eliminating the need to do aggressive tooth reduction, especially on the mesial of the canines. Second, a corrected anterior alignment would improve her canine guidance,[4] which would protect her new restorations in excursive movements.

After discussing our treatment options with the patient and her parents, we decided to do limited orthodontic treatment, at-home tray whitening, conservative tissue sculpting, and direct composite veneers on ##4-14.

Treatment

Pre-restorative Treatment

The patient required a prophylaxis and extensive oral hygiene education and reinforcement to improve the status of her gingivae prior to restorative treatment.

Treatment was initiated by taking the 12 AACD required views in digital format with a Canon 30D camera (Lake Success, NY). We then proceeded to take the radiographs and polyvinyl siloxane impressions necessary for the Invisalign (Align Techology; Santa Clara, CA) treatment. Our prescription included management of her crowding and rotated canines. The objective was to round the arches in the anterior segments and improve her canine guidance. The patient was able to finish orthodontics after 10 aligners were placed on both arches. She wore each aligner for two weeks, for a total of 20 weeks. The patient placed 16% carbamide peroxide whitening gel (Discus Dental; Culver City, CA) in the first set of aligners for two hours each day.

After orthodontic treatment was completed, we made new impressions with a facebow transfer (Axioquick; Munich, Germany). A

Figure 11: View before final contouring and polishing.

Figure 12: Preoperative; the degrees of hypocalcification, discoloration, and uneven texture can be appreciated. Postoperative; the overall appearance of the teeth is improved. The internal effects and translucency are apparent.

diagnostic wax-up was made from mounted study models. I fabricated a putty index from the palatal, which served as an incisal evaluation guide and a lingual matrix. A facial putty matrix was also made to evaluate facial reduction.

Restorative Treatment

Local anesthesia began with 2 carpules containing 1.8mL of 2% lidocaine with 1/100,000 epinephrine via buccal infiltration to anesthetize the anterior teeth. A gingivectomy was performed with an Opus 5 diode laser (Lumenis; Santa Clara, CA) at 1.5 watts continuous wave in order to balance the gingival form without invading biologic width.

Restoration of her teeth was done in segments beginning with #8 and #9. The hypocalcified layers of enamel were removed until I reached normal-looking hard tissue using a football-shaped diamond (Brasseler USA; Savannah, GA). I removed a thin layer off the facial of the teeth with a flame-shaped diamond (Brasseler). The facial putty matrix was utilized to confirm that there was enough space to layer composite. My goal was to do as little preparation as necessary and stay in enamel (Fig 9). The only places that were more aggressively prepared were the areas that were milky white and dark orange, because these hypocalcified areas must be bonded.[5] Size 0 retraction cord (Dux Dental; Oxnard, CA) was placed.

The teeth were etched with 37% phosphoric acid (Pulpdent; Watertown, MA) for 30 seconds, then rinsed and dried with a warm-air tooth dryer. Single Bond (3M ESPE; St. Paul, MN) was then added and light-cured. A lingual putty matrix was used to help mold the lingual form with Filtek Supreme white enamel (WE) (3M ESPE). A2B was

Figures 13a-13c: During the extended treatment time, #11 rotated considerably.

Figure 13a: Pre-orthodontic treatment.

Figure 13b: Post-orthodontic treatment, showing a proper embrasure after composite was placed and contoured.

Figure 13c: Rotation relapse and the cosmetic impact this had on the final outcome.

used to blend the deeply prepared areas with the rest of the prepared tooth structure to create a homogenous and even structure to build my layers on. On #8 and #9, I placed Filtek Supreme extra white body (XWB) on the prepared surfaces. This was cut back in between mamelons and WE was placed in this space (Fig 10). My intention was to create internal translucency by using a lower-value enamel composite shade. The entire facial surface was then covered with Filtek Supreme clear translucent (CT) nanofill. The laterals were then prepared, and I used similar shading as I did on the centrals. On the canines, after I formed the lingual with WE, I placed a dentin shade, Filtek Supreme A2D, in the areas that were lengthened to create opacity and block out any transition from tooth to composite.[6] This was coated with WB on the incisal two-thirds and Filtek Supreme B1B on the cervical. On the premolars, I used B1 on the cervical one-third and WB on the cervical two-thirds (Fig 11). All teeth had a final layer of CT so the final polish would result in a high luster (Fig 12).

I shaped the teeth with red stripe finishing diamond burs (Brasseler) and Flexidiscs (Cosmedent; Chicago, IL). The interproximals were refined with scalpel blades (Miltex; Bethpage, NY) and interproximal finishing strips (GC America; Alsip, IL). They were polished with fine pumice, green polishing cups (Ivoclar Vivadent; Amherst, NY), and Flexibuff discs (Cosmedent) with Enamelize polishing past (Cosmedent).[6]

Careful evaluation of the case was performed with photographs that revealed texture discrepancies and a couple of bubbles. These were remedied by removing the defects with a small diamond, beveling the defect, air-abrading the area, etching,

applying a thin layer of unfilled resin, placing a small amount of resin, curing, then finishing and polishing the area.[7]

A nightguard was fabricated and the patient was instructed to wear it every night to act as a retainer for the upper teeth and maximize the longevity of her restorations.

A Lesson Learned

This case took several visits over a period of weeks. When feasible, Essix (Dentsply Raintree Essix; Sarasota, FL) retainers were made in between visits. There were times when the patient did not have a retainer to wear and times when she had the retainer, but did not wear it. This caused some relapse in rotation of her canines. Instead of rotating the canines back into the desired positions, they were simply recontoured. This led to show-through of tooth structure, especially on #11, where the incisal lingual is visible (Figs 13a-13c).

Conclusion

A dark smile from amelogenesis imperfecta can challenge a teenager's self esteem. This was a young patient who was embarrassed to show her teeth and now loves to smile. Her mother recently told me she now really "hams it up" at every photo opportunity. This conservative approach was a challenging exercise in direct bonding. I am grateful to have had the opportunity to learn from this patient through the Accreditation process.

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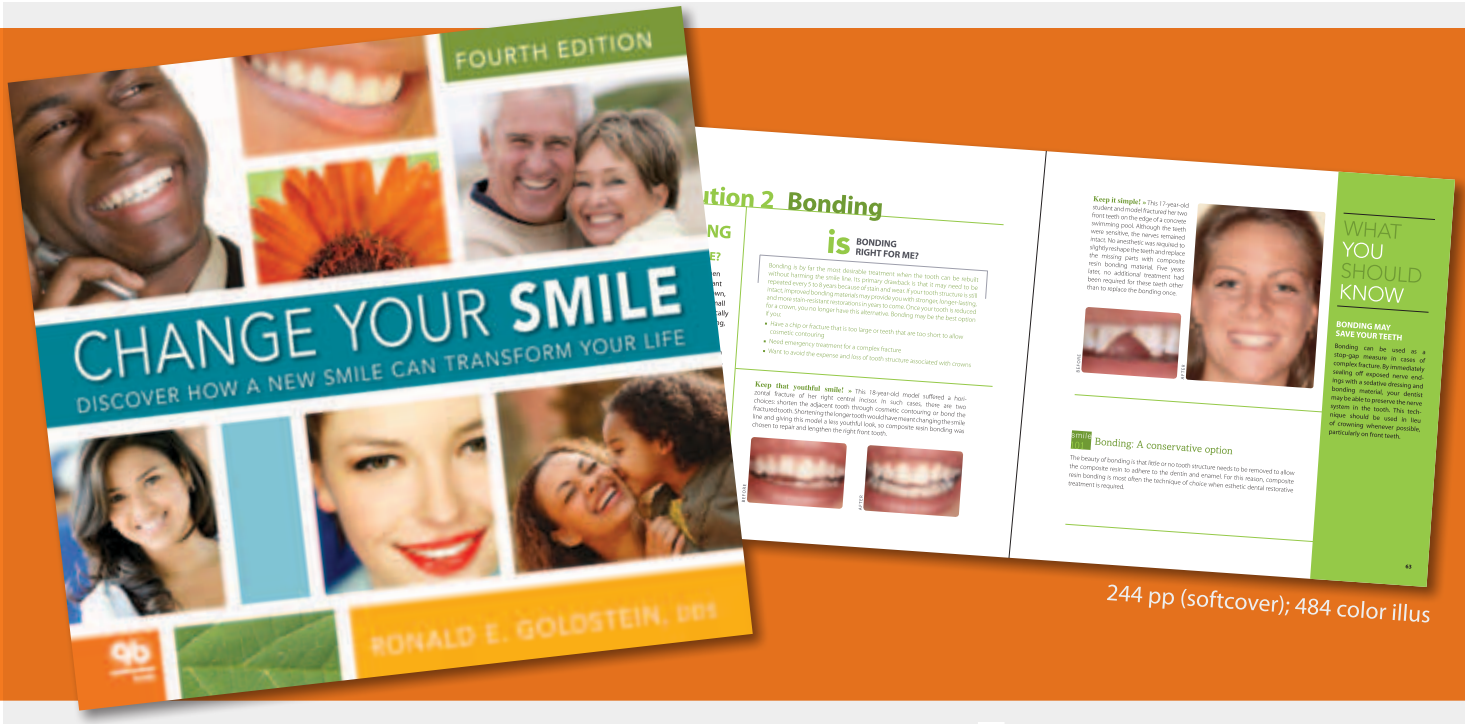

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Examiners' Perspective for Dr. Nick A. Addario

by Rebecca K. Pitts, DMD
AACD Accredited Fellow Member (FAACD)
Lake Mary, FL
www.drrebeccapitts.com

Accreditation Case Type V involves treatment of six or more maxillary anterior teeth with direct resin veneers. To succeed, the member in the process must possess the ability to create excellence in smile design, dental morphology, and usage of shade and effects without the assistance of a laboratory technician or the luxury of an extraoral working environment. Therefore, this case type is considered one of the most difficult of the Accreditation clinical case requirements. It is highly recommended that the members in the process not add burden to themselves or reduce their chances of passing by selecting cases that are too complicated or cases that will inevitably finish with a compromised outcome despite clinical excellence.

Dr. Addario was kind enough to allow us the privilege of illustrating this point with his case. Dr. Addario's exceptional proficiency in handling composite resin was clearly demonstrated. So why did the case pass marginally? The chief concerns expressed on all examiners' scorecards were the height asymmetry of the contralateral gingivae/teeth and the show-through of the discolored tooth structure on the canines.

Smile design is of paramount importance in Case Type V and symmetry is one of its critical elements. Selecting a case with preoperative asymmetry does not adversely affect the scores as long as the flaw does not exist postoperatively. Bear in mind that examiners are obligated to judge the esthetics of a case based on the final outcome compared to the ideal, rather than to how the case started. Therefore, whenever it is foreseeable that such significant compromises will not be rectified, as in this case, it is best to select a different patient. Otherwise, the member in the process is essentially starting with a minus score. A point deduction system is used in Accreditation clinical case evaluation, where a score of minus eight or more constitutes failure. Beginning a case with a negative score imposes

a major disadvantage to the member in the process.

Severe discoloration of the teeth added an additional challenge to this case. Dr. Addario managed to mask the defects superbly in most areas. However, all examiners observed show-through of the discolored tooth structure at the cervical of the canines.

Penalties from these two flaws, which cost Dr. Addario several points, could have been avoided by opting for another patient during the case selection process. To his credit, however, he performed very well in other areas, thereby minimizing further deductions and passing the case. Dr. Addario is to be congratulated on his impressive achievement.

The AACD has established a mentoring program comprising examiners who volunteer their time to help members in the process through different steps in the Accreditation process, including case selection. To find a mentor, visit www.aacd.com.

AACD Acknowledgment

The American Academy of Cosmetic Dentistry recognizes Dr. Rebecca K. Pitts as an AACD Accredited Fellow Member (FAACD) and Accreditation Examiner.

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Accreditation Clinical Case Report, Case Type II: One or Two Indirect Restorations

by Steven A. Gorman, DDS
AACD Accredited Member (AAACD)
North Oaks, MN
www.drstevegorman.com

Introduction

Porcelain laminate veneers offer some of the most exciting restorative and esthetic alternatives in dentistry today. With minimal tooth reduction, current adhesive materials allow for remarkable changes in appearance while using an extremely conservative approach.

Patient perceptions, expectations, general health, periodontal health, occlusion, condition of remaining dentition, and tooth and gingival alignments are some of the factors influencing treatment planning in these cases. Others are tooth shapes, colors, lengths, and relative sizes.

With minimal tooth reduction, current adhesive materials allow for remarkable changes in appearance while using an extremely conservative approach.

Patient History

The patient was a 49-year-old male in excellent health, with no significant medical history. He stated that he had not sought professional care for several years and he desired to get his mouth and teeth back in shape. He was also interested in improving smile esthetics. The patient reported having lost a lower left first molar due to decay, and he wanted to replace it. He also was aware of dentistry's more contemporary esthetic restorative materials and wanted to have all of his past metal-based dentistry removed and replaced with esthetic restorations. Teeth #8 and #9 had been injured two years earlier in a boxing match and they had darkened over the previous 18 months (Fig 1). There were no other symptoms reported.

Examination revealed several defective amalgam restorations and a fractured and decayed #18. In the area of the lower left first molar, the edentulous area showed significant bone loss. Tooth #4 had been treated endodontically

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Figure 1: Preoperative portrait.

and was held together with a large amalgam buildup. Periodontally, the patient presented with a Type II condition (American Dental Association [ADA])[1] characterized by generalized gingivitis and posterior pocket depths measuring 3 mm to 4 mm with bleeding. He had an Angle Class I relationship with proper anterior guidance both protrusively and laterally. The lower incisors were slightly crowded, giving them uneven heights incisally. There were wear facets in the upper and lower lateral incisors that occurred in the lateral protrusive positions. The discoloration reported by the patient in #8 and #9 was apparent. Radiographs showed periapical pathology radiolucency on #9.

The patient had several cosmetic dental concerns:

- There was a small "black triangle" at the gingival embrasure between #8 and #9.
- Teeth #8 and #9 were dark, especially in the gingival one-half.
- Tooth #4 appeared dark.
- The lower incisors were "uneven."
- The lower canines were too pointed.

Other observations were as follows:

- The patient had an attractive smile.
- He had very bell-shaped central incisors.
- There were diastemata present between #5 and #6, #6 and #7, and #10 and #11.
- The buccal corridors filled the smile; however, the premolar areas revealed short teeth and a "gummy" appearance.

Clinical Findings

Clinical findings were as follows:

- There were wear facets on the lateral incisors due to function in lateral protrusive movements.
- There was periapical pathology at #9 and nonvital pulps in both #8 and #9, as confirmed by an endodontist.
- There was ADA Type II periodontal disease.
- Tooth #18 was decayed and had a crown fracture.
- Tooth #19 was missing.
- Several posterior amalgam restorations were in disrepair but did not need immediate replacement.
- The black triangle at the gingival embrasure #8 and #9 was due to the bell-crown shape of these teeth.
- The dark nature of #8 and #9 was most probably due to the trauma they had experienced and blood product leaching into the teeth.

If the goal in this case had been to build ideal esthetics and restorations in the entire upper anterior segment, the treatment plan would have required the restoration of 10 teeth. However, the patient informed me early on that he was not concerned about the diastemata since they were not apparent from a frontal view, and he had no interest in changing the tissue heights in the bicuspid areas or in making those teeth larger. He also had no interest in a cosmetic restoration of his crowded lower incisors. His main concerns were the dark #8 and #9, the black triangle, and the uneven

Figure 2: Natural die shades for laboratory communication; approved provisionals.

Figure 3: Preoperative and postoperative smile.

lower incisors. The treatment plan was based upon health, function, esthetics, and the patient's desires.

Treatment Plan

The treatment plan comprised the following steps:

1. Endodontic therapy on teeth #8 and #9, performed by an endodontist.
2. Interceptive periodontal therapy utilizing ultrasonics, diode lasers, and reevaluation.
3. Cosmetic recontouring and polishing #7, #10, ##22-27.
4. Internal bleaching, access closure, and porcelain veneers #8, #9.
5. Posterior dentistry at a later date to replace failing dentistry and to replace tooth #19 with bone grafting, an implant, and a crown.

We initially were concerned with the amount of "step" in length between the central and lateral incisors, but when the patient and I viewed an overlay mock-up during treatment planning we felt the canine size, the expanse of the smile, and amount of tooth display made our proposed contours and length look natural.[2]

Treatment

Endodontic and Periodontal

The endodontic and periodontal procedures were carried out with excellent results. Teeth #7, #10, and ##22-27 were recontoured to provide improved esthetics, remove the remnants of wear from #7 and #10, and maintain proper anterior guidance. We were now ready to treat #8 and #9. After internal bleaching, the endodontic access closures were

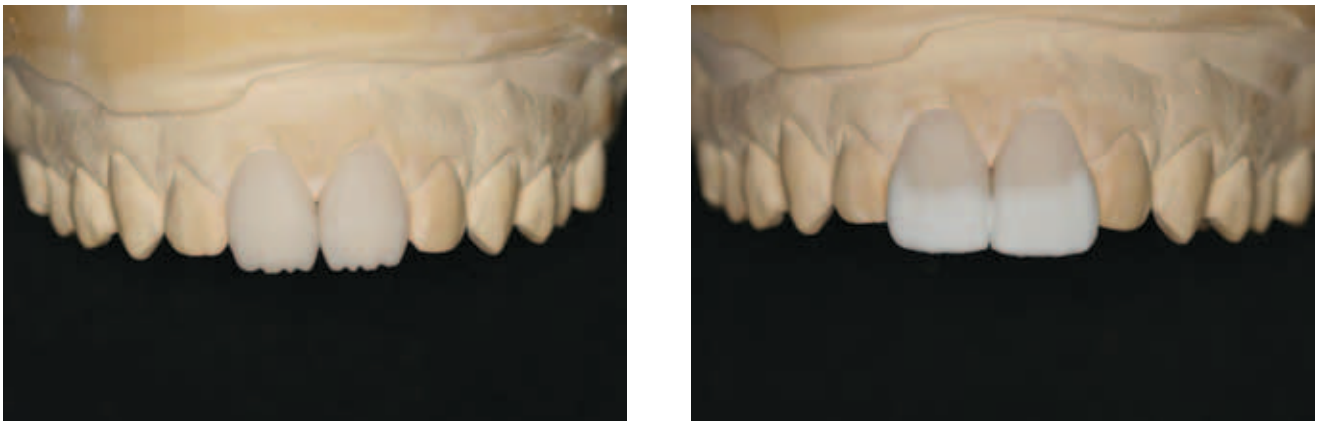

Figure 4: Initial cutback of pressed OM2 ingot; initial stacking of porcelain powder to create translucency.

