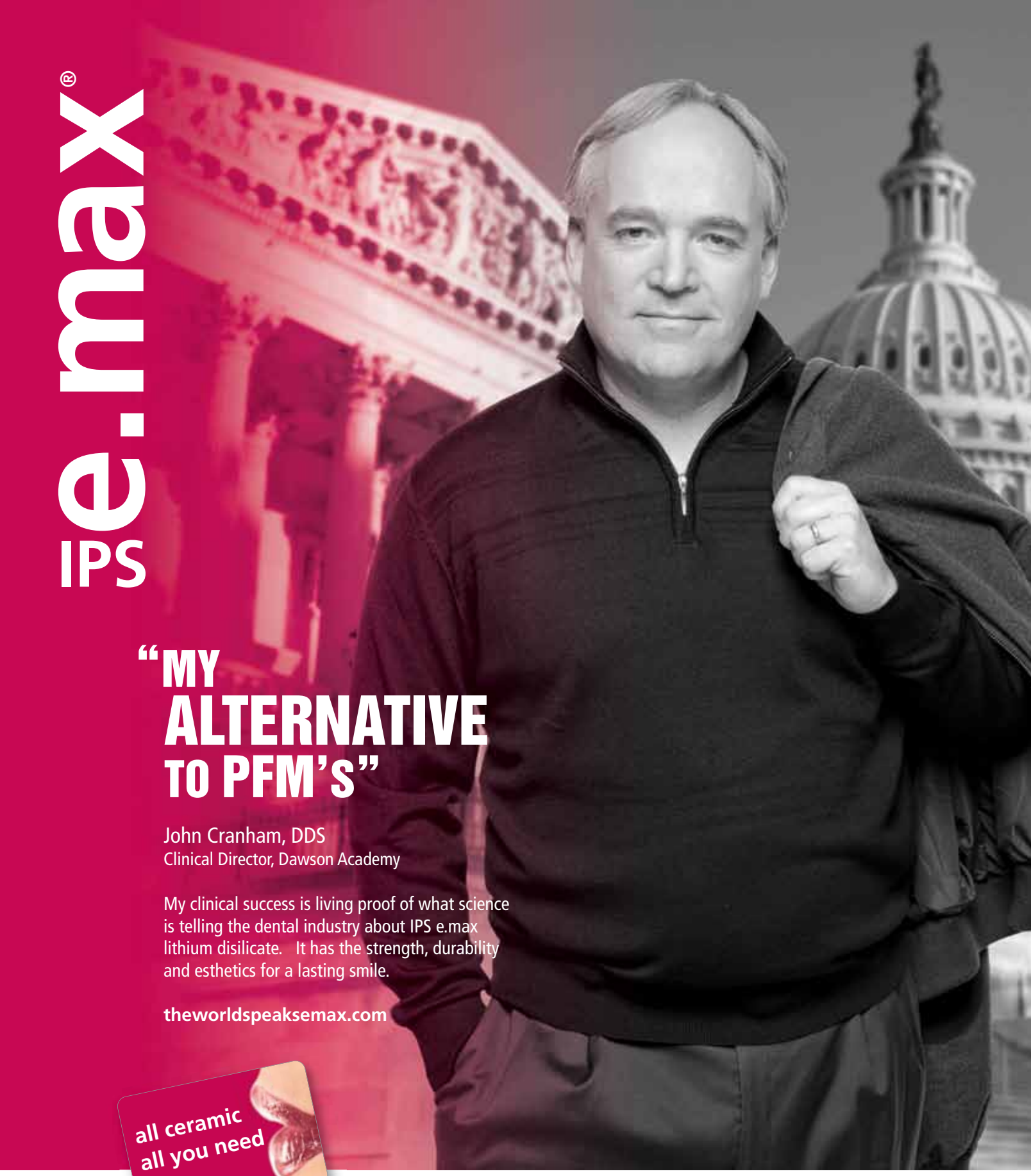
JCD
vol. 27 issue 3
Journal of Cosmetic Dentistry

MODERN, NO-PREP DIRECT RESIN
DR. JOHN F. WESTON

New Posterior & Anterior Composite Techniques
Dr. Didier Dietschi

Useful Posterior Composite Steps
Dr. Jason Smithson

FALL 2011
American Academy of Cosmetic Dentistry®



100% CUSTOMER SATISFACTION GUARANTEED!

ivoclarvivadent.com

Call us toll free at 1-800-533-6825 in the U.S., 1-800-263-8182 in Canada.

©2011 Ivoclar Vivadent, Inc. IPS e.max is a registered trademark of Ivoclar Vivadent.

ivoclar vivadent®
passion vision innovation

JCD
vol. 27 issue 3
Journal of Cosmetic Dentistry

A PUBLICATION OF THE
AMERICAN ACADEMY OF COSMETIC DENTISTRY

EDITOR-IN-CHIEF
Edward Lowe, DMD, AAACD
Vancouver, BC, Canada, edlowe@mac.com

MANAGING EDITOR
Tracy Skenandore, tracys@aacd.com

EDITORIAL ASSISTANT
Denise Sheriff, denises@aacd.com

ART DIRECTOR
Lynnette Rogers, lynnetter@aacd.com

GRAPHIC DESIGNER
Elizabeth Kiracofe, elizabethk@aacd.com

EDITORIAL CONSULTANT
Juliette Kurtz, publications@aacd.com

MANUSCRIPT DEVELOPMENT LIAISON
Allison DiMatteo, MPS, adimatteo720@centrainy.twcbc.com

MEMBERSHIP AND MARKETING DIRECTOR
Michael DiFrisco, michaeld@aacd.com

ADVERTISING AND SPONSORSHIP DIRECTOR OF STRATEGIC PARTNERSHIPS
Jeff Roach, jeffr@aacd.com