Figure 5: Preoperative and postoperative 1:2 retracted view.

achieved with resin and we proceeded to the porcelain veneers.

Preparation

Prior to the preparation appointment, a diagnostic wax-up was done on models mounted in a SAM 3 articulator (Great Lakes Orthodontics; Tonawanda, NY) with facebow in centric relation (CR). A Sil-Tech (Ivoclar Vivadent; Amherst, NY) putty index was made of this wax-up and a clear stent preparation guide was created to facilitate conservative preparations.

Shade mapping was done prior to preparation and documented with photographs. The patient had also made a trip to the laboratory to verify shades and characterization. Anesthetic was administered using 2% lidocaine with 1/100,000 epinephrine. The teeth were initially prepared with depth cuts in three planes: Gingival one-third, middle one-third, and incisal one-third. A round-end diamond (Brasseler USA; Savannah, GA) was used to reduce remaining tooth structure to these depths, again holding the bur in three distinct planes of reduction. Uniform reduction was carried out and distinct chamfer marginal finish lines were carried right to the free gingival margin. Interproximal finish lines in the contact areas were carried to the mesiolingual and distolingual areas to aid in correcting width. The reduction stent was used with a periodontal probe to ensure uniform reduction as dictated by the diagnostic wax-up. Shades of the prepared teeth were taken with an Ivoclar Stumpf guide and documented with photographs. These shades were equivalent to the Ivoclar IPS natural die shade ND-6 in

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Figure 6: Preoperative and postoperative 1:1 retracted view.

the gingival one-half and ND-7 in the incisal one-half (Fig 2).

Provisional Fabrication

Fine finishing strips (Cosmedent; Chicago, IL) were used interproximally to slightly open the contacts to allow distinct visualization and finishing by the dental laboratory.[3] The teeth were rinsed, dried, and smoothed with fine finishing diamonds (Brasseler). After further rinsing and drying, an impression was taken with a combination of light-bodied polyvinyl siloxane (Aquasil Ultra, Dentsply Caulk; Milford, DE) syringed over the teeth and a heavier-bodied material in a stock tray. The impression was removed, inspected and set on the bench. A facebow record, CR bite, and stick bite were taken and the stick bite photographed for the laboratory.[4] Provisionals were fabricated with a spot-etch technique, etching the midfacial of each preparation with a small dot of 35% phosphoric acid (Ultradent; South Jordan, UT).[5]

A putty matrix of the wax-up was used to make a Luxatemp B-1 shade provisional (Zenith/DMG; Englewood, NJ).[6] After trimming and polishing, the provisional was bonded for 60 seconds on each tooth. Occlusion was checked and adjusted in centric, protrusive, and lateral excursive movements. The patient was given postoperative instructions and asked to return to the office in three days. At that time, photographs and an impression were taken of the approved provisionals for laboratory usage. Vita (Vident; Brea, CA) shades 1M2 and 1M1 with moderate translucency would serve as our primary color guide (Fig 3).

Laboratory Communication and Fabrication

The laboratory prescription was very detailed in describing the porcelain veneer restorations. The technician and I prescribed Vita pressed porcelain veneers cut back and characterized with Vita layering porcelain as the restorative material. Our experience with these materials allows us to provide ultimate control in color mapping, characterization, and translucency. This is an excellent choice for pressed porcelain because of its ability to cover the dark prepared dentin in these teeth. The OM2 ingot was used to reach 1M1 as a base final shade, with the layering porcelain adding a little more opacity at the gingival and the rest of the color character to the case (Fig 4). Included with the prescription were preoperative photographs, the impression, opposing impression, shade photographs, bite registrations, facebow record, photographs of dentin shades, photographs of the approved provisionals, and an impression of the provisionals. Our technician also had his own shade verification on record.

Insertion and Finishing

The veneers were inspected on working and soft tissue solid models for integrity of margins, contacts, and passive fits. An incisal putty guide was fabricated from the provisionals and checked against the incisals of the finished restorations to ensure adherence to our specifications. All aspects appeared acceptable.

The patient was given anesthetic and the provisionals were removed. The spot-etched areas were carefully trimmed back and cleaned to ensure that no bonding agent remained on the prepared surface. This allows proper seating of the veneers and

Figure 7: Postoperative full-face view.

etching of the enamel in the area. The prepared teeth were pumiced, rinsed thoroughly, and dried. The restorations were tried in, first individually to ensure fit and marginal integrity, and together to observe contacts and relative contour in the mouth. The patient was extremely happy with the color, shape, characterization, and translucency of the restorations. A clear try-in gel (Insure; Cosmedent) was placed in the veneers for further evaluation. The value of #9 appeared slightly lower and several try-in pastes were tested to find improvement. When #9 was tried in with Insure clear paste and #8 with Insure YR light try-in paste, I was satisfied. The color was very pleasing and the patient was allowed to view the restorations while sitting in the chair, standing upright in front of a wall mirror, and at a window with natural light. He was happy with all views (Fig 5).

The veneers were carefully cleaned with cotton pellets and water, dried, and decontaminated with Ultradent phosphoric acid, rinsed, dried, and silanated. A thin layer of unfilled OptiBond light-cure adhesive (Kerr; Orange, CA) was coated over the silanated surface, air-thinned, and covered to protect from polymerization from ambient light.[7] The prepared teeth were isolated with a rubber dam, scrubbed with Consepsis, rinsed, and dried. A 35% phosphoric acid gel was applied to the teeth for 12 seconds.[2] The veneers were placed simultaneously to control relative position and midline.[2] The teeth were rinsed and dried and coated with Gluma desensitizer (Heraeus Kulzer; Armonk, NY) for re-wetting of the dentin. The teeth were then saturated with several coats of OptiBond dentin primer. Following the manufacturer's recommendation, after 20 seconds the excess was gently air-thinned to evaporate the solvent with a light, warm moisture-free air spray. The teeth were then coated with a thin layer of OptiBond unfilled resin. The clear shade of Insure luting resin was chosen as the luting agent for #9 and YR Light for #8, and placed into the veneers.

The veneers were placed on the teeth with light, even pressure until fully seated and the excess luting resin removed with Cosmedent brushes, Hu-Friedy explorer (Chicago, IL), and Ultradent resin applicator. Initial curing was a spot-tack to create stability for further resin cleanup before full curing.[2] The remaining resin was removed with brushes, explorer, and floss. The margins were covered with DeOx (Ultradent) to prevent an oxygen-inhibited layer.[7] Each veneer was cured for 90 seconds from all angles. Further excess cement was removed with a #12 Bard-Parker interproximal carver (Becton Dickinson; Franklin Lakes, NJ) and Cosmedent fine finishing strips. The lingual margins were blended and refined with Brasseler fine finishing diamonds. The proximal areas were refined with fine finishing strips, both metal and plastic. Occlusion was evaluated and adjusted in centric, protrusive, and lateral excursive movements.[8] All surfaces were smoothed and polished with Cosmedent rubber porcelain polishing points and finished with Ultradent porcelain polishing paste. The patient was seen one week later for a postoperative appointment to refine occlusion, esthetics, and comfort. All appeared satisfactory (Fig 6).

Summary and Conclusion

This case is a good example of relatively conservative treatment that can make a big difference for the patient. We as dentists often look at a case and envision doing

more dental treatment to attain optimal esthetics. Often, however, if we listen to the patient and what really is important to them we can see a more subtle solution that creates an excellent improvement. This may satisfy the patient and still leave open the possibility of more improvement later (Fig 7).

Acknowledgment

The author acknowledges the excellent ceramic artistry of laboratory technician Edgar Jimenez, AACD Accredited Member (AAACD).

AACD Acknowledgment

The AACD recognizes Dr. Gorman as an AACD Accredited Member (AAACD).

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Examiners' Perspective for Dr. Steven A. Gorman

by Rebecca K. Pitts, DMD
AACD Accredited Fellow Member (FAACD)
Lake Mary, FL
www.drrebeccapitts.com

Accreditation Clinical Case Type II is an assessment of the ability to match one or two indirect restorations of the maxillary incisors to the natural dentition.

In this case, two discolored central incisors were treated. Preoperatively, these two teeth were attractive except for the discoloration and the slight tapering at the cervical, which contributed to development of the dark triangle. One of the most conservative treatment options would be to bleach the teeth, then add fullness to the cervical contour with direct resin application to eliminate the unsightly space. However, when whitening yields limited results, as in this case, further treatment is necessary to obtain the match to the natural teeth. Dr. Gorman chose porcelain veneers to achieve this objective.

Accurate communication and fine collaboration between the dentist and the ceramist are vital to the success of Case Type II; this case was no exception. In fact, additional skills and artistry were demanded due to the need to mask the underlying discoloration. Dr. Gorman and his ceramist conquered such challenges and presented us with an outstanding result.

Minor faults observed by the examiners included the facial contour, which was somewhat convex and lacked line angle and lobe development. The margins were visible in several areas. The examiners also found the opacity/value to be slightly higher than the natural teeth. Once again, these few imperfections were considered minor. No major faults were noted.

Accreditation Examiners passed this case unanimously. Congratulations to Dr. Gorman and his ceramist on this accomplishment.

The AACD has established a mentoring program comprising examiners who volunteer their time to help members in the process through different steps in the Accreditation process, including case selection. To find a mentor, visit www.aacd.com.

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Clinical Science and Art

In This Section:

by Jason S. Olitsky, DMD
Ponte Vedra Beach, FL
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Clinical Cover Story

Introduction

A successful case begins with the end in mind.[1] The treatment is started only after there is a clear visualization of the end result. In the case discussed here, the patient was evaluated based on three goals, which enabled us to visualize a stunning new smile for Whitney Thompson, a future winner of "America's Next Top Model."

A successful case begins with the end in mind.

Patient History

The patient, a 19-year-old model, presented to our office in February 2006. She had been unhappy with her teeth for several years. She wore braces to straighten her teeth, but the enamel of her anterior teeth had suffered decalcification during the orthodontic treatment. A previous dentist had treated her maxillary centrals and lateral incisors with minimally invasive direct veneers, which were discoloring and unnatural in appearance. She wanted to have a more attractive and confident smile (Fig 1).

The patient's goal was to have a whiter, more uniform-looking smile that looked natural and not too "commercial." She was a successful model in Northeast Florida, and the esthetic challenge was to create a smile that complemented the other strong and photogenic features of her face without creating an imbalance to her facial harmony.

The three goals for treating the patient were to optimize oral health, develop occlusal stability, and provide natural-looking esthetics.

Diagnostics

Optimize Oral Health

A digital radiographic full-mouth series was taken and an intraoral and extraoral examination was performed. Oral hygiene instructions were discussed

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Figure 1: Preoperative full-face view showing strong, photogenic features and a smile that throws facial symmetry off balance.

Figure 2: Preoperative smile showing areas that need improvement.

with the patient in order to positively influence the lifespan of her new dental restorations. The treatment rationale as explained to the patient was to leave no place in her mouth that was not cleanable, and to reduce and control the stress in her mouth.

Develop Occlusal Stability

Examination of her tooth anatomy revealed no occlusal pathology. She had youthful-looking teeth that appeared unworn, with no signs of bruxism on the molars or wear due to functional stress on the anteriors or cuspids that would suggest proprioceptive interference avoidance from the posterior teeth.[2]

A thorough examination revealed healthy temporomandibular joints and normal musculature. Her occlusion was evaluated by taking an open bite centric jaw record along with impressions for study casts and a Panadent earless facebow (Colton, CA). The relationship between the upper and lower arches in centric relation (CR) was duplicated on a Panadent articulator nicknamed the "chewing simulator".[3] Clinical evaluation of her bite revealed a 2-mm overbite and 2-mm overjet, and that she appeared to close freely into CR without any slide into centric occlusion (CO). To verify the clinical diagnosis, her bite was duplicated with mounted study casts using the composite ball technique. The record was taken with the patient in hinge rotation and the posterior teeth out of contact. The bite established a fulcrum in the anterior area, allowing the mandible to seat itself in the fossa.[4,5]

Fabrication of the composite ball involved temporarily bonding flowable resin to the lower anterior incisor teeth, followed by the placement of an uncured ball of hybrid resin over the flowable. Using a modified chin point technique, the patient was allowed to close freely into the hybrid resin until the posterior teeth were just out of occlusion, then the hybrid composite was cured. A thin piece of articulating paper was pulled though the posterior quadrants to verify that the teeth were out of contact. After the position was verified for accuracy, the posterior occlusal relationship was recorded with a rigid occlusal bite registration. The composite ball was then removed and the anterior occlusal relationship was recorded using the same rigid bite registration material, giving the laboratory a stable tripod on which to mount the study casts.[6]

An accurate mounting of the clinical occlusion allows for evaluation of any posterior interferences to full closure, and any working or nonworking interferences that would put higher levels of stress on the new indirect porcelain veneers. The laboratory was then instructed to mark and adjust any posterior interference to full closure before waxing the case.

Provide Natural-Looking Esthetics

The 12 required AACD Accreditation photographs were taken with a Canon 20D camera (Lake Success, NY) fitted with a 100-mm macro lens and ring flash, and a preoperative full-face photograph was taken in the photography studio.[7] The full-face and smile images were viewed with the patient on the chair-mounted monitor (Figs 1 & 2). While discussing the patient's goals for her new smile, she was shown "before and after" images of other patients to give her a good idea of the capabilities of our dental team. She was also shown several images from a case done on another patient to give her an idea of what to expect at each of her appointments. The

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1 iData Research Inc., 2009. U.S. Market for Dental Prosthetics and CAD/CAM Devices.

Figure 3: Preoperative retracted 1:2 view showing teeth prior to minimal preparation techniques.

Figure 4: Teeth showing minimal preparation, which was able to achieve the patient's goals without breaking contacts.

patient was given the opportunity to discuss what she liked or disliked about our other patients' smiles and we guided her decision making with our own personal experience. Our goal was to provide information for the ceramist to design a functional and esthetic wax-up. We focused on improving and modifying the following areas of the smile design:

- smile line did not follow the lower lip
- incisal edge position
- incisal edge inclination was not parallel to intra-pupillary line
- midline was slightly off
- buccal corridor was deficient on the bicuspids
- individual tooth inclination should be toward the navel
- tooth shapes were not esthetically pleasing in relation to the patient's face
- color and morphology of enamel (decalcification and existing dentistry).

The patient wanted to solve these problems with a long-lasting solution that would look the absolute best. Options were reviewed and a treatment plan was agreed upon.

Treatment Plan

The treatment plan was as follows:

- whitening of the lower arch
- indirect porcelain veneers ##4-13.

Whitening

The patient elected to whiten her lower teeth as a conservative and cost-effective alternative to indirect veneers. The decision on the final shade of her new veneers was not contingent upon the final whitening results of the lower teeth, which had a nice starting shade. A professionally supervised custom take-home tray treatment was determined to be the best course for whitening. This allowed the patient to whiten her teeth until she was happy with the results and maintain her whitening at home.

Treatment

Preparation Appointment

The preparation appointment[8,9] was driven by three primary objectives: To optimize esthetics, strength of the final restorations, and predictable long-term function. Preparation was guided by the laboratory wax-up, which served as a working model of the final result. The wax-up was evaluated for smile design principles and functional design principles to meet our goals for the patient.

Because this was a minimal preparation case, the Sil-Tech (Ivoclar Vivadent; Amherst, NY) impressions of the wax-up loaded with Luxatemp (Zenith/DMG; Englewood, NJ) transferred to the patient's mouth with no initial reduction. Then the mock-up was transferred to the mouth and modifications were made. The maxillary arch was anesthetized using an AMSA injection with a .5 carpule of Septocaine (Septodont; New Castle, DE) per side, administered using the CompuDent Wand (Milestone Scientific; Livingston, NJ). The .5-mm facial reductions were made in the three facial planes with an 828 030 depth-cutting bur (Brasseler, USA; Savannah, GA) and 1.5 mm was reduced into the incisal edges of the mock-up to allow for at least 1.5 mm between the edge of preparation and edge of definitive restoration. The mock-up material was then prepared as if it were tooth with a Brasseler 6856L 018 bur, removing the reduction marks. After the reduction

Figure 5: Preoperative 1:1 view.

Figure 6: Postoperative 1:1 view showing improved shapes, proportions, and beautiful ceramics.

was completed, the excess Luxatemp material was removed with an instrument and margins were placed on the teeth.

I prefer, when possible, to place supragingival margins that are .2 to .3 mm in depth, to allow for the pressed ingot to become translucent and blend with the existing tooth color. In order to achieve our goals, we did not need to break contacts. The cuspid preparations were wrapped onto the lingual surfaces to control the guidance and the bicuspids were step-prepared. Care was taken to extend the finish lines enough interproximally to hide the margins on this minimal preparation whitening case (Figs 3 & 4).

Adequate reduction was confirmed utilizing the laboratory-fabricated acrylic facial and lingual reduction guides, and the teeth were polished and sharp angles were smoothed with a Brasseler 8856L 016 bur and Sof-Lex disks (3M ESPE; St. Paul, MN). A bite was then taken over the prepared teeth. A natural die shade that matched the patient's teeth was selected and photographed for the laboratory. The final impression was made with Virtual (Ivoclar Vivadent) light-body and heavy-body material using a custom tray without the use of retraction cord or Expasyl. The Sil-Tech impression of the wax-up was also used as a matrix for the provisionals. Shade BL Luxatemp, which closely approximates Chromoscope (Ivoclar Vivadent) shade 020/030, was locked on using Systemp. desensitizer (Ivoclar Vivadent) and OptiBond FL primer (Kerr; Orange, CA). The provisionals, which become a living prototype of the final design, were then trimmed and polished. The patient can test esthetics, phonetics, comfort, and occlusal forces.

An impression, bite, a Panadent earless facebow, and a stick bite were made of the provisionals, along with all necessary photographs for laboratory communication. Utilizing the bites and facebow, the laboratory was able to cross mount the provisional model and the working model on the Panadent articulator.[10]

The patient was allowed to wear the provisionals for several days, and then was contacted to discuss her feelings about her new smile. She loved the esthetic changes we made and felt very comfortable with the new lengths. Chromoscope shade 010/020 was chosen for a final shade, with minimal frosted translucency and medium surface texture. The transition in color from higher to lower value, which occurs in natural teeth, would be a result of the thinning of the pressed ingot toward the patient's gumline and not from a ceramic stain.

Laboratory Communication

Communication with the laboratory throughout the treatment was crucial to the success of the case and made the minimal preparation process easy. Esthetic pressable ceramics (Ivoclar Vivadent) were chosen for the case. EO1 ingots were pressed to full contour, then cut back and layered for ultimate natural esthetics (Figs 5 & 6). Choosing a laboratory that has the experience of working with doctors in a hands-on teaching environment greatly facilitates the communication between the dentist and laboratory and ensures predictable esthetic results. Consistently using the same laboratory allows the dentist to focus on patient care and smile design and not get bogged down in systems and protocols.

Cementation

The provisional restorations were removed with straight-ended

Figure 7: Postoperative smile showing the improvements made.

hemostats and cleaned with hydrogen peroxide in an Ultradent (South Jordan, UT) syringe. The interproximals were cleaned with a metal finishing strip. Restorations were tried in dry, one at a time, then two at a time to ensure a passive fit. They were then tried in collectively with RelyX veneer (3M ESPE) water-soluble try-in gels, Translucent on the right and B 0.5 on the left. A 1:2 photograph was taken of the patient's smile and was put on the chair monitor in front of the patient for her to evaluate her new smile (Fig 7) and confirm that it met our original smile design goals. The uprighting of the laterals and slight flare of the canines off the navel looked less commercial and more unique, to match the striking features of her face. There are modeling agencies that actually prefer a smile that looks less commercial for their models. The patient was also encouraged to look at the veneers in several different mirrors with different lighting in the office. After the cementation consent form was signed, the veneers were cemented in with RelyX veneer cement shade B 0.5 under rubber dam isolation. The teeth were prepared with Consepsis (Ultradent) in an Ultradent syringe, then etched with 35% phosphoric acid for 15 seconds per tooth. Systemp. desensitizer was applied for 15 seconds per tooth, then blot-dried; then two coats of Excite single-dose bonding agent (Ivoclar Vivadent) were applied. The teeth were air-dried thoroughly using moisture-free air (A-dec warm air tooth dryer; Newberg, OR) and light-cured for 10 seconds per tooth. All the restorations were seated completely, beginning with the centrals and moving distally, then "tacked" in the center for one second with a 2.0-mm light guide. Changing to the 13-mm light guide and holding the tip approximately 1.0 inch away from the restorations and polymerizing for three seconds preformed a "wave." The excess was cleaned and DeOx oxygen-inhibition medium (Ultradent) was applied around all margins. Each restoration was polymerized for 60 seconds per surface.

After the excess was removed, the occlusion was checked with a T-Scan (Tekscan; South Boston, MA) and adjusted until occlusal forces were balanced and there was short closure time. Lateral and protrusive excursions were performed to confirm immediate canine disclusion and anterior guidance.[5,11]

Realization of the Vision

The postoperative appointment was used to get additional feedback from the patient, and to take intraoral and portrait pictures. Portrait shots were taken in our reception room, which we had converted into a "photography studio" for the session. We moved the furniture out of the way and set up our 10-foot white paper backdrop and three studio lights. A professional makeup artist was hired for the photography session (Fig 8).

Taking your own portrait shots in your office builds patient confidence and gives alternatives for marketing other than stock photography.

Conclusion

Having a strong vision is important in everything we do. Being able to visualize the end result gives us a reference point for success. Working with an experienced laboratory that shares a similar passion for education and love for creating beautiful smiles reinforces to patients that they are being cared for by a team of professionals who

Figure 8: (Pre-"America's Next Top Model.") Portrait shot taken of Whitney at the author's dental office studio.

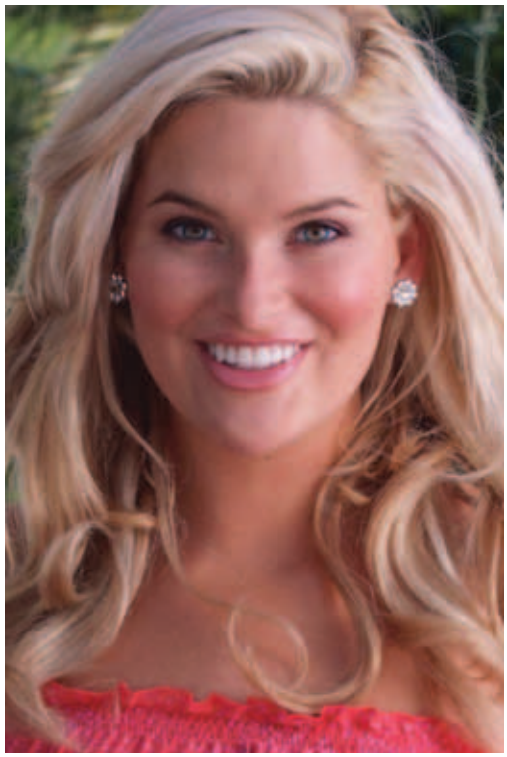

Figure 9: Using a professional photographer can help get the variety of images the Journal is looking for on its cover.

can achieve their goals. This patient had her goals for her new smile met, and it gave her the increased confidence to win cycle 10 of the hit TV show "America's Next Top Model"; and to appear on the cover of national magazines, on talk shows, and to book multiple national advertising campaigns.

Working with a professional photographer and makeup artist enabled us to get an even bigger variety of images to submit for the front cover of the *Journal of Cosmetic Dentistry* (Fig 9); it is an honor to be featured.

Acknowledgments

The author thanks ceramist Rob Maatta (Gold Dust Dental Laboratory, Tempe, AZ) for his superb work on this case. He also thanks Dr. David Hornbrook and The Hornbrook Group faculty, and the Gold Dust Clinical Mastery series for their dedication to teaching cosmetic dentistry in an enjoyable, hands-on environment. Special thanks go to the patient, Whitney Thompson, and to makeup artist Kimtasha Armstrong and photographer Tiger (Tiger Studios, Atlantic Beach, FL) for the photo shoot.

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A Systematic Approach to Esthetic and Functional Treatment

Editor's Note: This article was written primarily from a dentist's perspective, with contributions from a laboratory technician.

Although Dr. Hegyi is the developer and owner of the DATA Appliance discussed in this article, he does not profit from its fabrication or use. He does, however, teach courses related to the use of the appliance.

by Karl E. Hegyi, DDS, FAGD
North Royalton, OH
turnkeydentalacademy.com

Arpad Csapo
Fairview Park, OH
www.csapodentalarts.com

Abstract

The achievement of ideal esthetics and function should be the goal of every dentist choosing to restore a dentition. In addition, long-term durability of our restorations is mandatory if we are to consider our treatments successful. These objectives are most predictably realized if careful attention is given to all factors affecting each part of the masticatory system, including both microbial and biomechanical issues.

Long-term durability of our restorations is mandatory if we are to consider our treatments successful.

The purpose of this article is to describe a system that manages these biomechanical factors and also assists in developing ideal esthetics. This system consists of three elements: The Integrated Classification System (ICS), the Diagnosis and Treatment Assisting (DATA) Appliance, and a Stable Biomechanical Platform. ("DATA" is a proprietary registered trademark owned by Dr. Karl E. Hegyi for dental appliances used for diagnosing and treating biomechanical issues of the masticatory system.)

This article details how the ICS, DATA Appliance, and stable biomechanical platform were utilized to guide the evaluation and treatment of a patient with complex esthetic and functional problems.[1,2] It is divided into three parts, as follows:

- Part I focuses on utilization of the DATA Appliance and ICS to evaluate the patient and guide development of a stable biomechanical platform.
- Part II demonstrates the techniques and advantages of designing an ideal esthetic and functional restorative plan on this platform. Provisional restorations are then fabricated to represent this design.

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Tachycardia, bradycardia, and cardiac arrhythmias may occur with the use of phentolamine or other alpha-adrenergic blocking agents. Although such effects are uncommon with OraVerse (phentolamine mesylate), clinicians should be alert to the signs and symptoms of these events, particularly in patients with a history of cardiovascular disease. Following parenteral use of phentolamine at doses between 5 to 15 times higher than the recommended dose of OraVerse, myocardial infarction, and cerebrovascular spasm and occlusion have been reported, usually in association with marked hypotensive episodes producing shock-like states.

1 Median time to recovery was reduced by 85 minutes (55%) for lower lip and by 83 minutes (62%) for upper lip compared to control.

2 OraVerse is not recommended for use in children less than 6 years of age or weighing less than 33 lbs.

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BRIEF SUMMARY OF PRESCRIBING INFORMATION

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1. INDICATONS AND USAGE

OraVerse is indicated for reversal of the soft-tissue anesthesia, i.e., anesthesia of the lip and tongue, and the associated functional deficits resulting from an intraoral submucosal injection of a local anesthetic containing a vasoconstrictor.

OraVerse is not recommended for use in children less than 6 years of age or weighing less than 15 kg (33 lbs).

2. DOSAGE AND ADMINISTRATION

2.1 General Dosing information

The recommended dose of OraVerse is based on the number of cartridges of local anesthetic with vasoconstrictor administered:

Amount of Local Anesthetic Administered	Dose of OraVerse [mg]	Dose of OraVerse [Cartridge(s)]
½ Cartridge	0.2	½
1 Cartridge	0.4	1
2 Cartridges	0.8	2

OraVerse should be administered following the dental procedure using the same location(s) and technique(s) (infiltration or block injection) employed for the administration of the local anesthetic. Note: Do not administer OraVerse if the product is discolored or contains particulate matter.

2.2 Dosing in Special Populations

In pediatric patients weighing 15-30 kg, the maximum dose of OraVerse recommended is 1/2 cartridge (0.2 mg).

(Note: Use in pediatric patients under 6 years of age or weighing less than15 kg (33 lbs) is not recommended. A dose of more than 1 cartridge [0.4 mg] of OraVerse has not been studied in children less than 12 years of age.)

3. DOSAGE FORMS AND STRENGTHS

0.4 mg/1.7 mL solution per cartridge

4. CONTRAINDICATIONS

None

5. WARNINGS AND PRECAUTIONS

5.1 Cardiovascular Events

Myocardial infarction, cerebrovascular spasm, and cerebrovascular occlusion have been reported to occur following the parenteral administration of phentolamine. These events usually occurred in association with marked hypotensive episodes producing shock-like states. Tachycardia and cardiac arrhythmias may occur with the use of phentolamine or other alpha-adrenergic blocking agents. Although such effects are uncommon after administration of OraVerse, clinicians should be alert to the signs and symptoms of these events, particularly in patients with a prior history of cardiovascular disease.

6. ADVERSE REACTIONS

In clinical trials, the most common adverse reaction with OraVerse that was greater than the control group was injection site pain.

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice. Dental patients were administered a dose of either 0.2, 0.4 or 0.8 mg of OraVerse. The majority of adverse reactions were mild and resolved within 48 hours. There were no serious adverse reactions and no discontinuations due to adverse reactions.

Table 1: Adverse Reactions with Frequency Greater Than or Equal to 3% and Equal to or Exceeding Control

Adverse Event	OraVerse				Control
	0.2 mg (N = 83)	0.4 mg (N = 284)	0.8 mg (N = 51)	Total (N = 418)	Total (N = 359)
	N (%)	N (%)	N (%)	N (%)	N (%)
Patients with AEs	15 (18)	82 (29)	20 (39)	117 (28)	96 (27)
Tachycardia	0 (0)	17 (6)	2 (4)	19 (5)	20 (6)
Bradycardia	0 (0)	5 (2)	2 (4)	7 (2)	1 (0.3)
Injection site pain	5 (6)	15 (5)	2 (4)	22 (5)	14 (4)
Post procedural pain	3 (4)	17 (6)	5 (10)	25 (6)	23 (6)
Headache	0 (0)	10 (4)	3 (6)	13 (3)	14 (4)

Table 1 lists adverse reactions where the frequency was greater than or equal to 3% in any OraVerse dose group and was equal to or exceeded that of the control group. An examination of population subgroups did not reveal a differential adverse reaction incidence on the basis of age, gender, or race. Results from the pain assessments in Study 1 and Study 2, involving mandibular and maxillary procedures, respectively, indicated that the majority of dental patients in both OraVerse and control groups experienced no or mild oral pain, with less than 10% of patients in each group reporting moderate oral pain with a similar distribution between the OraVerse and control groups. No patient experienced severe pain in these studies.

6.2 Adverse Reactions in Clinical Trials

Adverse reactions reported by less than 3% but at least 2 dental patients receiving OraVerse and occurring at a greater incidence than those receiving control, included diarrhea, facial swelling, increased blood pressure/ hypertension, injection site reactions, jaw pain, oral pain, paresthesia, pruritus, tenderness, upper abdominal pain and vomiting. The majority of these adverse reactions were mild and resolved within 48 hours. The few reports of paresthesia were mild and transient and resolved during the same time period.

6.3 Post Marketing Adverse Reaction Reports from Literature and Other Sources

The following adverse reactions have been identified during postapproval parenteral use of phentolamine mesylate. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure. Acute and prolonged hypotensive episodes and cardiac arrhythmias have been reported with the use of phentolamine. In addition, weakness, dizziness, flushing, orthostatic hypotension, and nasal stuffiness have occurred.

7. DRUG INTERACTIONS

There are no known drug interactions with OraVerse.

8. USE IN SPECIFIC POPULATIONS

8.1 Pregnancy *Pregnancy Category C*

There are no adequate and well-controlled studies in pregnant women. OraVerse should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

8.4 Pediatric Use

In clinical studies, pediatric patients between the ages of 3 and 17 years received OraVerse. The safety and effectiveness of OraVerse have been established in the age group 6-17 years. Effectiveness in pediatric patients below the age of 6 years has not been established. Use of OraVerse in patients between the ages of 6 and 17 years old is supported by evidence from adequate and well-controlled studies of OraVerse in adults, with additional adequate and well-controlled studies of OraVerse in pediatric patients ages 12-17 years old [Studies 1 (mandibular procedures) and 2 (maxillary procedures)] and ages 6-11 years old [Study 3 (mandibular and maxillary procedures)]. The safety, but not the efficacy, of OraVerse has been evaluated in pediatric patients under the age of 6 years old. Dosages in pediatric patients may need to be limited based on body weight.

10. OVERDOSAGE

No deaths due to acute poisoning with phentolamine have been reported.

Overdosage with parenterally administered phentolamine is characterized chiefly by cardiovascular disturbances, such as arrhythmias, tachycardia, hypotension, and possibly shock. In addition, the following might occur: excitation, headache, sweating, pupillary contraction, visual disturbances, nausea, vomiting, diarrhea, or hypoglycemia. There is no specific antidote; treatment consists of appropriate monitoring and supportive care. Substantial decreases in blood pressure or other evidence of shock-like conditions should be treated vigorously and promptly.

14. CLINICAL STUDIES

The safety and efficacy of OraVerse when used for reversal of soft-tissue anesthesia (STA), i.e., anesthesia of the lips and tongue following a dental procedure that required local anesthesia containing a vasoconstrictor, were evaluated in the following clinical studies. OraVerse induced reversal of local anesthetic effects on the teeth, mandible and maxilla has not been assessed.

Two Phase 3, double-blinded, randomized, multi-center, controlled studies were conducted in dental patients who had mandibular (Study 1) or maxillary (Study 2) restorative or periodontal maintenance procedures and who had received a local anesthetic that contained a vasoconstrictor. The primary endpoint was time to normal lip sensation as measured by patient reported responses to lip palpation. The secondary endpoints included patients' perception of altered function, sensation and appearance, and their actual functional deficits in smiling, speaking, drinking and drooling, as assessed by both the patient and an observer blinded to the treatment. In the mandibular study, the time to recovery of tongue sensation was also a secondary endpoint. Patients were stratified by type and amount of anesthetic administered.

OraVerse was administered at a cartridge ratio of 1:1 to local anesthetic. The control was a sham injection. OraVerse reduced the median time to recovery of normal sensation in the lower lip by 85 minutes (55%) compared to control. The median time to recovery of normal sensation in the upper lip was reduced by 83 minutes (62%).

In Study 1 (mandibular), OraVerse accelerated: a) the recovery of the perception of normal appearance and function by 60 minutes (40%), b) the recovery of normal function by 60 minutes (50%), and c) the recovery of normal sensation in the tongue by 65 minutes (52%). In Study 2 (maxillary), the recovery of the perception of normal appearance and function was reduced by 60 minutes (50%) and the recovery of normal function was reduced by 45 minutes (43%).

Study 3, a pediatric, Phase 2, double-blinded, randomized, multi-center, controlled study was conducted in dental patients who had received 2% lidocaine with 1:100,000 epinephrine. Dental patients (n = 152, ages 4-11 years) received ½ cartridge of local anesthetic if they weighed ≥15 kg but <30 kg, and one-half or one full cartridge if they weighed ≥30 kg at a cartridge ratio of 1:1 to local anesthetic.

The median time to normal lip sensation in patients 6 to 11 years of age who were trainable in the lip-palpation procedures, for mandibular and maxillary procedures combined, was reduced by 75 minutes (56%). Within 1 hour after administration of OraVerse, 44 patients (61%) reported normal lip sensation, while only 9 patients (21%) randomized to the control group reported normal lip sensation. In this study, neither the patients' perception of their appearance or ability to function nor their actual ability to function was evaluated.

16. HOW SUPPLIED/STORAGE AND HANDLING

OraVerse (phentolamine mesylate) Injection 0.4 mg/1.7 mL is supplied in a dental cartridge, in cartons of 10 and 50 cartridges. Each cartridge is individually packaged in a separate compartment of a 10 cartridge blister pack.

NDC 45293-101-01
NDC 45293-101-02

Store at controlled room temperature, 20-25°C (68-77°F) with brief excursions permitted between 15-30°C (59-86°F) Protect from direct heat and light. Do not permit to freeze.

Manufactured by Novocol Pharmaceutical of Canada, Inc., Cambridge, Ontario, Canada
For Novalar Pharmaceuticals, Inc., San Diego, CA 92130

US Patent Nos.: 6,764,678; 6,872,390; 7,229,630 Trademark of Novalar Pharmaceuticals, Inc.

17. PATIENT COUNSELING INFORMATION

Patients should be instructed not to eat or drink until normal sensation returns.

Figure 1: Retracted pretreatment smile, 1:2 view.