CONTRIBUTING EDITORS

Scott W. Finlay, DDS, FAGD, FAACD, Arnold, MD
Julie M. Gillis, DDS, AAACD, Grand Junction, CO
James H. Hastings, DDS, AAACD, Placerville, CA
James H. Peyton, DDS, FAACD, Bakersfield, CA
Nelson A. Rego, CDT, AAACD, Santa Fe Springs, CA
Gregory B. Wright, DDS, FAACD, Southlake, TX

EDITORIAL MISSION

The mission of the *Journal of Cosmetic Dentistry* is to educate AACD members, as well as other professionals in the field, on the art and science of cosmetic dentistry. We will endeavor to do this by publishing well-researched, peer-reviewed articles accompanied by high-quality, comprehensive clinical imagery. The objective is to enhance readers' knowledge and skills while showcasing the latest cosmetic techniques and procedures. The *Journal of Cosmetic Dentistry* will strive to help readers become better clinicians, so they can offer their patients the best—and most responsible—treatment possible.

AACD OFFICE

CHIEF EXECUTIVE OFFICER
Ed Simeone

402 West Wilson Street, Madison, WI 53703
800.543.9220 • 608.222.8583
fax 608.222.9540 • info@aacd.com • www.aacd.com

Advertising: 800.543.9220 • 608.222.8583 or jeffr@aacd.com
Editorial: 800.543.9220 • 608.222.8583 or publications@aacd.com

EDITORIAL REVIEW BOARD

Pinhas Adar, MDT, CDT, Marietta, GA
Naoki Aiba, CDT, Monterey, CA
Gary Alex, DMD, AAACD, Huntington, NY
Edward Pat Allen, DDS, PhD, Dallas, TX
Elizabeth M. Bakeman, DDS, FAACD, Grand Rapids, MI
Oliver Brix, MDT, Kelkheim, Germany
Christian Coachman, DDS, CDT, Sáo Paulo, Brazil
Michael W. Davis, DDS, Santa Fe, NM
Gerald E. Denehy, DDS, Iowa City, IA
Newton Fahl Jr., DDS, MS, Curitiba-PR, Brazil
Hugh D. Flax, DDS, AAACD, Atlanta, GA
David A. Garber, DMD, Atlanta, GA
Ronald E. Goldstein, DDS, FACD, FICD, Atlanta, GA
Dan Holtzclaw, DDS, MS, Austin, TX
Steve D. Hoofard, CDT, AAACD, Hermiston, OR
Nelson Y. Howard, DDS, AAACD, San Marcos, CA
Ronald D. Jackson, DDS, FAACD, Middleburg, VA
Michael J. Koczarski, DDS, AAACD, Woodinville, WA
John C. Kois, DMD, MSD, Seattle, WA
Gerard Kugel, DMD, MS, PhD, Boston, MA
Trevor R. Laingchild, RDT, AAACD, Burlington, ON, Canada
Ernesto Lee, DMD, Bryn Mawr, PA
David A. Little, DDS, San Antonio, TX
Robert A. Lowe, DDS, Charlotte, NC
Frank J. Milnar, DDS, AAACD, St. Paul, MN
Ricardo Mitrani, DDS, MSD, Mexico D.F., Mexico
Michael T. Morris, CDT, FAACD, Lexington, KY
Carlos A. Munoz, DDS, MSD, Buffalo, NY
Thomas W. Nabors lll, DDS, AAACD, Nashville, TN
W. Peter Nordland, DMD, MS, La Jolla, CA
Paul S. Petrungaro, DDS, North Oaks, MN
Gary M. Radz, DDS, Denver, CO
Christopher D. Ramsey, DMD, AAACD, Jupiter, FL
Nelson A. Rego, CDT, AAACD, Santa Fe Springs, CA
Dwight G. Rickert, CDT, AAACD, Indianapolis, IN
Robert G. Ritter, DMD, Jupiter, FL
Matthew R. Roberts, CDT, AAACD, Idaho Falls, ID
Jean-François Roulet, DDS, PhD, Schann, Liechtenstein
Henry Salama, DMD, Atlanta, GA
Maurice A. Salama, DMD, Atlanta, GA
Michael R. Sesemann, DDS, FAACD, Omaha, NE
Michael Sonick, DMD, Fairfield, CT
Rhys D. Spoor, DDS, AAACD, Seattle, WA
Thomas T. Teel, DDS, Fort Wayne, IN
Thomas F. Trinkner, DDS, AAACD, Columbia, SC
Eric Van Dooren, DDS, Antwerp, Belgium
Marcos A. Vargas, DDS, Iowa City, IA
Dennis J. Wells, DDS, AAACD, Brentwood, TN

Journal of Cosmetic Dentistry • Fall 2011 • Volume 27 • Number 3

A peer-reviewed publication and member benefit of the AACD

Features

Columns

CE CREDIT

Take advantage of free CE!

PATIENTNEWS

877.779.2767

Here's the proven way to attract high-quality new patients, fill your schedule, & increase your revenue!

Call **877-779-2767** for a free 20-minute business assessment and marketing consultation.

We'll demonstrate the potential to build your reputation and generate more ideal new patients for your practice. The only one of its kind, our new-patient program is based on two decades of dental marketing experience with over 6,400 dentists. It's not just about getting more patients through your door. It's also about bringing in better-quality patients.