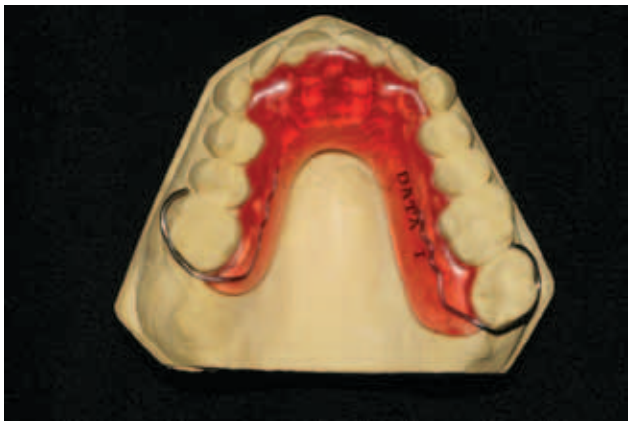

Figure 2: A DATA Appliance.

- Part III describes a process for creating and seating final restorations mimicking the esthetic and functional qualities developed in the provisional restorations. It then describes utilization of the DATA Appliance to perfect and protect these restorations.

Part I

Patient History and Preliminary Findings

The patient was a 53-year-old male dentist who had been experiencing a level of facial pain for the previous year that had affected his ability to eat. In addition to wanting to be more comfortable, however, he was also concerned with the health and maintainability of his teeth. He knew that he had several fractured and worn teeth and large old amalgam restorations. Because of the condition of his dentition, he was aware that he needed extensive restorative treatment. While a desire for improved esthetics was mentioned, he initially stated it was not a high priority.

Preliminary evaluation of microbial issues revealed excellent periodontal health and no active caries. Evaluation of biomechanical force issues revealed generalized moderate-to-severe excessive tooth wear, painful masticatory muscles, and damaged temporomandibular joints (TMJs). Both joints could accept firm loading with no sign of tension or tenderness, although clicking sounds that had been present for many years were noted in the left joint. Range-of-motion measurements were within normal limits.

For the appliance to give meaningful information about each biomechanical element, and to also achieve complete condylar seating, it must be worn for at least three to four weeks.

Initial esthetic evaluation revealed many potential issues, including moderate-to-severe tetracycline staining, worn and misaligned anterior teeth, occlusal plane and gingival level issues, collapsed buccal corridors, and asymmetric lip dynamics (Fig 1). While many esthetic issues existed, the patient's initial concerns clearly focused on biomechanical issues. Therefore, a more detailed evaluation of these issues was performed.

The Data Appliance in Biomechanical Evaluation

The concept of using an anterior stop to assist in condylar seating and bite registration is well documented and has been used clinically for many years.[3] Lucia jigs and leaf gauges were among the earliest types of anterior stops used. In recent years, some clinicians, notably Dr. John Kois and Dr. John Cranham, have adapted the anterior stops to removable acrylic appliances; their appliances are known as "deprogrammers."[4,5]

These modifications not only made anterior stops more practical for longer-term use, but also expanded the clinical applications of the appliances. The DATA Appliance represents the primary author's version of an anterior stop appliance design and its application. It is a removable appliance that is used to

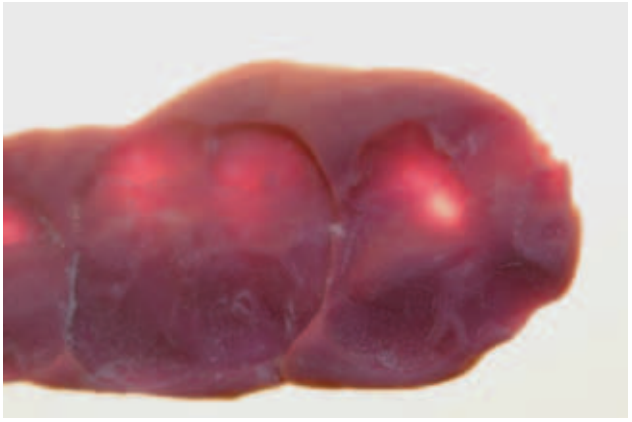

Figure 3: Perforation of Futar bite registration confirming #15 and #18 in contact with DATA Appliance seated.

assist in both evaluating and treating biomechanical force issues. It also is tooth-supported, has a different anterior stop design from other appliances, and is used to provide patient information regarding each biomechanical element of the ICS[2,6] (Fig 2). It is used to assist in both evaluating the patient and in providing appropriate treatment to develop a stable biomechanical platform.[6,7]

For this appliance to give meaningful information about each biomechanical element, and to also achieve complete condylar seating, it must be worn for at least three to four weeks. Therefore, excellent patient compliance is critical. To ensure this, a major design objective of the appliance was to make it as comfortable and esthetic as possible. As a result, the primary author has found patient compliance issues to be rare.

The patient's preliminary biomechanical evaluation and history were consistent with damaged, but well-adapted, TMJs. To confirm this, a DATA Appliance was fabricated and seated. The anterior stop was adjusted to allow contact of one lower incisor with closure, perpendicular to the arc of closure, allowing approximately 2 mm interocclusal space between the most posterior teeth.

The patient was initially reevaluated after wearing the appliance 24 hours a day for 10 days (except during eating and oral home care). Three significant responses were noted, as follows:

- There was a near-complete elimination of facial pain and joint sounds.
- There was little evidence of parafunctional activity on the appliance's acrylic anterior stop.
- The patient reported that after seven days of wearing the appliance, teeth #15 and #18 were in contact if he closed with the appliance in place.

The ICS is a classification system that individually considers the biomechanical elements of TMJ orthopedic stability, the functional occlusion, and parafunctional activity.

A bite registration using Futar D Occlusion bite registration material (Kettenbach GmbH & Co.; Eschenburg, Germany) with the DATA Appliance in place confirmed that teeth #15 and #18 were in contact (Fig 3). At that time, additional acrylic was added to the anterior stop to once again allow approximately 2 mm posterior tooth interocclusal space.

The patient was next seen 21 days later. He reported a continued near-complete absence of facial pain, with no joint sounds, and there was little evidence of parafunctional activity on the appliance's anterior stop. Another bite registration was made and revealed #15 and #18 to be nearly in contact again. Subsequent identical bite registrations were made over the next two weeks. Stabilization of interocclusal and maxillomandibular relationships is confirmed when the following criteria are met:

- Identical bite registrations are made on at least two occasions at least one week apart.
- Both condyles can accept firm loading with no sign of tension or tenderness at the condylar position of bite registration.

- The first point of occlusal contact with closure of the mounted casts on the articulator is identical to that of the patient closing with the appliance inserted with its stop reduced to first tooth contact.

A facebow registration to record the hinge axis was made and the maxillary cast mounted. The mandibular cast was then mounted using a Futar bite registration.

UNION OF THE DATA APPLIANCE AND ICS IN TREATMENT PLANNING

The ICS is a classification system that individually considers the biomechanical elements of TMJ Orthopedic Stability, the Functional Occlusion, and Parafunctional Activity.[1] The ICS classifies TMJ stability as *stable, manageably adapted, transitioning, or unstable*. The functional occlusion is classified as *benign, posterior dysfunction, or anterior dysfunction*; and parafunctional activity as *benign, structural, CNS, or secondary*. (The entire ICS document is available from the primary author to any readers who request it.) Patient response to the DATA Appliance gives critical information regarding each of these elements.[2] Once each element is evaluated, the ICS guides appropriate occlusal and restorative treatment design and methodology.[1]

In this patient's case, information from appliance response, along with history and clinical examination findings, confirmed an ICS TMJ stability diagnosis of "manageably adapted." Manageably adapted joints are those that are damaged, but well adapted.[6] Response also confirmed a functional occlusion diagnosis of "posterior dysfunction" and an *initial* parafunctional activity diagnosis of "benign" or "structural parafunctional activity."[2] With posterior dysfunction, posterior teeth interfere with function. *Structural* parafunctional activity is parafunctional activity that is affected by occlusal relationships. *Benign* parafunctional activity is diagnosed when parafunctional activity is either not present or is not causing disease.

The DATA Appliance's role in platform development is to first confirm stable or manageably adapted TMJs.

This combination of TMJ stability, functional occlusion, and parafunctional activity diagnoses is common and one that can predictably benefit from occlusal correction. As in many cases, this patient not only can benefit from occlusal correction, but the occlusal correction is a fundamental requirement to developing a stable biomechanical platform. Creating this platform will not only ensure patient comfort, but will also serve as a foundation upon which ideal esthetic and functional design can be effectively developed and delivered.

The vertical dimension that allows the least invasive treatment possible, which is also consistent with all the patient's functional, restorative, and esthetic goals, should be chosen.

THE CONCEPT OF A STABLE BIOMECHANICAL PLATFORM

A stable biomechanical platform is achieved when interocclusal relationships are in harmony with masticatory muscle function, together with healthy or well-adapted TMJs, *at the final treatment vertical dimension of occlusion* (VDO). It requires that maximum intercuspation occurs with equal intensity contact of all teeth with both condyles in their physiologically seated positions (centric relation [CR]). It also requires an anterior guidance that allows disclusion of the posterior teeth and one that is in harmony with the envelope of function. The DATA Appliance's role in platform development is to first confirm stable or manageably adapted TMJs. Next, it assists in achieving and confirming physiologically seated condyles. Finally, it guides appropriate treatment to create the stable biomechanical platform.[2,6,7]

The most critical decision in creating a stable biomechanical platform is choosing the appropriate VDO. The vertical dimension chosen has an impact upon three important clinical factors:

- The invasiveness of reductive reshaping or restorative treatment necessary to develop the platform.
- The horizontal, anterior-posterior relationship of upper incisor lingual contours to lower incisor edges (also referred to as the *available* envelope of function).
- The vertical interocclusal or interincisal room available for esthetic and/or restorative treatments.

The vertical dimension that allows the least invasive treatment possible, which is also consistent with all the patient's functional, restorative, and esthetic goals, should be chosen.

While a stable biomechanical platform may be achieved directly with the preparation of teeth and placement of provisional restorations, in many comprehensive restorative/esthetic treatments it is ad-

Figure 4a

Figure 4b

Figure 4c

Figures 4a-4c: Frontal and lateral views of pretreatment interocclusal relationships with condyles physiologically seated.

vantageous to develop this platform prior to final functional and esthetic design or tooth preparation. There are three primary benefits from doing this:

- Many patients are not concerned with ideal esthetic or restorative treatment until they experience the physical comfort that occurs with development of a stable biomechanical platform.
- It allows an easier and more predictable process of functional and esthetic design.
- Because a stable biomechanical platform establishes the final treatment vertical dimension and functional relationships, definitive tooth preparation and restoration can proceed immediately or be phased over extended periods of time.

With initial development of a stable biomechanical platform, full-mouth reconstructions can be achieved with simultaneous preparation of both arches, one arch at a time, by quadrant, or tooth by tooth. This offers a tremendous practical advantage to patients with financial limitations, as it allows extensive dental treatment to be phased over a period of time so that the patient can afford it.

Restoring biomechanical harmony is beneficial to all components of the masticatory system, including the TMJs, masticatory muscles, periodontium, and denti-

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Figure 5: Anterior tooth relationships after planned reductive reshaping.

tion.[8] Therefore, development of a stable biomechanical platform is also helpful for patients without extensive restorative or esthetic needs. Many patients' treatment ends with creation of a stable biomechanical platform, with little or no restorative care. Treatment options to create this platform include orthognathic surgery, orthodontics, additive reshaping with direct or laboratory fabricated restorations, and reductive reshaping. The option(s) that most conservatively achieves the requirements of a stable biomechanical platform, and is also consistent with all other patient functional and esthetic goals, should be utilized.

Stable Biomechanical Platform Development

Stable biomechanical platform development begins on accurate mounted casts of the patient with both condyles physiologically seated (in CR). A diagnostic evaluation of the relationship of these casts is critical for both functional and esthetic design planning. When significant restorative treatment or esthetic changes are anticipated, a complete series of photographs is also needed. It is at this time that initial determination of the VDO and the treatment option(s) to develop it should be made. For most patients, a functionally acceptable stable biomechanical platform is possible at different vertical dimensions of occlusion. However, the *appropriate* vertical dimension is the one that is most consistent with *all* the patient's goals and objectives—functional, esthetic, and restorative. This should be determined before any patient treatment to develop the platform has begun.

The creation of a stable biomechanical platform prior to final esthetic and functional design is very beneficial to the laboratory technician.

In this case, the mounted casts of the patient revealed an interocclusal relationship very different from that in maximum intercuspation (Figs 4a-4c). Diagnostic evaluation of the casts began with determination of the appropriate vertical dimension. Reductive reshaping of the patient's casts revealed that when all left posterior teeth were adjusted into equal intensity, simultaneous contact, #5 and #28 just came into contact. At this vertical dimension, the remaining right posterior teeth were still slightly out of contact. However, visual assessment of the casts suggested that the remaining interincisal space seemed appropriate for an ideal esthetic and functional restoration of the anterior teeth (Fig 5). A simple wax-up of the anterior teeth on the casts supported this assessment (Figs 6a-6c). The end point of reductive reshaping and the VDO were now determined. (Note: *Final* confirmation of the appropriate vertical dimension is made in the mouth. While the vertical dimension chosen during this diagnostic cast and photograph assessment is usually correct, there is occasional need for minor modification in the mouth, usually for esthetic reasons.)

The DATA Appliance was now used to assist in achieving this relationship in the patient's mouth. With the appliance seated, a gradual reduction of the anterior stop guided reductive reshaping of the patient's dentition precisely to the point where #5 and #28 made contact. At this time, the end point of reductive reshaping had been achieved. With conservative additive

Figure 6a

Figure 6b

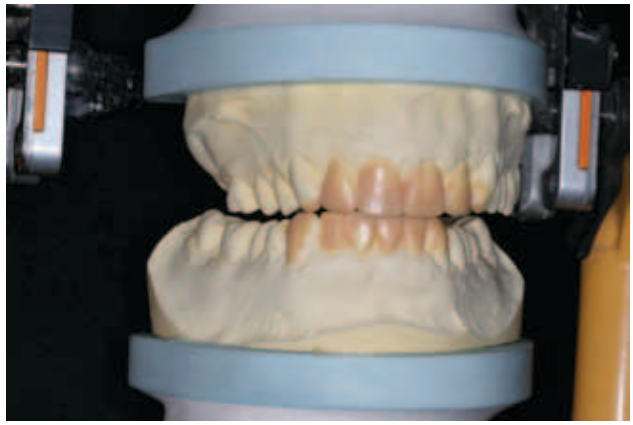


Figure 6c

Figures 6a-6c: Preliminary wax-up of anterior teeth confirming that planned vertical dimension is appropriate for ideal anterior esthetics and function.

reshaping with bonded composite to the occlusal surfaces of #29 and #30 and the lingual of upper anterior teeth, the stable biomechanical platform was created. This platform will become the foundation upon which definitive functional and esthetic restorative planning and treatment begins.

With platform development complete, the appliance was removed and set aside for use after the final restorations were seated. Definitive restorative/esthetic treatment could proceed immediately, be phased over time, or be deferred to a future date. In this case, the patient wanted to proceed immediately and as quickly as possible.

The next part of this article will illustrate the process of designing and developing esthetic and functional restorations on the newly created stable biomechanical platform. It will consider esthetic and functional planning, tooth preparation, esthetic crown lengthening, and the fabrication of provisional restorations.

PART II

INTRODUCTION

Part I of this article focused primarily on biomechanical issues in our patient's care. It described the use and advantages of the DATA Appliance, the ICS, and development of a stable biomechanical platform. It concluded with development of a stable biomechanical platform on the patient, who required extensive restorative treatment. It is important

Figure 7: Laboratory technician's pretreatment esthetic analysis.

to recall that initially, esthetic improvement was not a high priority for this patient. However, once development of a stable biomechanical platform made him comfortable, he indicated that improved esthetics were very important. The patient now indicated that there were no restrictions on treatment options he would accept to achieve ideal function *and* esthetics—except that he did not want treatment of any type for his remaining second molars.

This second part of the article will first explore the laboratory technician's perspective of the techniques and advantages of designing ideal functional and esthetic restorations on a stable biomechanical platform. This will include the importance of clinician/laboratory technician interaction and the responsibilities of each in case design. Because the success of this case also depends on clinical techniques not involved with the ICS, DATA Appliance, or stable biomechanical platform, some of the most important of these will also be described. This part will conclude with the creation of provisional restorations designed for ideal function and esthetics, intended to serve as a template for final restorations.

Esthetic and Functional Design

The creation of a stable biomechanical platform prior to final esthetic and functional design is very beneficial to the laboratory technician. In addition to knowing that the patient is comfortable, we know that a functionally acceptable VDO has already been determined and confirmed by the dentist. If the dentist has also done an esthetic assessment of this vertical dimension (as it was in this case), we also know it is a vertical dimension that is appropriate for ideal esthetic design. Often, as laboratory technicians, we are asked by the clinician to decide treatment vertical dimension. While input from the laboratory technician to the clinician is helpful, choosing treatment vertical dimension ultimately should be the responsibility of the dentist.

A stable biomechanical platform also provides information about other functional considerations, including the anterior guidance and envelope of function. Combined with an already determined final vertical dimension, these elements give guidance to the laboratory technician in both functional and esthetic design. Having this information makes the process of restoration design easier and more predictable. It is also makes efficient use of our time, with little need for remakes or modifications.

In every large or esthetically critical case it is extremely important for the clinician and the technician to work as a team. Their combined experiences and perspectives, along with input from the patient, offer the best opportunity for an ideal outcome. This process should begin as soon as initial records have been acquired. In this particular case, the clinician provided us the required 12 AACD photographic views and the mounted casts of the case after the stable biomechanical platform had been developed.

The patient's pretreatment photographs show a gummy smile, deficient buccal corridor, and a lack of symmetry and golden proportions (Fig 7). Our "educated guess" indicated that these could be corrected with a combination of:

Figure 8a

Figure 8b

Figure 8c

Figures 8a-8c: Planning ideal gingival levels, incisal edge and buccal cusp tip positions, and buccal corridor development.

- incisal edge lengthening and shortening
- esthetic crown lengthening
- adding to the buccal contours
- reducing lingual contours.

These corrections were discussed with and agreed to by the clinician. They were then presented to the patient, and a decision was made to move forward.

Verified mounted master casts of the stable biomechanical platform, along with upper and lower duplication impressions of these casts and a facebow transfer, were sent to the laboratory. The impressions were poured up and mounted on a semi-adjustable Stratos articulator (Ivoclar Vivadent; Amherst, NY). The mounting of casts is verified when the first point of occlusal contact with closure of the mounted casts on the articulator is *identical* to that of the patient closing with the DATA Appliance inserted with its stop reduced to first tooth contact (in this case, the buccal incline of the mesio-lingual cusp of #15 and the lingual incline of the mesio-buccal cusp of #18).