Actual Independent Client Results:

- $223,284 increase in annual revenue
- 10:1 return on investment
- $10,000 increase in monthly revenue
- $140,000 increase in annual revenue
- 20% increase in revenue in one year
- 30% increase in patients-of-record within 12 months

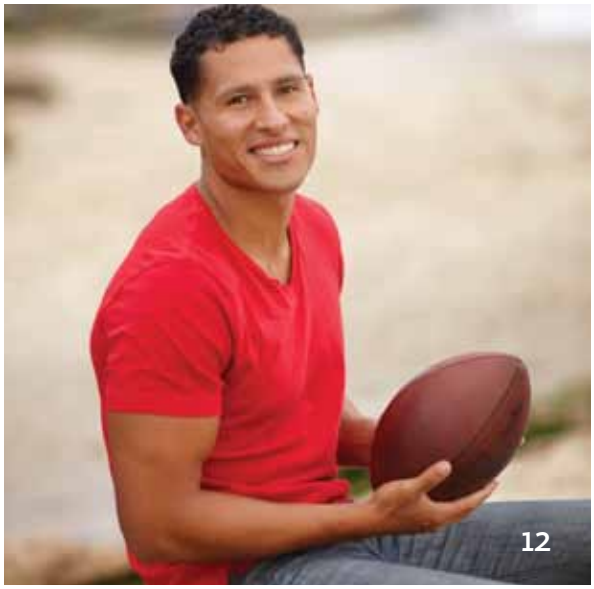
Call for a quick 20-minute consultation today!

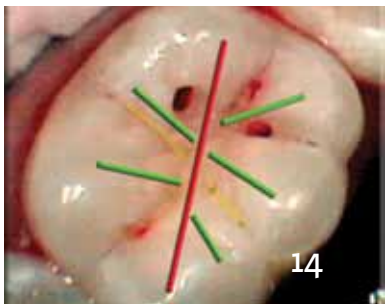
877.779.2767

Journal of Cosmetic Dentistry • Fall 2011 • Volume 27 • Number 3

A peer-reviewed publication and member benefit of the AACD

Departments





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.

Member Publication AADE American Association of Dental Editors

FSC www.fsc.org MIX Paper from responsible sources FSC® C006849

2011 Statement of Ownership, Management and Circulation

Statement of Ownership, Management and Circulation, required by Title 39, United States Code 3685. Title of publication: Journal of Cosmetic Dentistry. Date of filing: August 25, 2011. Publication number: 1532-8910, USPS# 10452. Frequency of issue: quarterly. Annual subscription price: members, included in the membership dues; non-members/subscribers, $200.00 (US and Canada), $240.00 (all other countries) by the American Academy of Cosmetic Dentistry®, 402 West Wilson Street, Madison, WI 53703. 800.543.9220 OR 608.222.8583. Periodicals postage paid in Madison, WI, and additional offices.

Mailing address of publisher: American Academy of Cosmetic Dentistry, 402 West Wilson Street, Madison, WI 53703. County: Dane. Name and address of the Editor: Edward Lowe, DMD, 402 West Wilson Street, Madison, WI 53703. Name and address of the Managing Editor: Tracy Skenandore, 402 West Wilson Street, Madison, WI 53703. Average number of copies each issue during preceding 12 months: Total number of copies (net press run): 7288; mailed outside-county paid subscriptions stated on PS Form 3541: 5924 paid distribution by other classes of mail through the USPS: 7; total paid distribution: 5931; free or nominal rate copies mailed at other classes through the USPS: 75; free or nominal rate distribution: 83; total free or nominal rate distribution: 158; total distribution: 6089; copies not distributed: 1199; percent paid: 97. Number of copies of single issue published nearest to filing date: Total number of copies (net press run): 6477; mailed outside-county paid subscriptions stated on PS Form 3541: 5146; paid distribution by other classes of mail through the USPS: 0; total paid distribution: 5146. Free or nominal rate copies mailed at other classes through the USPS: 17; free or nominal rate distribution outside the mail: 0; total free or nominal rate distribution: 17; total distribution: 5163; copies not distributed: 1314; percent paid: 99. I certify that all information furnished is correct and complete. Signed Tracy Skenandore, Managing Editor.

POSTMASTER: send address changes to:
Journal of Cosmetic Dentistry
American Academy of Cosmetic Dentistry
402 West Wilson Street
Madison, WI 53703

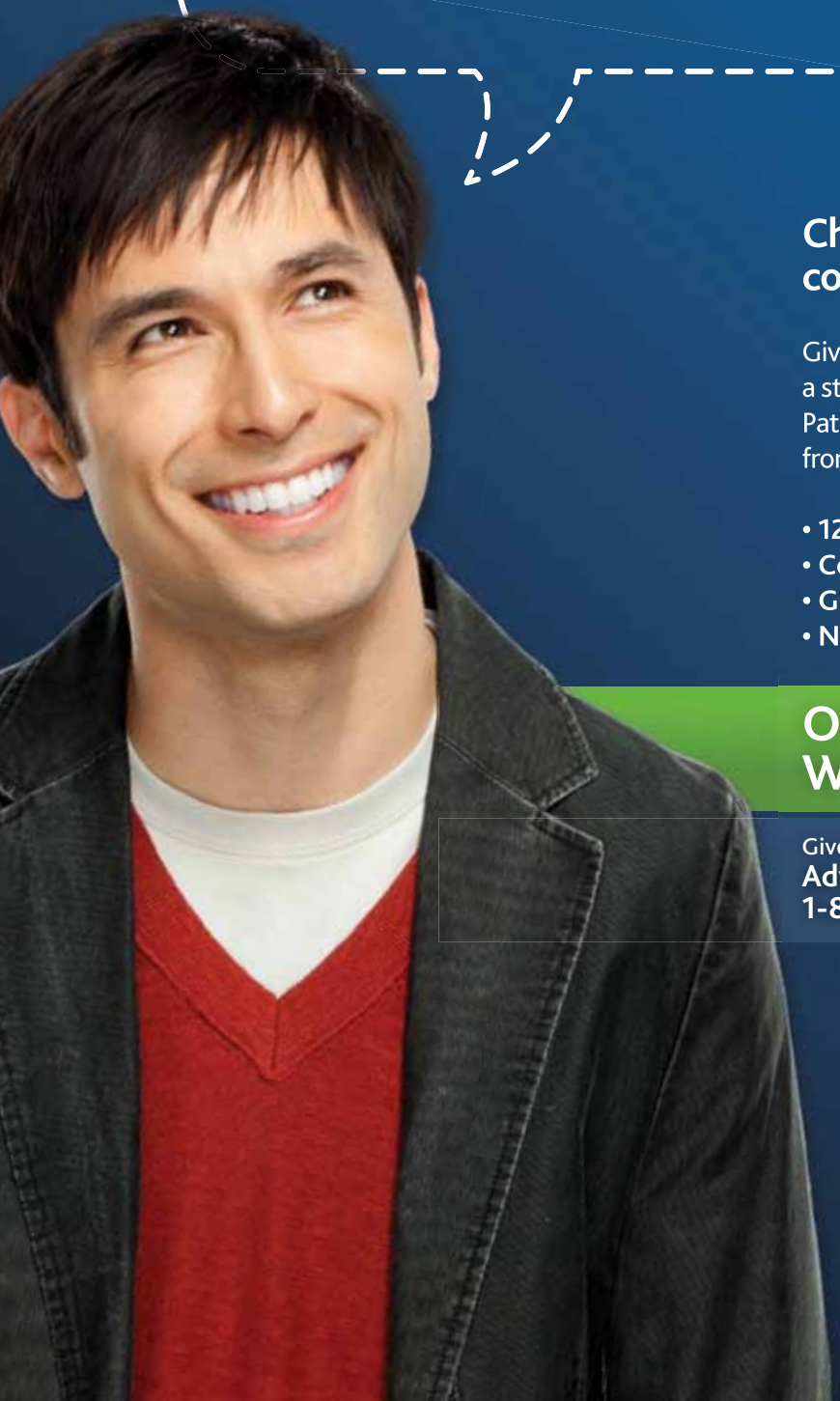
Peer-reviewed articles are denoted with the following symbol ❖