Measurements were made and steps were taken to balance the teeth, lips, and gingivae, and a semi-full contour additive-only wax-up was completed (Figs 8a-8c). (Please note the accuracy of the clinician's impressions. This is critical for diagnostic accuracy. Diagnostic impressions should be as good as final impressions for restorations.) A Sil-Tech stent (Ivoclar Vivadent) of the additive wax-up was laboratory-fabricated and the case was sent back to the clinician's office for try in.

Transfer of this wax-up design directly to the patient's dentition using the laboratory-fabricated Sil-Tech stent and Luxatemp temporary material (Zenith/DMG; Englewood, NJ) allowed for a careful assessment and refinement of each characteris-

Figure 9: Additive wax-up intraoral transfer.

Figures 10a & 10b: Proposed lingual arch form reduction.

tic (Fig 9). This esthetic preview is beneficial to both the dentist and laboratory technician. In addition, the preview is a powerful motivator for patient case acceptance. With incisal edge position, buccal corridor, and gingival levels determined, an accurate full contour wax-up of both esthetic and functional details can be made. With planned changes confirmed, the full contour wax-up now represents a refined design rather than an educated guess.

A full contour wax-up allows a better understanding of required tooth preparation, including margin placement and reduction needs. During this process, every step is meticulously and methodically planned for chairside conservation of time and to ensure that the most minimally invasive procedures are used. The following steps describe the process used by the laboratory technician in this case to ensure predictable functional and esthetic results and help the clinician during patient treatment.

Step 1: Additive wax-up stent fabrication

1) Fabricate esthetic additive wax-ups on mounted casts of the stable biomechanical platform.
2) Duplicate additive wax-ups and pour in die stone.
3) Fabricate a Sil-Tech stent of each additive wax-up. (These stents will be filled with Luxatemp and transferred to the patient's mouth to confirm planned esthetic changes [as described previously] and then assist initial tooth preparation by the clinician [described in the "Initial Tooth Preparation and Provisionalization" section to follow]).

Step 2: Arch form and occlusal plane correction

1) Fabricate green reduction guides over duplicated additive wax-up casts.

Figure 11a

Figure 11b

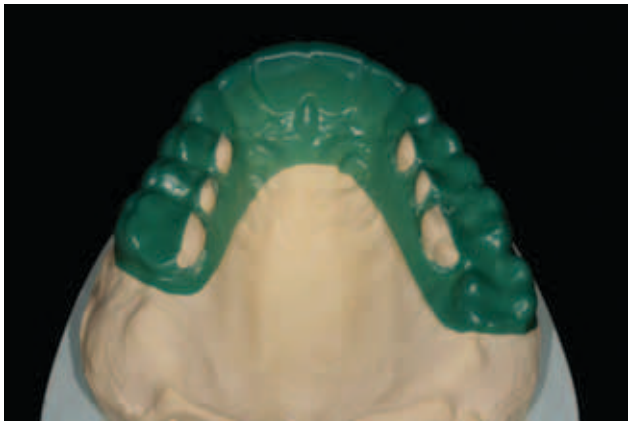


Figure 11c

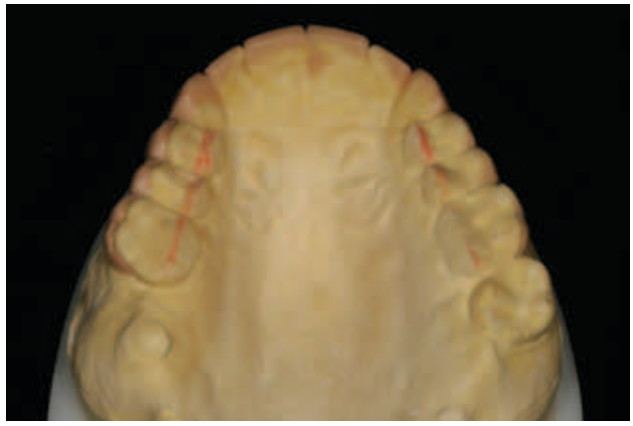
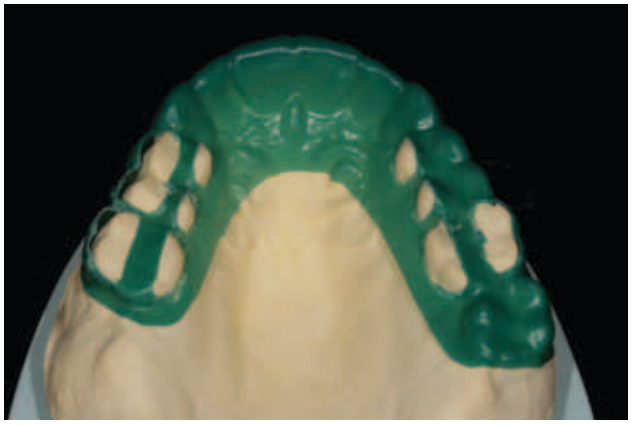
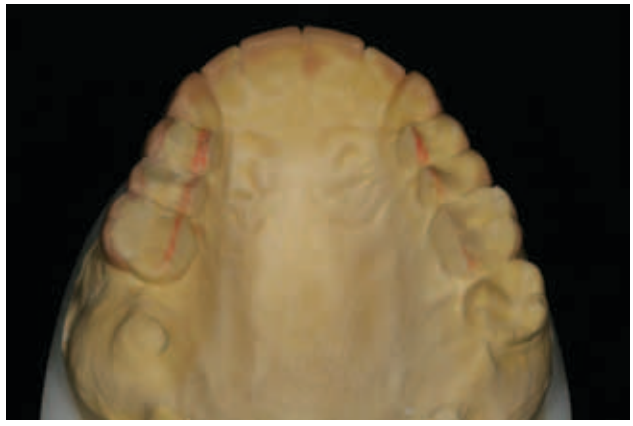


Figure 11d

Figures 11a-11d: Green reduction guide adjusted to correct arch form.





Figures 12a & 12b: Green reduction guide adjusted to correct occlusal plane.

2) On original mounted additive wax-up casts, outline lingual tooth contours needing reduction to correct arch form in red pencil (Figs 10a & 10b).
3) Place green reduction guides over original additive wax-up casts and reduce guides to the red lines to indicate the new lingual contours (Figs 11a-11d).
4) Reduce the occlusal surfaces of the green guides to be continuous with the upper and lower incisal planes to indicate the new occlusal plane (Figs 12a & 12b). (These green reduction guides will be used by the clinician during initial tooth preparation [described in the "Initial Tooth Preparation and Provisionalization" section to follow]).
5) Fabricate a new Sil-Tech stent of these modified additive wax-up casts (to be used in Step 4 below).

Step 3: Full-contour wax-up cast preparation

1) Make pilot depth cuts into modified mounted additive wax-up casts (Figs 13a-13c).
2) Continue preparing teeth on casts to depths meeting the ceramic manufacturer's specifications (in this case, pressed Swiss SNF Metals [Toronto, Ontario, Canada]).
3) Refine tooth preparations and margins on casts.
4) Duplicate each prepared cast in die stone and review reduction needs with clinician.

Step 4: Full-contour wax-up, clinician's reduction guide, and provisional restoration; matrix fabrication

1) Place new Sil-Tech stents (from Step 2 above) over mounted prepared casts.
2) Inject wax into stents over prepared teeth on casts.
3) Refine anatomy, contour, and function of new full-contour wax-ups (Figs 14a-14c).
4) Duplicate upper and lower full-contour wax-ups in die stone.
5) Fabricate provisional restoration and tooth reduction matrixes for clinician (described in the "Initial Tooth Preparation and Provisionalization" section).

Because gingival levels were to be changed, esthetic crown lengthening needed to be performed.

These steps will help to ensure success and predictability in final preparation by the clinician and will be repeatable intraorally with the combined use of the additive wax-up stents, the green reductive stents, and the final temporary stents.

The case was then packaged and sent to the clinician's office for review and preparation.

Initial Tooth Preparation and Provisionalization

Because gingival levels were to be changed, esthetic crown lengthening needed to be performed. In this case, this was done in two phases. While this is a novel approach to esthetic crown lengthening, it is based on sound biological principles with advantages to both the patient and clinician.

At the tooth preparation appointment, the first (soft tissue) phase was completed. Measurements from the midfacial gingival margin to the crestal bone of each tooth to be crown-lengthened were made and recorded. The gingival margins were then surgically trimmed to match the contours and levels determined previously in the esthetic additive-only process. The osseous phase of surgery was performed only after the patient accepted the new gingival levels, and will be described in the next section of this article. Although the initial trimming of soft tissue may invade the biologic width, it is virtually nontraumatic for the patient, and the second (osseous) phase is performed within six weeks—before any adverse biological response occurs. This "two-stage" method requires adequate amounts of attached tissue, but offers the benefit of allowing the patient to live with and approve their new gingival levels before osseous recontouring commits them to these levels.

During tooth preparation, proper tooth reduction and contour are critical for both restoration esthetics and strength. When significant change in tooth contour or dimension is required, it is easy to "get lost" during tooth preparation, resulting in either over- or under-reduction. A simple, yet effective three-step process to ensure proper reduction begins with a guide to gross reduction.

The first step begins with an overlay representing final planned restoration contours and dimensions that will be outside those of the existing teeth. To do this, a small area of enamel on each tooth is etched and bonded to aid in retention of the overlay. A Sil-Tech index of the additive wax-up (from Step 1 of the previous section) is then filled with a provisional-type composite resin, inserted and *completely* seated. To approximate final restoration dimensions, it is also important that there is no tooth structure lying outside these dimensions. To accom-

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Figure 13a

Figure 13b

Figure 13c

Figures 13a-13c: Initial depth cuts into additive wax-up.

plish this, the green reduction index (from Step 2 of the previous section) is used to guide the removal of this tooth structure (Fig 15). Tooth preparation now proceeds through both the composite overlay and remaining tooth structure to depths appropriate for restoration type and shade—in the same manner in which preparation is done on teeth when no change is made in contour or dimension.

In the second step, once gross reduction is completed, each preparation is checked and refined with a putty silicon index of the full-contour wax-up sectioned through each tooth (from Step 4 of the previous section) (Fig 16). In the final step, after all functional and esthetic adjustments are made to the provisional restorations, the thickness of each provisional restoration is checked with a crown gauge (Fig 17).

Combined, these three steps ensure that reduction of every part of each preparation meets restoration esthetic and strength requirements. (Note: In this patient, because tooth preparations were to be finalized after osseous esthetic crown lengthening, only the first two steps of this process were done at this time. The third step of checking provisional restorations with a crown gauge will be done at the time of final tooth preparation and impressions.)

All restorations in this case were to be bonded pressed ceramic, including full-coverage and three-quarter crowns. Because of this, following preparation, all teeth received immediate dentin sealing. The benefits of immediate dentin sealing have been well described by Pascal Magne and include:[9]

Figure 14a

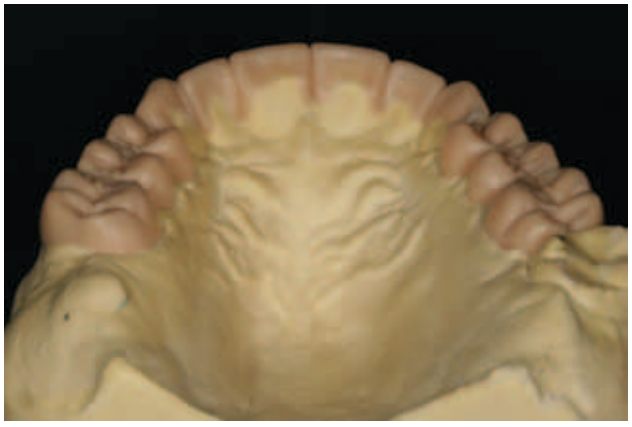

Figure 14b

Figure 14c

Figure 14d

Figure 14e

Figures 14a-14e: Completed full-contour, fully functional diagnostic wax-up.

Figure 15: Intraoral view of green reduction guide for initial arch form and occlusal plane correction during tooth preparation.

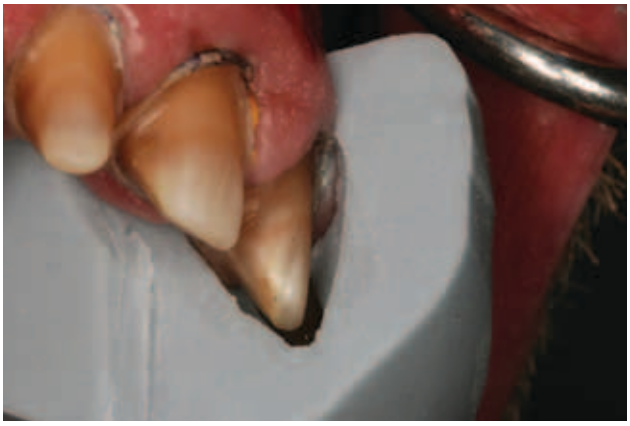

Figure 16: Sil-Tech index in second step of tooth preparation guidance process.

Figure 17: Crown gauge for final confirmation of tooth preparation reduction.

Figure 18: Use of occlusal indicator wax to confirm anterior tooth relationships in harmony with envelope of function.

Figure 19: Initial provisional restoration occlusion prior to adjustment. (Note occlusal contact #15 confirming maintenance of planned vertical dimension.)

Figure 20a

Figure 20b

Figure 20c

Figures 20a-20c: Biologically guided esthetic crown lengthening.

- increased bond strength of the resin dentin bonding agent to the dentin
- protection of the dentin and pulp from bacteria
- decreased tooth sensitivity during the provisionalization phase.

Immediate dentin sealing may be done with either total-etch (wet) or self-etching methods. In this case, a self-etching protocol was followed using Clearfil Protect Bond (Kuraray America; New York, NY). With immediate dentin sealing complete, direct, splinted provisional restorations were made using another putty silicon index of the full-contour wax-up filled with Luxatemp Fluorescent provisional material. (Note: If composite or bis-acryl provisional restorations are made directly over sealed preparations, it is important to lightly coat the preparations with a lubricant, such as petroleum jelly, prior to fabrication. This is necessary to prevent the provisional restorations from bonding to the preparations.)

One of the most critical functional elements requiring confirmation in the provisional restorations is the lingual contour of the upper anterior teeth. This is the contour of the lingual aspect of upper anterior teeth between the incisal edge and the occlusal stop. It is crucial that these contours allow disclusion of the posterior teeth with all excursive movements, yet be in harmony with the envelope of function. While many functional and esthetic elements can be determined on the workbench with accurately mounted casts and photographs, even the most carefully created wax-up represents only an educated guess of these contours. They are determined by the envelope of function and

Figure 21: Final stump shades.

must be confirmed directly in the mouth, with the patient in function.

The research of Lundeen and Gibbs made clear that with chewing, if the upper incisor lingual contour is properly shaped, lower incisal edges should contact upper incisors only at the beginning and end point of the chewing cycle—the point of maximum intercuspation.[10] Only the lingual surfaces of upper canines, and not the upper incisors, guide the mandible into maximum intercuspation during the chewing cycle.[10]

Clinically, a proper lingual contour can be confirmed with the application of Kerr (Orange, CA) occlusal indicator wax to the lingual surface of the upper anterior teeth (or provisional restorations). With the patient chewing something firm (peanuts or carrot pieces work well), it is proper for the wax to be perforated along the lingual contour of the upper canines. However, on central and lateral incisors, the wax should be perforated only at the point of maximum intercuspation (Fig 18). Occasionally, it is even necessary to change upper or lower incisal edge positions to accommodate the envelope of function. This is one reason why incisal edge positions represent both a key esthetic *and* functional element. In this case, no occlusal adjustment of the provisional restorations was required on the day of preparation, and only minimal adjustment at the one-week follow-up visit (Fig 19).

Osseous Esthetic Crown Lengthening

A key biologic principle in periodontics is that the relationship of the gingival margin to crestal bone is genetically determined and variable from patient to patient.[11] As a result, if crestal bone height is surgically reduced, the gingival margin can be expected to mature at the same relationship to the new osseous crest as it had before osseous reduction—as long as a normal epithelial attachment exists and gingival tissues are healthy.

If osseous surgery is performed, the final gingival margin levels after healing can be predicted at the time of surgery. Knowing this, the gingival flaps may be immediately positioned at these levels at the surgical appointment. This allows finalization of tooth preparations and impressions as soon as early healing is complete—approximately four to six weeks after surgery. Without applying this biological principle, final gingival levels cannot be predicted at the time of surgery, and final tooth preparation and impressions must wait until full gingival maturation has occurred—a minimum of 12 weeks after osseous reduction. These concepts were the basis for our patient's esthetic crown-lengthening technique.

Once he accepted gingival levels and contours developed at the tooth preparation appointment, the patient was referred to a periodontal surgeon, Dr. Michael Morgan (Independence, OH), for the osseous phase of esthetic crown lengthening. Pretreatment distances of gingival margins to the osseous crest (measured and recorded earlier, prior to initial soft tissue recontouring), combined with final approved provisional margin position, guided crestal bone reduction and flap positioning (Figs 20a-20c).

Final Tooth Preparation and Impressions

Six weeks after osseous crown lengthening was complete, the func-

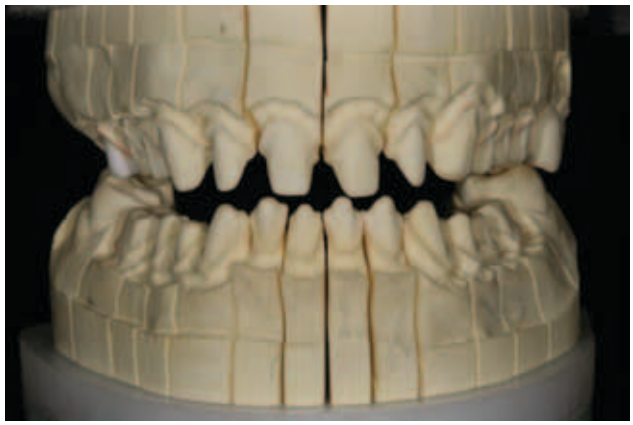

Figure 22a

Figure 22b

Figure 22c

Figures 22a-22c: Cross-mounted working dies and provisional restoration casts.

tionally and esthetically approved lower provisional restorations were removed. At this time, the final step to ensure proper tooth reduction was done by checking the thickness of each provisional restoration with a crown gauge (Fig 17). Necessary adjustments to tooth preparations were made to allow adequate and uniform restorative material thickness for optimum strength and esthetics. A single Ultrapak retraction cord (Ultradent Products; South Jordan, UT) was placed, and the immediate dentin sealing process described previously was performed again in those areas where teeth were re-prepared. After dentin sealing was complete, the retraction cord was pushed deep enough into each sulcus to expose approximately .5 mm of tooth structure apical to preparation margins. Expasyl (Kerr) gingival retraction paste was then injected into each sulcus. Although Expasyl does not seem to create much gingival retraction on its own, it does a good job of maintaining gingival retraction already developed by other means, and it provides excellent hemostasis. Sixty seconds after the last increment of Expasyl was injected, all was rinsed off with an air/water spray. Final impressions were immediately taken with custom trays filled with Aquasil LV and Aquasil XLV (Dentsply Caulk; Milford, DE) injected into each sulcus.