Statements of fact and opinion are the responsibility of the authors alone and do not imply an opinion on the part of the officers of the AACD. Materials may not be reproduced without written permission. Contents© 2011 American Academy of Cosmetic Dentistry®

ChaseHealthAdvance℠
PATIENT FINANCING

Financing as advanced as the care you provide.

Sometimes the best surprise is getting exactly what you expect.



ChaseHealthAdvance takes the complexity out of patient financing.

Give your patients just what they need from financing – a straightforward plan with affordable monthly payments. Patients choose a plan and know exactly what to expect from the first payment to the last. No surprises.

- **12, 18 and 24 month no interest plans**
- **Convenient online application**
- **Generous credit lines for comprehensive care**
- **No Surprise financing**

OUR NEW, EASIER-TO-USE WEBSITE IS NOW AVAILABLE.

Give your patients a trusted payment option to start their care:
AdvanceWithChase.com/JCD
1-888-388-7633

CHASE

AACD American Academy of Cosmetic Dentistry®
BUSINESS PARTNER

Information above is for providers and not for patient distribution.
©2011 JPMorgan Chase & Co. All rights reserved.
JC1011

Help Us Give You What You Need!

This is the fifth issue for which it has been my pleasure to serve as Editor-in-Chief of the *Journal of Cosmetic Dentistry (jCD)*. As I continue to enjoy serving, I look forward to implementing more ideas to cultivate and facilitate your learning. Looking back over the last four issues, the editorial team's accomplishments have been many, including a fresh design; the recruitment of new editorial board members; and, of course, a revitalization of the content.

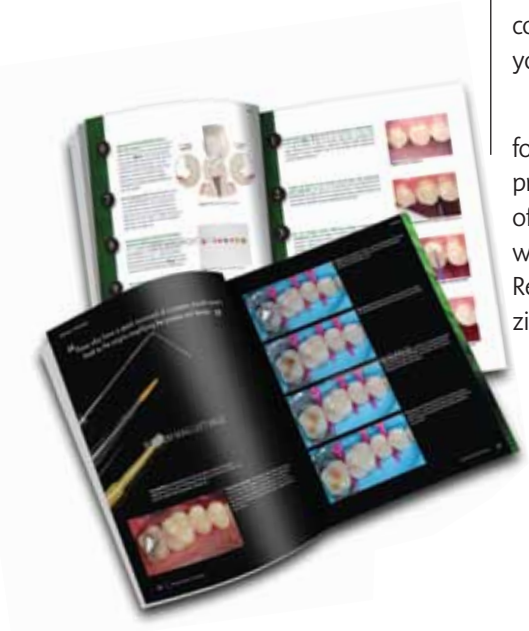
Even with such progress, I feel the *jCD* team is just getting started. Although we have received a sprinkling of useful feedback, we need much more. Your comments will aid us in continuing to grow your journal—we want it to be one of your premier sources of learning!

For example, is the Up Front column thought-provoking? Visually Speaking endeavors to creatively showcase amazing photography; do you enjoy it? Are the "tip" features helpful? Have you discovered the Members' Exchange "pearls" on the last page of the journal? If so, will you consider contributing? The main continuing education (CE) feature strives to provide you with an important and easy way to earn CE credit. Do you find it useful?

Your responses will help us to produce a journal with improved content you will value even more.

To make it easy for you to provide feedback, a selection of random members will receive a survey for each of our journal's issues. It will take only a few minutes to complete—I promise! It is vital we receive your thoughts, to know if we are meeting or falling short of your expectations. Your responses will help us to produce a journal with improved content you will value even more.

While sustaining the importance of "responsible esthetics" within the vision of the American Academy of Cosmetic Dentistry, we will continue to encourage minimally invasive treatment, whether restoring a single tooth or completing a full-mouth restoration. This issue focuses on composite and glass ionomer restorative materials. It is our hope that these articles will enhance your library...and your practice.