Prior to removing the upper provisional restorations, a bite registration between the final lower tooth preparations and these provisionals was made and set aside to be used later for cross-mounting procedures.

The upper provisional restorations were then removed, preparations refined, retraction cord placed, and final impressions made in the same manner they were for the lower teeth. A facebow registration to re-

cord the hinge axis was made. Next, the critical final bite registration between upper and lower final preparations was made. Even with a facebow registration made, it is a good idea to make this bite registration at, or as close as possible to, the final vertical dimension of occlusion. This can usually be accomplished with an acrylic or composite Lucia jig made chairside to fit over the upper incisor preparations and adjusted to the final VDO. (Remember to lubricate the teeth first if you have done immediate dentin sealing and are making a composite jig directly in the mouth.) As with the DATA Appliance, the Lucia jig should allow contact of one lower incisor, perpendicular to the path of closure. With the Lucia Jig made, a Futar bite registration was made. Stump shade photographs were taken and upper and lower provisional restorations re-cemented with a polycarboxylate temporary cement (Fig 21).

The last part of this article will describe the process of communicating esthetic and functional elements with the laboratory technician. This communication will guide fabrication of the final restorations. The restorations will then be seated and the appliance reintroduced to refine the functional occlusion. After refinement of the functional occlusion, the appliance will be used to confirm a final parafunctional activity diagnosis and protect the final restorations from potential nocturnal bruxing and clenching.

Part III

Introduction

Completion of the treatment described in Parts I and II of this article left the patient ready for final restoration fabrication and seating.

The following have been accomplished for the patient thus far:

1) A DATA Appliance has been utilized to create a stable biomechanical platform.
2) Ideal functional and esthetic restorative treatment objectives have been determined and designed on this platform.
3) Tooth preparations and crown-lengthening procedures consistent with this design have been performed.
4) Provisional restorations matching this design have been fabricated and seated.

The final part of this article will illustrate a process for creating and seating final restorations mimicking the esthetic and functional qualities developed in these provisional restorations. Key functional and esthetic qualities requiring communication will be listed and methods of communicating them detailed. In conclusion, techniques for utilizing the appliance to perfect and protect these restorations will be described.

Laboratory Communication

Communication of both the functional and esthetic qualities developed in the provisional restorations is critical if each is to be realized in the final restorations. Key esthetic elements to be communicated include:

- upper and lower incisal edge positions
- upper and lower incisal embrasure forms
- upper posterior buccal cusp tip positions
- upper and lower labial and upper buccal contours
- the most gingival point of anterior tooth interproximal contacts.

Key functional elements to be communicated include:

- upper and lower incisal edge positions
- anterior tooth stop presence and locations
- upper anterior tooth lingual contours
- lower posterior tooth buccal and lingual contours
- posterior tooth fossa and incline forms.

These elements can be effectively communicated by cross mounting accurate casts of the provisional restorations against casts of the master dies. This involves first mounting the casts of the upper and lower working dies using the facebow and final bite registration. Next, the cast of the upper provisional restorations is mounted opposing the lower working die cast. Finally, the cast of the lower provisional restorations is mounted to the upper provisional cast. With this completed, all provisional and working die casts are cross mounted (Figs 22a-22c). Fabrication of putty silicon indexes of the mounted provisional casts then allows precise duplication of functional and esthetic elements. Processes to communicate one functional element will be described in greater detail.

As detailed in the previous part of this article, one of the most important functional elements is the lingual contour of the upper anterior teeth. Once perfected in the patient's mouth on the provisional restora-

Figure 23a

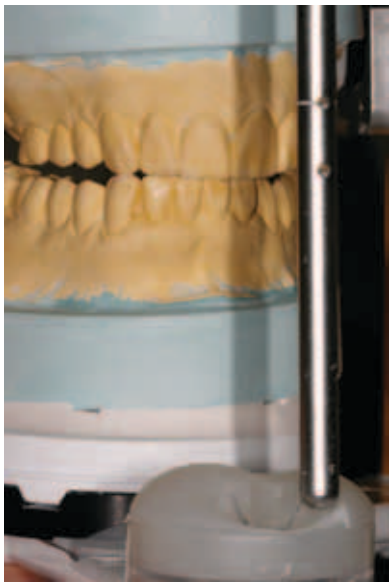

Figure 23b

Figure 23c

Figures 23a-23c: Custom incisal guide table recording lingual contour of approved upper anterior provisional restorations in lateral and straight excursive movements.

tions, it is critical that they be duplicated in the final restorations. This is most effectively done with use of a custom incisal guide table (Figs 23a-23c). The custom incisal guide table is made using the cross-mounted casts of the upper and lower provisional restorations and records the lingual contours of the upper provisional restorations. Once fabricated, it is used to confirm duplication of these contours on the final restorations. Duplication of contours is confirmed when the articulator's incisal pin maintains contact with the custom guide table while the upper and lower final restorations maintain contact with each other through all excursive movements on the articulator. If a restoration causes the incisal pin to separate from the guide table, this would indicate that the lingual contour of that restoration is more restrictive to the envelope of function than the provisional restoration. More restrictive lingual contours create potential problems with both functional occlusion and parafunctional activity movements and should be avoided.

RESTORATION FABRICATION

Sil-Tech indexes are made from the cross-mounted provisional casts to record incisal edge and buccal cusp tip positions. These will be used to confirm the final wax-ups and to guide porcelain cutback and layering techniques (Figs 24a-24d).

Full-arch Sil-Tech matrixes are made from the upper and lower provisional casts. The die casts are then checked for any areas that may interfere with complete seating of the matrixes over these casts. Once complete seating is confirmed, the matrixes are injected with wax onto the die casts.

The wax injections are then checked against the index of the cross-mounted provisional casts for accuracy. They are then individually separated and the anatomy, contours, and function are refined. Each individual wax crown is then sprued.

The sprued wax-ups were invested, burned out, pressed, broken out of the investment, and fit and contoured to match the provisional casts. The restorations were cut back utilizing the wax-up stents and layered. Each restoration was carefully checked to make sure there was only point contact on cusp tips and in fossae or on marginal ridges. Upper anterior tooth lingual contours were confirmed utilizing the custom incisal guide table.

The restorations were then checked for shade, glazed, pol-

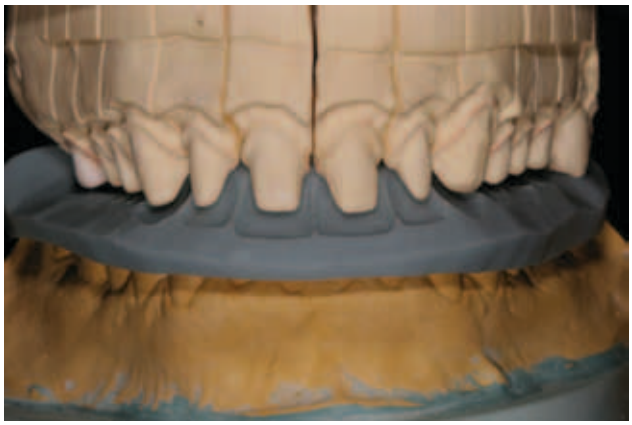

Figure 24a

Figure 24b

Figure 24c

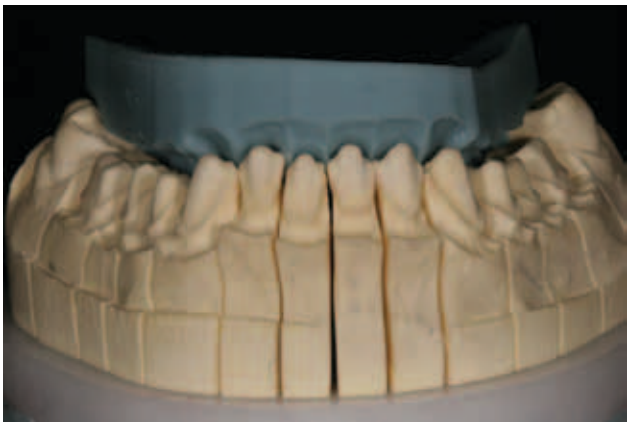

Figure 24d

Figures 24a-24d: Sil-Tech guides for incisal edge and buccal cusp tip communication. These will also be used to assist in porcelain cutback and layering procedures.

ished, etched, and ready for delivery (Figs 25a-25c).

Restoration Seating

There are a number of protocols for seating final restorations. Protocols include the choice of cementing/luting media and restorations being seated in either one or multiple visits. Cementing/luting protocols should be based upon the type of restorations and the manner in which the teeth were treated at the time of preparation (e.g., was immediate dentin sealing utilized?). The decision to seat all restorations in one or multiple visits is affected by several factors, including patient availability, comfort, and operator preference. Either option is acceptable and should be chosen to meet the specific needs of each case. In this case, limited patient availability made it more practical to seat all restorations in one visit.

The facts that the final restorations were pressed ceramic and that immediate dentin sealing was used at the time of tooth preparation determined the cementation technique. Pressed ceramic restorations rely on a strong bond between the restoration and prepared tooth structure (dentin and enamel) for their strength. With immediate dentin sealing, the bond to enamel and dentin are created at the time of preparation, leaving both exposed enamel and dentin covered with a thin layer of bonded resin. Therefore, the critical bond at the time of seating is that between the restoration and this layer of resin. In this case, because immediate dentin sealing was performed with Kuraray Protect Bond, Kuraray DC Bond and Esthetic cement were chosen for final bonding and cementation. Kuraray DC Bond is a dual-cure, self-etching adhesive. Esthetic cement is a dual-cure resin cement. After removal of

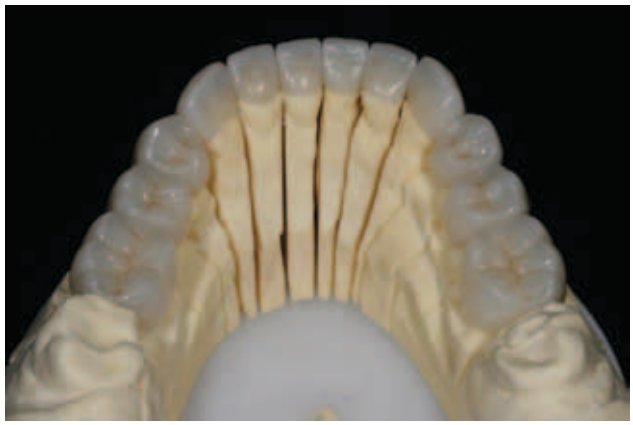

Figure 25a

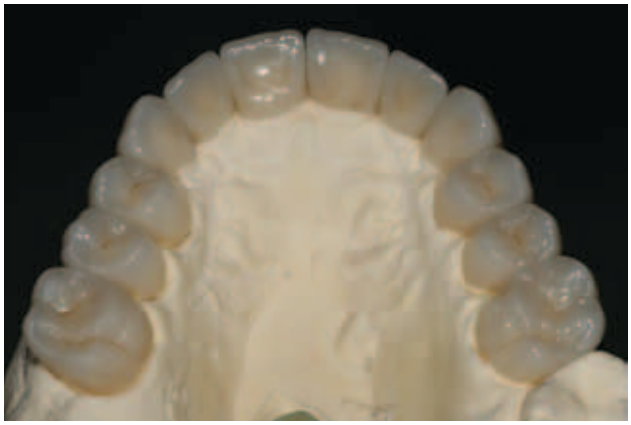

Figure 25b

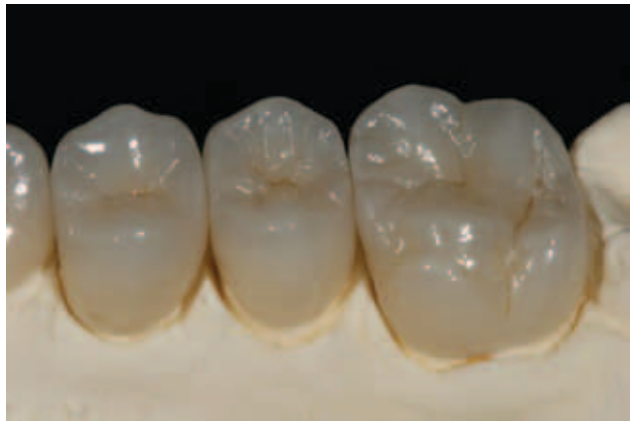

Figure 25c

Figures 25a-25c: Final restorations on casts.

the provisionals, the preparations were cleaned with micro abrasion. The DC Bond was then applied to the already sealed preparations to ensure bonding to the existing resin layer and any tooth structure that may have become exposed during cleaning. The inside of the restorations were primed with Kuraray ceramic primer. The restorations were filled with Esthetic cement, seated, and cured.

Functional Occlusion Refinement and management of Parafunctional Activity

With careful attention to all case details, from tooth preparation and bite registration techniques to final restoration seating protocols, there should not be much need for occlusal adjustment. However, subtle refinement is required in nearly all cases. If necessary, initial occlusal adjustments can be made at the seating appointment. Conversely, final refinement of the functional occlusion is best completed at a later visit, when the patient's masticatory muscles are rested and deprogrammed, and mandibular movements are not influenced by local anesthetic. If many restorations are involved, it is helpful to make these refinements with use of the DATA Appliance.

A brief time of wearing the appliance after restorations are seated once again allows complete relaxation and deprogramming of masticatory muscles. Then, the appliance can guide final adjustment of the restorations in the same manner it guided reductive reshaping of the original dentition (although this should involve only very slight adjustment of the restorations) (Fig 26). While use of the appliance is not mandatory, it is a simple technique to finalize the functional occlusion with tremendous precision.

If the appliance is to be used after restorations are seated, the existing

Figure 26: Occlusal stops after final occlusal adjustment with the DATA Appliance. (Again, note occlusal stop on #15 confirming achievement of planned vertical dimension.)

appliance may be refit chairside, or refit or refabricated in the laboratory on casts of the final restorations. The practicality of re-using the previous appliance, or fabricating a new one, depends primarily upon the amount of change in upper tooth contours. In this case, because major changes were made in the lingual contours of upper teeth, a new appliance was made and seated to finalize the functional occlusion.

Even with the functional occlusion perfected, unmanaged parafunctional activity can damage natural teeth or any type of restorations. Therefore, once refinement of the functional occlusion is complete, attention should turn to management of parafunctional activity. During the evaluation phase, this patient's response to the appliance determined a *preliminary* parafunctional activity diagnosis of benign or structural parafunctional activity. This was based on the fact that there was little evidence of parafunctional activity on the appliance stop for the six weeks it was worn. However, a *final* diagnosis of parafunctional activity requires at least six *months* of monitoring. For this reason, if there is suspicion of nocturnal bruxing or clenching, it is recommended that the appliance be used as a nightguard following placement of final restorations. This is for two important reasons:

- It will allow monitoring of parafunctional activity to determine if there is need for long-term nightguard utilization.
- It will protect the new restorations from any nocturnal bruxing or clenching activity, if any is present.

To perform these functions, after occlusal finalization, the DATA Appliance is modified by adding additional acrylic to the anterior stop. However, the stop is now designed differently than it was during initial patient evaluation. At initial placement, only a single lower incisor made contact with the anterior stop. Now, acrylic is added to allow both lower central incisors to contact the anterior stop with equal intensity. The anterior stop is also vertically opened enough to clear canine tooth interference in lateral excursive movements.

Conclusion

Many systems exist today for dentists to help their patients achieve ideal esthetics and function. To be most useful, a system should fulfill five basic requirements. It should:

- provide highly predictable esthetic *and* functional results
- be simple enough to be understood and used by most dentists
- be usable in a broad range of clinical situations
- make efficient use of operator and patient time
- allow flexibility in phasing treatment.

It has been the goal of this article to illustrate how utilization of the DATA Appliance, the Integrated Classification System, and development of a stable biomechanical platform fulfill these requirements.

Although the case illustrated in this article involved significant functional and esthetic challenges,

Figures 27a & 27b: The patient, free of pain, with a new smile and a new attitude.

the principles utilized apply to all patients who desire an improvement in masticatory system comfort, function, or esthetics. These fundamental principles include first using the DATA Appliance and ICS to determine if the patient can benefit from definitive restorative or occlusal treatment. Second, the appliance is used to facilitate development of a stable biomechanical platform. If no other restorative or esthetic needs exist, development of this platform represents the end of treatment—leaving the patient comfortable and in a biomechanically maintainable state of dental health. If, on the other hand, the patient needs or desires additional restorative or esthetic treatment, the stable biomechanical platform provides the foundation upon which this treatment can be predictably planned and delivered. In addition, because the platform is developed at a vertical dimension of occlusion that is appropriate for planned restorative and esthetic treatment, many phasing options for final treatment are possible. Final restorations may be completed simultaneously, as they were in this case, or phased over time, without compromise to esthetics or function.

While this article has highlighted the benefits of utilizing the ICS, the DATA Appliance, and developing a stable biomechanical platform, achieving long-lasting esthetics and function requires techniques and skills beyond those needed just to utilize these tools. Proper tooth preparation and laboratory communication are among those most essential. For this reason, a description of some of these additional techniques has also been detailed in this article to acknowledge their importance. In the end, consideration and management of all factors affecting each part of the masticatory system are critical if predictable outcomes are to be realized.

By accepting treatment, our patients demonstrate a high level of confidence in our clinical skills and judgment. By agreeing to provide treatment, we in turn should assume responsibility to provide the finest care possible. However, while clinical excellence is important, if we are to truly consider our treatments successful, patients should benefit from our efforts. We should in some way make our patients' lives better for what we have done for them (Figs 27a & 27b).

Acknowledgments

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Replacing Congenitally Missing Lateral Incisors and Enhancing Soft-Tissue Esthetics with Metal-Free Three-Unit Fixed Restorations

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(AAACD)
Vancouver, BC, Canada
www.mysmilemakeover.com

Nelson A. Rego, CDT
AACD Accredited Member
(AAACD)
Santa Fe Springs, CA
www.regosmiles.com

Introduction

Replacing a missing anterior tooth has traditionally been a daunting and frustrating endeavor for esthetic dentists and their laboratory ceramists to undertake. The difficult task of creating natural-looking restorations that blend seamlessly with the surrounding dentition is compounded by the challenges of re-establishing or maintaining the gingival architecture.[1]

In the past, the treatments for a missing anterior tooth have included, but were not limited to, a flipper partial denture, orthodontic movement, or a three-unit porcelain-fused-to-metal bridge.[2-4] With the advent of new dental materials and techniques intended to raise the level of esthetic and functional outcomes, different treatment alternatives are available to close the gap between natural and artificial dentition. For example, dental implants are rapidly becoming the treatment modality of choice, particularly for the replacement of a single tooth.

There are still situations in which the replacement of a single missing tooth is most appropriately accomplished with an anterior bridge.

However, there are still situations in which the replacement of a single missing tooth is most appropriately accomplished with an anterior bridge. For example, despite the availability of small-diameter implants,[5] inadequate inter-tooth space may eliminate some patients from consideration for implant therapy to replace a missing anterior tooth. For such patients, a three-unit bridge esthetically created using metal-free materials may be the best alternative.

Figure 1: Preoperative, full face. Note the two obvious congenitally missing lateral incisors (i.e., #7 and #10).

Figure 2: Preoperative, close up.

The astute clinician and laboratory technician can conquer the challenges associated with reproducing tooth form, function, color, and esthetics while blending anterior three-unit bridge restorations into the dental-facial composition by developing a well thought out and implemented treatment plan.[6] Such treatment plans should incorporate diagnostic and provisionalization techniques so that all members of the dental team (e.g., dentist, laboratory technician, and patient) are able to evaluate the anticipated effects of proposed restorations designed to replace the missing anterior tooth/teeth.[7] They should account for such aspects of the dental-facial composition as the face, lips, gingival tissues, and teeth as they relate together in smile design.[8]

This article presents in detail a case in which the tooth replacement method of choice was a zirconium-based anterior bridge. Paramount to the success of the case was the manner in which the treatment plan was developed using diagnostic wax-ups, as well as how the patient was provisionalized with an ovate pontic that was developed using a gravity technique. Equally significant to the success of the case was how the gingival architecture was managed throughout the treatment protocol.

Case Presentation

Chief Complaint

A 21-year-old female patient was referred specifically for treatment of the anterior region (Fig 1). She presented with an existing acrylic partial denture with wire clasps to replace the congenitally missing upper left and right lateral incisors (i.e., teeth #7 and #10) (Fig 2). The patient was in the restaurant industry and very self-conscious about her appearance. She felt her partial denture did not look natural, and she did not like having to remove it from, and return it to, her mouth. Therefore, she was seeking to replace the partial denture with a more natural-looking and fixed alternative, one that would not produce a dark gingival margin such as she had seen in elderly people.

Additionally, the patient did not like the yellow color of her teeth and was aware of the mottled appearance of the central incisors, the diastema between them, and the misshapen canines (Figs 3 & 4). She was anxious to address the unesthetic appearance of her anterior teeth as soon as possible, and she also wanted to take advantage of this opportunity to whiten the rest of her dentition.

Medical and Dental History

Findings

A comprehensive examination and review of the patient's medical history showed her to be in good health, with no significant abnormal findings. The soft tissue in the palate had severe candidiasis from the maxillary partial retainer. Her tonsils were present.

Her upper and lower lips were thin, exhibiting a normal smile line. Her gingival health was fair, with minimal areas of recession and no pocketing greater than 4 mm upon probing. The teeth had light areas of staining and supragingival calculus. There were hypocalcification spots/stains present on the facial aspects of some of her teeth that resulted from the orthodontic therapy she had in her teens. Her occlusion was Class

Figure 3: Retracted preoperative view of the patient showing the yellow color of her teeth and the mottled appearance of the central incisors.

Figure 4: Close-up 1:1 view of the patient's central incisors. Note the diastema between them.

I with a 3-mm overbite and 2-mm overjet. The maximum opening was 1.75 inches, and centric relation equaled centric occlusion. The temporomandibular joint and muscles of mastication were asymptomatic.

Radiographically, mild root resorption from the orthodontic treatment was noted for teeth #8 and #9. At the #7 and #10 sites (Fig 5), the space between the roots was 4.5 mm. If an implant were to be placed, we would need 1 mm to 1.5 mm on either side of the implant to adjacent root, meaning that we would have to place a 1.5- to 2.5-mm implant perfectly. To make room for it we would need to consider doing orthodontics again. The patient declined this option as the previous orthodontic therapy had contributed to the shortening of the roots of the upper anterior teeth. It appeared that tooth #6 was also missing, but the retained primary canine demonstrated a solid root and was not mobile. The #7 and #10 pontic areas had been distorted by the partial denture, and it appeared that no attempt had been made to create an ovate pontic site in the tissue. The ridge had collapsed mildly from the facial at the #7 and #10 sites.

The patient had had all four wisdom teeth extracted as a teenager, and the previous dentist had begun to change some of her posterior restorations from amalgam to composite. She still had existing amalgam restorations on teeth #2, #3, ##13-15, #18, #19, #30, and #31. Composite restorations were present on teeth #12, #20, #21, and #28.

Diagnosis and Planning

Several challenges were noted after a thorough examination of the digital photographs, evaluation of stone casts, and discussions between the restorative clinician and the laboratory technician. The maxillary midline was 2 mm to the right of the facial midline and the central incisors looked quite long due to the width-to-length ratio being 75%. The smile was canted, being lower on the left side than the right, and the teeth were not axially aligned. The gingival heights, contours, and zeniths could be improved on both canines.

The upper and lower arch forms were ovoid. The buccal corridor was fairly well developed in the natural dentition, and the contact points migrated apically moving posteriorly. It should be noted that having minimal buccal corridors has been found to be a preferred esthetic feature in both men and women, with large buccal corridors being something to be included in the problem list during treatment planning.[9]

After discussing all the possible restorative options, including implants, the patient opted for a full-coverage three-unit zirconium-based bridge for teeth ##9-11. This option also would enable the restorative team to address the patient's desire for better anterior esthetics on the abutment teeth.

A three-unit zirconium-based bridge was also planned for the retained primary right canine to tooth #8 in order to match the left bridge. While it was possible to include tooth #5 in the treatment plan, it was decided not to sacrifice

a virgin tooth in order to increase the lifespan of the bridge. Since the primary tooth had not demonstrated any signs of mobility, it was decided that the combination of group function, and regular examinations for signs of root resorption would ensure that the bridge would last the patient well into her 30s.

To address all of the patient's requests, as well as satisfy all clinical requirements, the treatment plan/sequence was as follows:

1. Treat the maxillary candidiasis with nystatin lotion.
2. Whiten teeth with Zoom 2 (Discus Dental; Culver City, CA) in-office whitening.
3. Perform ridge augmentation with connective tissue grafts at the #7 and #10 sites.
4. Fabricate diagnostic wax-up and reduction guides.
5. Prepare teeth, create ovate pontic sites, and provisionalize (Luxatemp, Zenith/DMG; Englewood, NJ).
6. Refine prepared teeth and take final impressions for porcelain-pressed-to-zirconium (IPS e.max ZirCAD/ZirPress, Ivoclar Vivadent; Amherst, NY) bridges.
7. Create two three-unit bridges.
8. Insert bridges with a dual-cure resin cement (Multilink, Ivoclar Vivadent).
9. Follow-up treatment with hygiene and home care for optimal gingival health.

Clinical Protocol

Following treatment of the candidiasis with nystatin lotion[10] and in-office whitening (Zoom 2), preoperative maxillary and mandibular full-arch impressions were taken using Precision (Discus Dental) light-body polyvinyl siloxane (PVS) wash material and Precision medium-body PVS matrix material in a full tray. A facebow relation also was taken (Kois Dento-Facial Analyzer, Panadent; Colton, CA), in addition to a stick bite to relate the horizontal plane. A diagnostic wax-up was fabricated and sent back to the clinician.

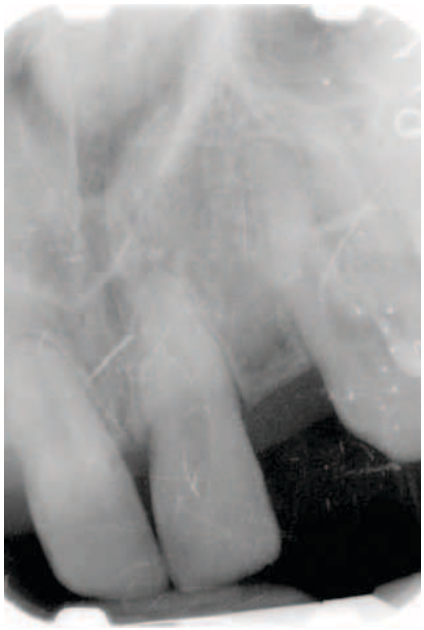

Figure 5: Preoperative x-ray of missing #10. Note the minimal space (4.5 mm) between roots of the natural teeth.

Tissue Management

The augmentation of edentulous sites can permit the placement of three-unit bridges with highly esthetic pontics.[11] The periodontist was given a stone model and diagrammatic photographs to serve as a guide for where the tissue should finish. The pontics on the partial denture were shortened, and the connective tissue graft was allowed to heal for eight weeks. With the swelling subsided and the facial and lingual tissue in the pontic space bulked up, the development of the ovate pontic areas could begin.

Provisionalization

After determining overall healing of the pontic areas, the abutment teeth were prepared with heavy 1.5-mm reduction and 360° chamfer margins using coarse and fine bullet-nose diamond burs (Fig 5). All line angles were polished to ensure that there were no sharp ones.

A wax-up of the proposed bridges had been returned from the technician with a putty matrix for creation of provisional restorations. The putty matrix was filled with temporary material (Luxatemp acrylic shade A1) in the areas of the bridge preparations and placed over the teeth. The bis-acrylic was allowed to set for two minutes before being removed to ensure that the provisional did not lock onto the teeth. The margins of the provisional were trimmed using finishing burs and discs.

To create the ovate pontics, a light-cured flowable acrylic (Luxaflow, Zenith/DMG) was added to the pontics in increments using a "gravity technique" (Figs 6 & 7) until slight blanching of the tissue was visible. The egg-shaped pontic was polished until it was glassy-smooth, and the embrasures were contoured to ensure that the interproximal papilla was not pinched, yet received the guidance necessary to create a symmetrical papilla and close off any black triangles. It should be noted that unless care is taken to ensure proper healing of the papilla, clinicians could witness an unwanted gingival overgrowth or limited re-

Figure 6: The abutment teeth were prepared with heavy 360° chamfer margins using coarse and fine bullet-nose diamond burs.

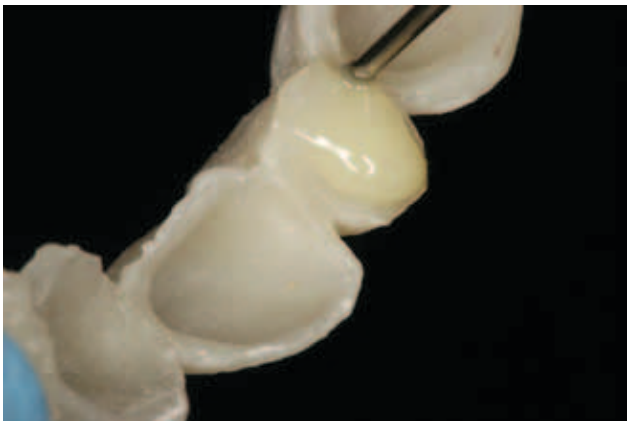

Figure 7: Flowable composite is added incrementally to the pontic sites of the provisional bridge restorations that were created from a putty matrix of the wax-up.

generation potential in this esthetically demanding area.[12]

The polished provisional bridge was cemented with temporary cement (Systemp.link, Ivoclar Vivadent), after which the occlusion was checked for clearance (Figs 8 & 9). The patient was instructed to keep the area clean by flossing and using a hydrogen peroxide infuser tip.

After two weeks, the provisional restoration was removed and the pontic sites assessed. The future sites were checked using a periodontal probe to ensure that the 1-mm to 3-mm depths of the ovate pontic sites were above the underlying bone by 1 mm or more. The sites were successfully created, and each resembled a freshly extracted tooth. The areas were cleaned with hydrogen peroxide and compared to ensure similarity of the facial contours of the #7 and #10 sites. The provisional bridge was replaced using temporary cement (Systemp.link).

The preparations were refined and final PVS impressions, bite registrations, and records were taken for the laboratory. A detailed prescription that included digital photographs, a shade map, and the final shade of Chromascope 110/040 (Ivoclar Vivadent) was provided to the laboratory technician (Fig 10). It is important to note that although the patient approved the selected shade, she was adamant that the restorations mimic the natural incisal translucency exhibited in her natural mandibular teeth. These characteristics were noted and also forwarded to the laboratory. A Kois facial analyzer record also was sent, along with an impression of the approved provisionals with midline and horizontal plane placement for the definitive bridgework.

Laboratory Fabrication

When the impressions were received at the laboratory, they were poured in a Class IV die stone and allowed to harden for 24 hours. Careful attention was paid to the water/powder ratio to ensure the proper expansion. Working models (Fig 11) were fabricated and mounted on a Panadent articulator using the Kois Dento-Facial Analyzer, and the approved provisionals were also mounted to the opposing model. A matrix of the approved provisionals was fabricated and used to evaluate facial and proximal reduction.

Because these bridge restorations needed to satisfy a combination of functional and esthetic requirements, it was determined that a single restorative system should be selected that would meet these criteria and blend seamlessly with the natural teeth. Therefore, a recently introduced universal all-ceramic system that combines computer-aided design/computer-aided manufacturing (CAD/CAM) and pressable technologies (IPS e.max) was selected. This system's integration of high-strength zirconium substructures enabled the use of connectors that were small enough to allow natural-looking interproximal contours, yet with the required separation between abutments and pontics.[13,14]

In preparation for the CAD/CAM design process, the dies were carefully trimmed and all undercuts were blocked out with wax. The working model was powder-coated with a scanning spray (Dentaco, Vident; Brea, CA) and scanned

Figure 8: After the flowable composite is added to the provisional pontic, the temporary is turned over, allowing the composite to flow with gravity, thereby creating the egg-shaped ovate pontic.

Figure 9: Retracted full-facial view of the patient immediately following placement of the provisional restoration.

using the InEos Scanner (Sirona Dental Systems; Charlotte, NC). The opposing cast was also scanned to ensure that the frameworks would demonstrate sufficient room for lingual porcelain.

The zirconium frameworks (ZirCad) were designed and milled using a CEREC 3D milling machine (Sirona). The margins were cut back to minimize the opacifying effect of material at the margins. Note that zirconium is milled in a partially sintered state that allows for easier milling, and the majority of the framework contouring was accomplished at this time. Final sintering was achieved by using a sintering oven that baked the zirconium at 1515° C over a seven-hour period.

The frameworks were evaluated for fit, and final adjustments were made (Fig 12). After steam cleaning, the frameworks were coated with ZirLiner (Ivoclar Vivadent) to create an optimal bonding surface and baked at 960° C. The zirconium frameworks were placed on the working model (Fig 13), after which a full-contour wax-up was created, with careful attention paid to matching the approved provisionals (Figs 14 & 15).

The waxed bridges (Fig 15) were sprued and invested utilizing the speed press technique and pressed in ZirPress using the LT B1 ingots. After cooling and divesting, the bridges were evaluated for fit and then ready for layering. As one of the patient's primary requests was that her new restorations exhibit the same type of translucencies and subtle colors as her lower anteriors, after a careful examination of the digital photographs, the ZirPress material was cut back to create the many nuances and characteristics required to make the bridges "disappear."

A foundation bake was created with a small amount of Transpa ceramic and Essence powders (Ivoclar Vivadent) and baked at 750° C (Fig 16). The bridges were layered with Incisal white, bamboo, blue, and amber powders (Ivoclar Vivadent) to create the dispersion of colors that were present in the patient's natural dentition and then baked at 750° C. The bridges were checked with the matrix to ensure that the effects were in the proper places. A final layer of Transpa and Opal Incisals (Ivoclar Vivadent was added to create the translucency necessary to achieve seamless integration with the patient's natural teeth.

The bridges were contoured using various diamonds and rubber wheels, with careful attention given to reflective and deflective areas. The matrix of the approved provisionals was used to ensure that the final contours of the restorations were consistent with the patient's expectations. The interproximals were contoured to create room for the interdental papillae to grow and mature; spe-

Figure 10: Close-up retracted view of the patient's provisional restoration. Note the immediately enhanced symmetry, color, and appearance of the gingival architecture despite the need for more long-term healing.

Figure 11: The final shade for the restorations was determined to be Chromascope 110/040.

Figure 12: Working models were created at the laboratory using Class IV die stone. Careful attention was paid to the water/powder ratio to ensure the proper expansion.

Figure 13: After milling, the zirconium frameworks were tried back on the model to verify fit, and the shoulders were cut back circumferentially at the margins to reduce the likelihood of high value in this area.

Figure 14: View of the bridge framework with a 360° cutback following application of the ZirLiner to enhance bonding and application of the layering porcelain.

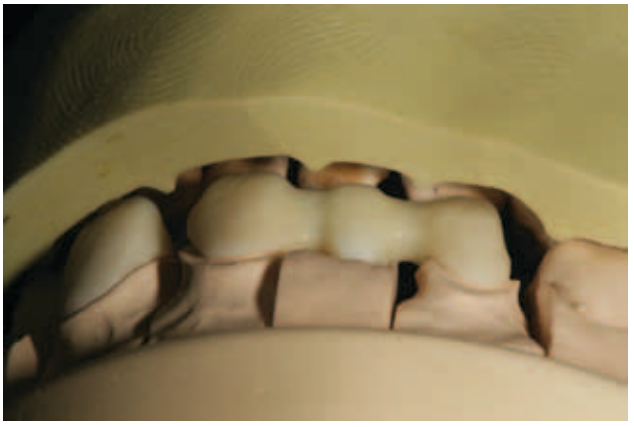

Figure 15: Using a matrix of the approved temporaries as a guide, the size of the bridge connectors are verified to ensure sufficient space for correctly applying and layering the porcelains.