The issue begins with sage words from cosmetic dentistry pioneer Dr. Ron Goldstein, followed by a Speaker Spotlight interview with Dr. Graeme Milicich. Dr. Jason Smithson presents a beautiful visual essay on posterior composites, while Dr. John Weston's brilliant use of composite artistry is displayed on the cover. Dr. Didier Dietschi demonstrates a new concept with anterior composites, Dr. Dan Ward presents 20 tips on glass ionomers, and our Myths vs. Realities section features Dr. Jose-Luis Ruiz and Dr. Gordon Christensen comparing supragingival zirconia to bonded porcelain restorations.

We hope you find much of value in this issue of the *jCD*. May it enrich your expertise!

Edward Lowe, DMD, AAACD
Editor-in-Chief

PRECISION

WE MAKE IT
PERSONAL

DENTAL LK STUDIO

LKDENTALSTUDIO.COM A FULL SERVICE DENTAL LABORATORY 866·550·3522 TOLLFREE

Laura Kelly AACD Joint 2008 President American Academy of Cosmetic Dentistry® ACCREDITED MEMBER

"Now, 50 years later, where are we ethically and economically?"

Ronald E. Goldstein, DDS

Ethics and Economics of Composite Resin Restoration

Up Front *provides a forum for influential leaders to share their opinions. In this issue, we welcome Dr. Ronald E. Goldstein. Dr. Goldstein is a clinical professor at the Georgia Health Sciences University and an adjunct clinical professor at both Boston University and the University of Texas. He practices in Atlanta, Georgia.*

Disclosure: The author did not report any disclosures concerning this article.

It was 50 years ago when Dr. Michael Buonocore asked if I would help develop the esthetic uses of his and Rafael Bowen's newly developed bis-GMA composite resin. The possibilities for doing this were exciting. Having utilized both silicate- and acrylic-based materials for esthetic restorations and achieving little satisfaction with even the best long-term results, the first large particle composite materials were welcomed for their strength and beauty. Since these materials were self-curing, it was necessary to work fast. Buonocore's only proven use was to restore a fractured tooth, so I developed techniques for the different classifications of restorations. I also created the beveled overlay technique still used today, and showed that the material could also be used for closing a diastema, making crowded teeth look straight, and masking discolored teeth.

Buonocore and Bowen's contributions[1,2] were significant because they allowed for a much more conservative restorative treatment.[3,4] When I began my dental career, the full crown was really the main option being taught for esthetic dentistry. With the development of composite resins, we could refrain from reducing valuable enamel; this not only saved the patient money, but also helped to preserve teeth and lessened the potential for endodontic pathology.

Now, 50 years later, where are we ethically and economically? Unfortunately, there has been a return to the full-crown restoration, not because it is better, but because it seems to be more economical, and not for the patient...but for the dentist. This brings to mind the young dentist who, when I asked how he was doing, said "wonderful" because he was doing all crowns and virtually no composite restorations, regardless of the patient's problem, due to a greater percentage of insurance coverage. He is certainly not the only one who may well have forgotten the true meaning of ethics....and above all, "to do [the patient] no harm."

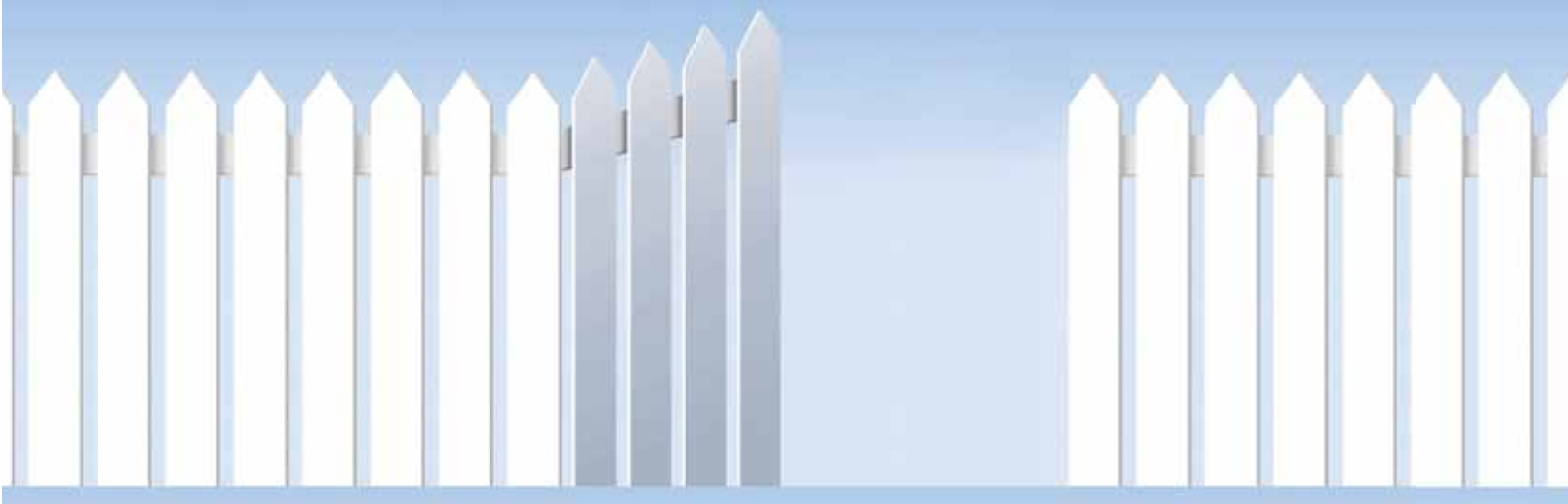
Please don't misunderstand...I love and continue to teach the esthetics of the full-crown restoration. However, the patient needs to be able to make the best decision for his or her treatment...rather than what will afford the dentist the most profit.

The composite resin materials available today are extraordinary, but take time to apply, contour, and polish effectively. Unfortunately, insurance companies have not kept up with rising costs or considered the valuable conservative service provided to our patients when achieving superior results with composite resins. As you study the excellent results and step-by-step techniques shown in this issue of the *jCD*, I am proud that so many of our leading clinicians understand and appreciate what ethical dentistry really means now and for the future.

References

1. Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res. 1955;34:849-53.
2. Bowen RL. Investigations of the surface of hard tooth tissues by a surface cavity test. In: Phillips RW, Ryge G, editors. Adhesive restorative dental materials. Spencer (IN): Owen Litho Service; 1961. 177 p.
3. Goldstein, RE. Current concepts in esthetic treatment. Proceedings of the Second International Prosthodontic Congress; Las Vegas, NV; 1979; 310-2. St. Louis: Mosby.
4. Goldstein, RE. Diagnostic dilemma: to bond, laminate, or crown? Int J Perio Rest Dent. 1987;7(5):8-29.

You are the gatekeeper of your patients' total body health and well-being



OralDNA® Labs

Advancing Patient Wellness Through Salivary Diagnostics

Helping patients fight the battle against existing disease is a noble cause, but imagine if you could help them win the fight even before disease has a chance to take hold. With salivary diagnostic tests from OralDNA® Labs, you now have the ability to learn more about your patients' oral health even before clinical signs and symptoms appear. Our tests are based on a wellness model that strives to keep patients healthy by allowing you to detect disease earlier, determine who is at risk, and put them on a path toward a lifetime of overall health and wellness.

It's amazing what we can find out from a few drops of saliva.
It's even more amazing what you can do to help patients with that knowledge.

September 22-24, 2011

- Visit us at CDA North

Booth #2041

Dental PRODUCT SHOPPER BEST PRODUCT 2011

DENTISTRY TODAY TOP 100 PRODUCTS 2011

Learn more about OralDNA® Labs and salivary diagnostics

www.OralDNA.com
877.577.9055

eco DENTISTRY ASSOCIATION ACCEPTED

ORALDNA® LABS
Innovations in Salivary Diagnostics
A Quest Diagnostics® Company

© 2011 OralDNA® Labs Inc. All Rights Reserved.
OralDNA® Labs is a subsidiary of Quest Diagnostics® Inc.

A Trendsetting Smile

I met Robert 10 years ago when I hired Judy, my lead clinical assistant for our large multispecialty group practice. Judy is very bright and has a great attitude and excellent work ethic, so I was not surprised to see the same attributes in her oldest child, Robert J. Ortiz. He graduated with honors from San Diego State, where he played college football and finished in the top 10 for receiving. The San Diego Chargers signed him in 2006 as an undrafted free agent (wide receiver). Robert has also been a member of the Frankfurt Galaxy, Seattle Seahawks, BC Lions, San Francisco 49ers and, most recently, the New England Patriots.

In addition to his success as an athlete, Robert exhibits amazing energy and commitment as a successful model and dedicated entrepreneur.

In addition to his success as an athlete, Robert exhibits amazing energy and commitment as a successful model and dedicated entrepreneur. His lifestyle clothing brand, ArtistiCreation, shows a strong understanding of and passion for professional athletes and trendsetters similar to what he feels for the game of football. His entertainment company, R Entertainment, was started in college and spins music for private parties, clubs, corporate events, and weddings. In addition, Robert recently entered the reality television world by competing on ABC's newest adventure series, "Expedition Impossible."

Robert's dental history included orthodontic treatment during which his teeth were determined to be undersized for his arches, leaving him with diastemas. During his consultation, he mentioned he was getting married soon and of course wanted to look his best. He was also starting to notice wear on the edges of his front teeth.

We started with an intraoral composite mock-up smile design to determine ideal esthetics, function, and phonetics. Our goal of "zero preparation" direct resin restorations was completed on the front eight teeth using a single shade; this meshed well with Robert's healthy lifestyle and modeling career. This case demonstrates the power of developing the skills of direct bonding and smile design in your practice and why the AACD includes Case Type V, six or more direct resin veneers, in its credentialing process. Robert has never given up on his dreams and continues to strive for greatness and to make a difference in the world. His life motto is, "Don't talk about it...be about it."

For information on the clinical aspects of this case, please turn to page 50.

Dentistry and clinical photography by John F. Weston, DDS, FAACD (La Jolla, CA). Portrait images by Paul Barnett, Barnett Photographics (San Diego, CA). Cover photo shot with a Canon (Canon USA; Lake Success; NY) Mark III 1Ds with an 85-mm 1.2 EF lens as well as a Canon Mark III 1D with a 70-200 EF IS lens.

Preoperative

Postoperative

The "Super-Specialty" of Minimally Invasive Dentistry

An Interview with Dr. Graeme Milicich

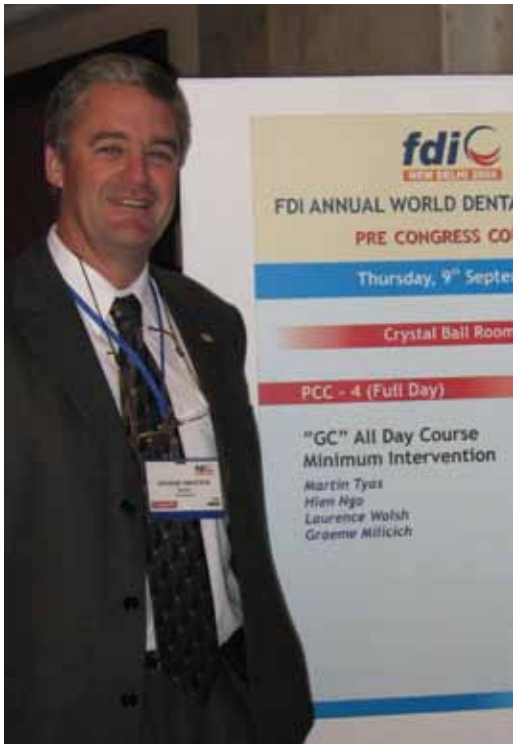
David Eshom, DDS, AAACD
George Tysowsky, DDS, AAACD

Graeme Milicich, BDS, is a Fellow, Diplomate, and founding board member of the World Congress of Minimally Invasive Dentistry. He is also a Fellow, Master, and board member of the World Clinical Laser Institute, and a founding board member and honorary lifetime member of the New Zealand Institute of Minimal Intervention Dentistry. In this interview, Dr. Milicich answers questions from Drs. David Eshom and George Tysowsky.