Figure 16: The contours of the approved provisional restorations are waxed onto the zirconium framework.

Figure 17: A foundation bake was created with a small amount of Transpa ceramic and Essence powders and baked at 750° C.

Figure 18: The interproximals were contoured to create room for the interdental papillae to grow and mature; specifically, the clinician's instructions called for 2 mm of open embrasures.

Figure 19: View of the definitive restorations after hand polishing to create unique, natural-looking surface reflective areas.

cifically, the clinician's instructions called for 2 mm of open embrasures (Fig 17).

The bridges were lightly stained and baked once. The final polish was accomplished by hand using a soft bristle brush and Diashine (VH Technologies; Bellevue, WA) to achieve the prescribed polished gloss (Fig 18).

Final Placement and Cementation

When the bridgework was returned from the laboratory, it was inspected for fit and color on the models. Then the provisionals were removed, the preparations cleaned with hydrogen peroxide, and the bridges tried in. The fit was verified, and the pontics were checked for a snug placement.

The restorations were removed from the mouth and their internal aspects treated with 35% phosphoric acid for one minute. After rinsing and drying, the bridges were treated with Multilink zirconium primer (Ivoclar Vivadent). The manufacturer asserts that this process results in significantly higher bond strengths of approximately 25 to 35 MPa.[15,16]

The preparations were cleaned with chlorhexidine and rinsed. Multilink primer A and B were mixed and applied to the preparations for 15 seconds. Multilink dual-cure resin cement was mixed and applied to the bridge abutments.[17]

The bridges were placed, excess cement removed, and the abutment's spot tacked with a 2-mm tacking tip. By using a Butler gum stimulator (Sunstar Americas; Chicago, IL) and micro brushes, almost all excess cement was removed. The bridges were flossed and glycerin was placed around the margins to

Figure 20: Postoperative full-facial view of the patient following definitive placement of the maxillary anterior metal-free bridge restorations.

Figure 21: Postoperative close-up view of the patient in natural smile. Note the enhanced symmetry between the right and left side, and seamless color integration among the restorations and the natural dentition.

ensure curing of the oxygen-inhibited layer. The restorations were cured for one minute using a light-emitting diode curing light (bluephase, Ivoclar Vivadent). The margins were polished using a #12 scalpel blade, an extra-fine football-shaped diamond, and ET9 carbide (Brasseler USA; Savannah, GA). The occlusion was checked, and any areas adjusted were polished with a porcelain polishing kit (CeraGlaze, Axis Dental; Coppell, TX).

Conclusion

The use of full-coverage, metal-free bridges in this case enabled the restorative team to meet the patient's immediate esthetic demands in viable, positive ways (Figs 19 & 20). The combination of pressed porcelain and high-strength zirconium oxide on the natural teeth allowed the team to realize esthetic and functional possibilities.

Since the case was inserted more than 12 months ago, the tissues and the pontic sites have matured nicely (Figs 21-23). The natural teeth, having been whitened, may need touching up periodically to maintain the increased value. Future dental treatment includes finishing the posterior amalgam replacements (at the patient's request), addressing the spacing of the lower anterior teeth, and possible orthodontic treatment with clear aligners (Invisalign, Align Technology; Santa Clara, CA) if the patient desires. The possibility of future implant dentistry is not out of the question should it be necessary to replace the primary retained cuspid C, which might be lost due to its short clinical length.

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Figure 22: Postoperative; retracted view showing the harmony of color and translucency among the maxillary bridge restorations and the mandibular natural dentition.

Figure 23: Postoperative; 1:1 view of the definitive bridge restorations spanning the retained primary canine to #8 and #9 to #11. Note the harmony of the gingival heights of contour and color of the restorations.

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Predictable Smile Design

by Andre Michel, CDT, AACD
Accredited Member (AAACD)
Dana Point, CA
www.andresdentalstudio.com

Abstract

This article describes a ceramic layering technique using both a translucent and high-strength pressable ceramic. Additionally, principles of smile design, case planning, and glamour photography are touched upon; these can be used to increase patient acceptance of what a smile makeover can do for them.

Before the restorative process could begin, the patient received four-quadrant scaling and root planing and was educated on the importance of good daily oral hygiene habits.

Patient History and Case Objectives

The 35-year-old male patient presented with tooth #11 sheared off at the gum line; and #4, #8, and #10 had severe decay. Tooth #3 was missing a previous full-coverage restoration. Before the restorative process could begin, the patient received four-quadrant scaling and root planing and was educated on the importance of good daily oral hygiene habits. It was determined that #11 would receive a buildup on preparation day. The patient's chief complaint was lack of confidence in social situations (Fig l). There were three objectives to this case: To restore the broken and decayed teeth, brighten the smile, and create restorations that blended seamlessly into the oral environment.

Meeting the Case Objectives

Predictable results for smile design cases begin with a diagnostic wax-up, where function and esthetics can be worked out. A diagnostic wax-up helps plan preparation design, using minimal reductions where possible; and identifies margin placement to achieve the desired result. In this case, the teeth were in good arch form and the gingival architecture was ideal on ##6-11.

Figure 1: Preoperative portrait.

Figure 2: Provisionals.

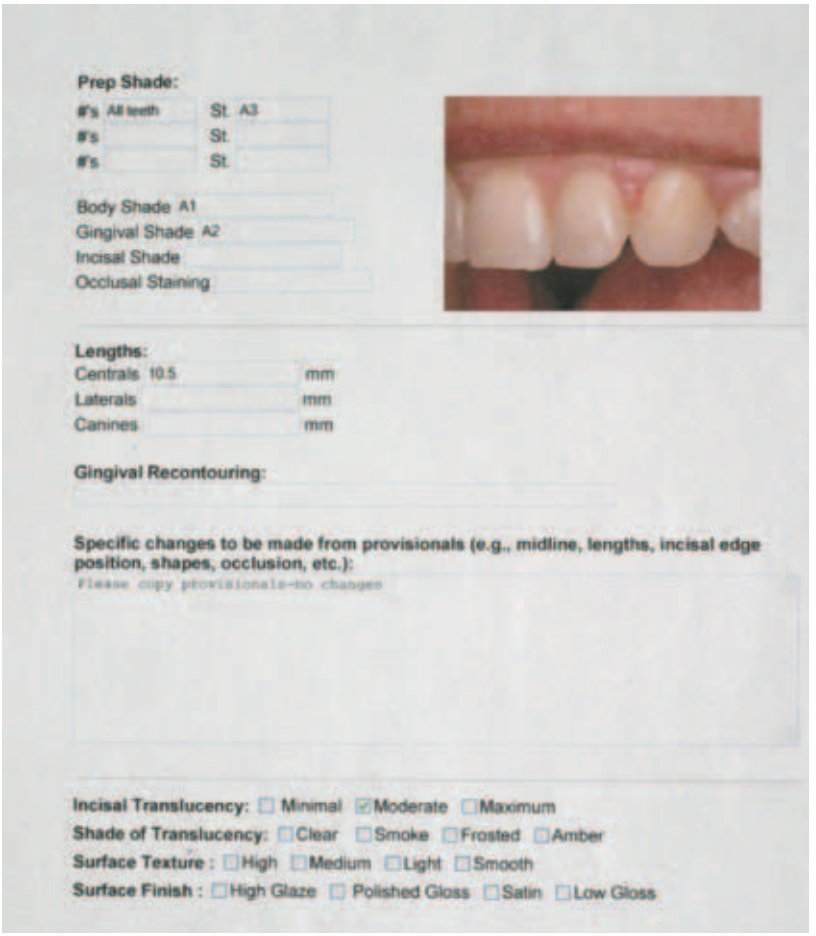
Figure 3: Stick bite.

Crown lengthening was proposed for #4, #5, #12, and #13 to improve the gingival heights in the buccal corridor, but this treatment was not accepted because the patient did not feel it important enough to justify the cost. The wax-up was all additive, there were no rotations or misalignments to correct; it was simply a matter of replacing decay and wear and then fine-tuning the form.

After being prepared, this wax-up was transferred to the patient as a provisional (Fig 2) on preparation day through the use of a silicone putty matrix. The restorative dentist provided a comprehensive laboratory prescription that included the goals of the case; detailed shade mapping; desired lengths of centrals, laterals, and cuspids; master impression with good tissue capture; opposing impression; transfer jig; diagnostic wax-up; preoperative impressions; and impression of the patient-approved provisional. Also important were the 12 standard AACD photographs, and the natural smile of the provisional not numb, stick bite in place (Figs 3 & 4). At a follow-up appointment three days later, photographs were taken of the provisionals with a natural smile and a profile shot in repose.

WAXING AND PRESSING

The model and photography of the provisional were reviewed; no changes were necessary. A silicone matrix was created over the model and placed in a pressure vessel at 40 psi (this produces excellent adaptation). This matrix was placed on the master die model and was used as a mold to inject wax on the master model (on which the dies had not been trimmed) (Fig 5). With this technique, the emergence profile and interproximal embrasures can be perfected with all of the soft tissue features in place. The margins were trimmed, and then the occlu-



Prep Shade:

#'s All teeth St A3
#'s St
#'s St

Body Shade A1
Gingival Shade A2
Incisal Shade
Occlusal Staining

Lengths:
Centrals 10.5 mm
Laterals mm
Canines mm

Gingival Recontouring:

Specific changes to be made from provisionals (e.g., midline, lengths, incisal edge position, shapes, occlusion, etc.):
Please copy provisionals-no changes

Incisal Translucency: ☐ Minimal ☑ Moderate ☐ Maximum
Shade of Translucency: ☐ Clear ☐ Smoke ☐ Frosted ☐ Amber
Surface Texture : ☐ High ☐ Medium ☐ Light ☐ Smooth
Surface Finish : ☐ High Glaze ☐ Polished Gloss ☐ Satin ☐ Low Gloss

Figure 4: Laboratory prescription.

Figure 5: Master die model wax-up with soft tissue features in place.

Figure 6: Master die model with dies trimmed.

Figure 7: Occlusal view of wax-up.

Figure 8: Vertical reduction.

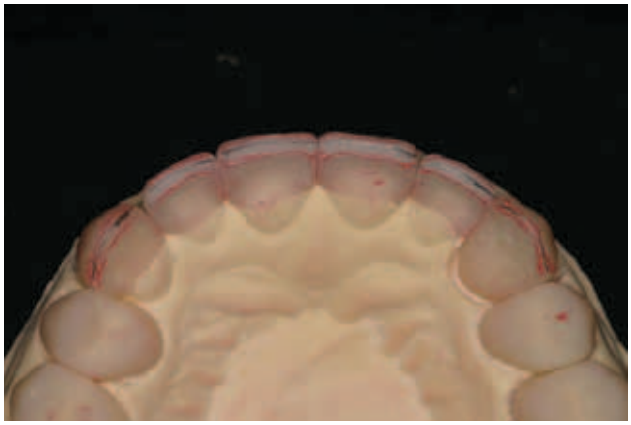


Figure 9: Incisal taper.

Figure 10: Mesial and distal troughs.

Figure 11: Mammelon structures.

Figure 12: Mammelon structures.

Figure 13: Internal staining.

Figure 14: Internal effects powders.

Figure 15: Contrasting opals.

Figure 16: Layered to contour.

Figure 17: Ready for final contouring.

Figure 18: Ready for glazing.

Figure 19: Final glaze and polish.

Figure 20: Preoperative view.

Figure 21: Postoperative view.

sion and esthetics were perfected (Figs 6 & 7).

Materials

The materials chosen for this case were Authentic pressable ceramic (Microstar Dental; Lawrenceville, GA) for anterior ##6-11 and e.Max (Ivoclar Vivadent; Amherst NY) for ##3-5, #12, and #13. Authentic is a translucent material that has a full complement of enamels and effects powders that allow a ceramist to create the "inner life" of a tooth. The ingots are translucent enough to pick up the preparation shade; this allows the restorations to "disappear" in the oral environment. E.max lithium disilicate is a translucent high-strength pressable ceramic that is well suited for posterior occlusal forces and has a very tooth-like appearance.

Cutback

Once the units were devested and fitted, the pressings were measured to see that they matched the lengths of the provisional model. Next, the incisal edge was reduced vertically 0.3 mm on ##7-10 (Fig 8). The perimeter of this area was outlined with a red pencil, and then a thin black line was drawn 0.5 mm from the facial (Fig 9). The incisal edge was then beveled back, gradually reducing from 0.5 mm to 0.2 mm down to the midfacial of ##6-11. A straight groove in the mesial-incisal edge and a curved groove in the distal-incisal edge were created to hold the low-value porcelain on ##6-11 (Fig 10). Next, the internal lobe formation was created to mimic lobe formations studied from an anonymous central incisor sliced in half (Figs 11 & 12).

Staining and Effects Powders

A blue stain (Authentic) was placed in the mesial and distal troughs, and a salmon stain (Creation, Jensen Industries; North Haven, CT) was applied to one of the

Figure 22: Postoperative view.

Figure 23: Glamour shot.

middle lobes and then fired to set the stain. Effects powders Pearl and Orange Fluoresence (Authentic) were placed over the core lobe details and then fired (Figs 13 & 14). After firing and evaluating the effects, the mesial and distal troughs were filled with Opal 3 and Opal 2 (Authentic) was placed between the lobes, which contrasted well with the effects. After firing, the contrasting Opals were evaluated and then the restorations were brought to full contour using Opal 2, while being careful to place back only what was removed in the cutback (Figs 15 & 16).

Final Contours and Glaze

The restorations were then shaped, paying close attention to the deflective and reflective zones. The lobe formations and surface texture were developed. The restorations were then rubber-wheeled (Brasseler USA; Savannah, GA) on the surface. Then the perikymata were developed using a fresh tapered diamond (850.11.016, Brasseler). A thin, even coat of fluorescing glaze (Authentic) was applied and fired. Finally, the restorations were rubber-wheeled and then polished with Diashine diamond paste (VH Technologies; Bellevue, WA) and a felt wheel and chamfered hard 22 mm, to bring up a natural-looking luster (Figs 17-19).

Conclusion

Through the use of wax injection and matrices, I was able to maintain the shapes and contours created in the diagnostic wax-up and provisionals all the way through to the final restorations (Figs 20-22).

Finally, after exceeding the patient's expectations it is important to have some professional photographs taken of the finished case and its beautiful results to help with future patient acceptance during case presentation (Fig 23).

Acknowledgment

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The American Academy of Cosmetic Dentistry recognizes Andre Michel as an AACD Accredited Member (AAACD) and a member of the AACD Board of Directors.

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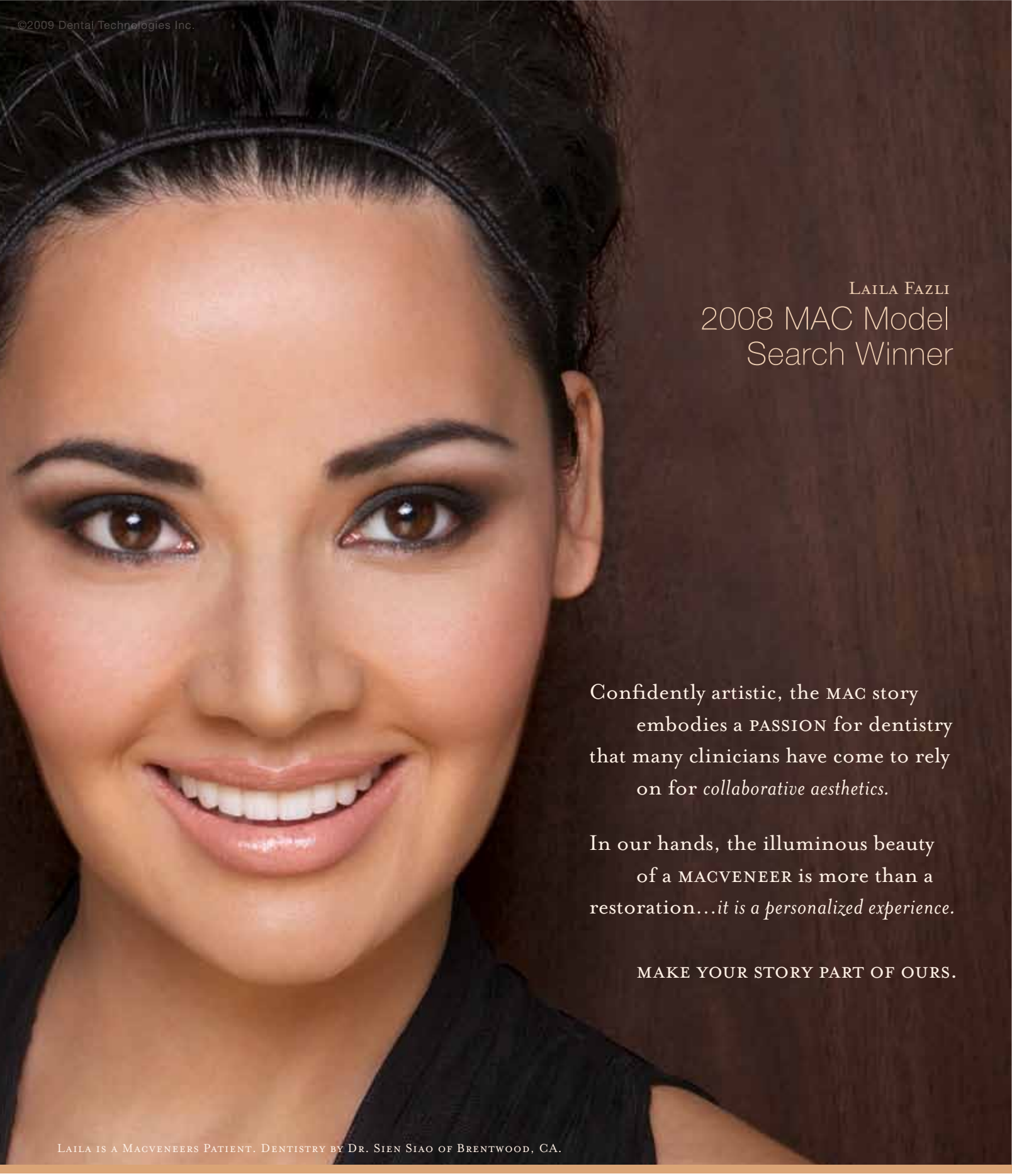

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Laila is a Macveneers Patient. Dentistry by Dr. Sien Siao of Brentwood, CA.

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