Dr. Milicich will be speaking at the 28th Annual AACD Scientific Session in Washington, D.C., on May 4, 2012.

Q: Dr. Milicich, you have been a researcher, lecturer, and practitioner in New Zealand for 35 years. What led to you becoming a leader in developing the "subspecialty" of minimally invasive (MI) dentistry?

A: I was embracing mechanical MI concepts even before I graduated dental school in 1976. Notice, I say "mechanical" at this point, because the reality of true MI dentistry is to do nothing. To do that you have to effectively deal with the disease, dental caries, and help your patients attain true oral health, rather than just being a dental mechanic cutting smaller preparations. Sadly, this approach did not "gel" with me in the first half of my career.



It is interesting that you describe MI dentistry as a "subspecialty." From my perspective, MI is an all-encompassing concept and philosophy that extends to involve all dental specialties so that it actually is a "super-specialty," encompassing all of dentistry; the subspecialties to MI would then be what we currently describe as specialties. As technologies, materials, and techniques have advanced, MI has taken hold not only in dentistry, but all across medical care. Diagnose early and accurately, then treat with MI techniques and adjunct materials and morbidity is reduced. That is what MI is all about.

There is a story I like to tell about when I was at dental school and was faced with the preparation of my first mesial-occlusal (MO) cavity in 1974. I have a mechanical bent, and even then, I struggled with G.V. Black's cavity designs and how, to me, they seriously compromised the biomechanical integrity of the tooth. We are constantly faced with the evidence of this compromise with all the teeth suffering cusp fractures that we now have to repair on a daily basis.

The tooth had a very small occlusal cavity and a new D1 interproximal lesion. I carefully prepared a fully retentive proximal box (which we now call a slot preparation), and a separate occlusal cavity, leaving behind all the sound enamel and dentin between the two mesial cusps. To me, this just made common sense. However, I was failed on my cavity preparation design by the clinical instructor and made to remove all

the sound tooth structure I had so carefully preserved, to make my preparation into an MO, "just like the picture in the textbook." I continued this decimation of sound tooth structure to ensure I could graduate—and on that day, I went back to my "failing" ways and began preparing amalgam slot preparations.

I have had a chance to review my own work for 35 years and see all the successes and failures. Essentially, I am a skeptic. I like to see proof. However, I am also impatient and cannot wait for a 20-year double-blinded clinical trial to tell me it is OK to change what I was taught. By then, not only would I have missed the train, it would have totally flattened me. So I apply my own thoughts and logic to a problem and then have to be prepared to live with the consequences. One of the most successful long-term restorations have been the early slot preparations. The restorations simply last, because they are not mechanically overloaded by occlusal forces due to their size; and, more importantly, the teeth do not fracture because their biomechanical integrity was not significantly compromised.[1]

I always question myself regarding materials and techniques that I incorporate into my practice, because I will be faced with the consequences of any wrong decisions. Therefore, I look for solid evidence before making a change. That evidence was, more often than not, staring me in the face in my own patients. I could see things that were not working well or were performing beyond expectations, so I was not too hesitant to try new things when they made sense to me, rather than listening to and being swayed by marketing hype. I have always loved Dr. Gordon Christensen's comment, "The final test is clinical success."

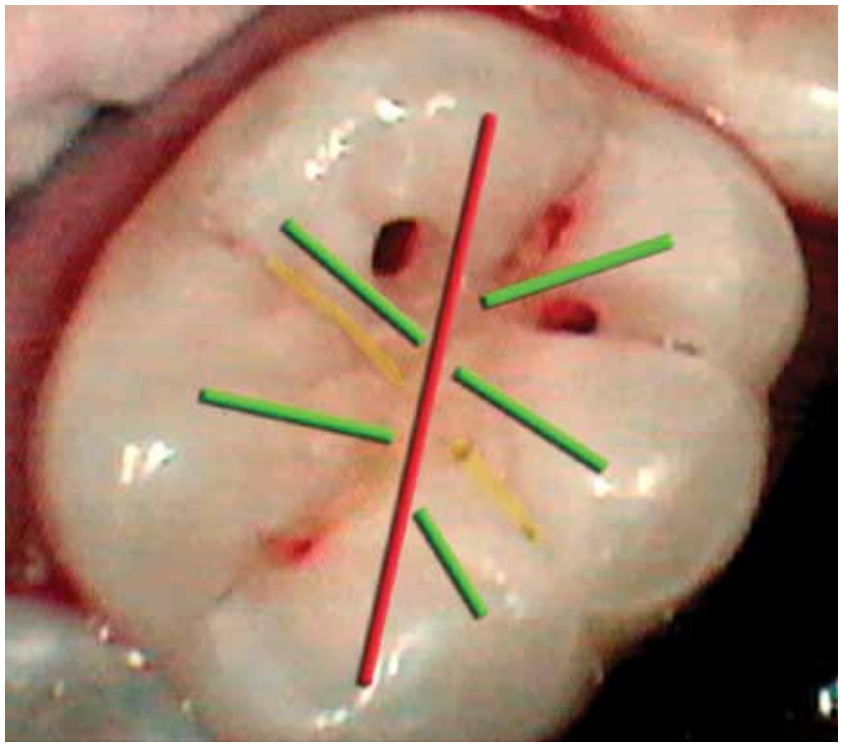


Figure 1: This lower first molar has small areas of fissure decay highlighted with caries detection dye and the remaining fissures highlighted in yellow. The sub-occlusal oblique transverse ridge (red) runs from the mesio-lingual to the disto-buccal as a subsurface band of solid enamel.[2] Off this is a web of sound enamel (green) that then supports what is described as the peripheral rim of enamel. Cutting an occlusal cavity preparation could cause interproximal decay.

I have constantly questioned what I was doing for my patients…and if I was not satisfied with the answers I received, I would go out and try and find better ones. Sometimes with little success. I would then start my own investigations and research, finding mentors who were asking themselves similar questions about MI concepts and collaborating until we got the answers we sought. In the early days of MI in the 1990s, being at the leading edge (and sometimes it felt more like the bleeding edge), was a very uncomfortable place to be, but time is now proving this direction was the correct one to take. At the time, cosmetic dentistry was on the rise and everyone was focusing on the technicalities and the associated financial rewards. From an MI perspective, I watched the evolution of cosmetic dentistry with some trepidation, seeing so much sound tooth structure consigned to the suction trap in the quest for, what often appeared to me, to be a caricature of what a healthy smile should look like. Tooth structure was often sacrificed to meet the requirements of many of the cosmetic material options. MI was often viewed as an annoying background static that was perceived to potentially compromise the financial success of a practice. How could you possibly make money if you didn't do much; or, even worse, if you did nothing? I particularly like a quote from one of the unsung fathers of true MI, Dr. Bob Berkley: "Patients don't start buying dentistry until they stop growing cavities."

Figure 2: Auto-cure GIC sealants/preventive restorations at nine-year recall.

Figure 3: A patient presented with old, worn out composite veneers on tetracycline stained teeth and was unhappy with her gummy smile. The teeth were only 7.5 mm long, so at least 2.5 mm needed to be added to their overall length; .5 mm was added to the incisal edge and the other 2 mm had to be found on the gingival side of the equation.

Q: What technologies, techniques, and materials have developed over the last 15 years that make practicing MI dentistry possible today versus 20 years ago?

A: In the early days of MI, the focus was primarily on maintaining biomechanical integrity at all levels of tooth preparation. For me, technology went hand in hand with developing MI concepts—initially with the use of loupes, which in the early 1990s were not common in general dentistry. Loupes simply allowed for a better, less invasive preparation. However, it was very difficult back then to find burs small enough to do MI cavity designs. The advent of quality air abrasion and the incorporation of an operating microscope in 1996 was the turning point for me. Finally, here was a combination of technologies that provided true MI cavity preparations. Early cavity diagnosis using laser-induced fluorescence in the form of the DIAGNOdent (KaVo Dental GmbH; Biberach, Germany) followed shortly after in 1998. Combined with good vision and air abrasion, early lesions could be microscopically dissected and restored, allowing the retention of vital cross-bracing structures like the subocclusal oblique transverse ridge **(Fig 1)**.

The critical factor was magnification. This allowed me to observe what was happening in the depths of fissures and led to me developing a compact disc that helped dentists understand what was being detected by the DIOAGNdent and how to treat it. Dentists who used the DIAGNOdent without magnification and air abrasion often grossly overcut the tooth on their first pass with a high-speed bur and then declared there was nothing there, because they had destroyed all the evidence with the "rotary sledgehammer"!

Predictable, long-term restoration of these early fissure lesions was often disappointing, depending on the resin system that was chosen. In New Zealand, glass ionomer cements (GIC) have been used successfully for many years, and the adoption of a GIC restorative technique has proven to be incredibly successful and predictable. It is based on a technique I researched and developed in conjunction with my mentors that involved many hours on a scanning electron microscope (SEM) and led to an article on a technique for examining the GIC/enamel interface.[3] Suffice to say, the long-term success of these MI restorations continues, with the evidence greeting me at recall exams 10 years later. Seeing is believing **(Fig 2)**!

Hard/soft tissue lasers have also been a boon to my practice. With a more broad-brush view of MI, any treatment that reduces operative morbidity has to be good. The original Waterlase and then the Waterlase MD (Biolase; Irvine, CA) changed my practice forever. From an MI cosmetic

perspective, I could not offer the combination of laser hard/soft tissue options that were possible unless I was prepared to resort to full-on open flap surgery **(Figs 3-6)**. Equally, lasers have enhanced the delivery of MI periodontal treatment and, having been involved in the research and development of radial firing tips, I have had the pleasure of seeing a revolution in endo-canal debridement.

The next piece in the technology puzzle for me was E4D computer-aided design/computer-assisted manufacturing (CAD/CAM) (D4D Technologies; Richardson, TX) in 2009. The delay wasn't due to the technology, but rather to the restorative material options. I was never happy with the reports I read on the performance of available porcelains until the advent of lithium disilicate e.max CAD (Ivoclar Vivadent; Amherst, NY), which was the tipping point. Now there was a material that allayed my fear of introducing a restorative technique that could come back and bite me. Colleagues' stories of CAD crowns (fabricated from materials before the advent of e.max) failing after five years simply confirmed my hesitance was justified.

I love CAD/CAM dentistry. Because of my MI focus, I often struggled to remove large volumes of sound tooth structure simply to get a crown to stay on a fractured tooth. As a consequence, I tended to place a great number of large, direct posterior composites and became very good at it. Seeing these come in over a 10-year period, the evidence shows they have a very finite performance window, and every time you go back into a tooth, you risk compromising pulpal vitality. I wanted a long-term MI restorative option.

Do we prepare teeth just to make our temporaries last for two weeks? With same-day CAD, this problem disappears and I now very rarely prepare a full crown. Most restorations now are minimally invasive adhesive ceramic inlay/onlay designs. The use of the term "minimally invasive" is in relation to the other option of a full-crown preparation **(Figs 7-13)**.

I often wonder why all these MI technologies are slow to be adopted. They have totally changed my practice for the better, allow me to do what I consider to be better, less invasive dentistry and, as a side effect, have enhanced my income, though that was never the focus—it just happened. When the high-speed handpiece was developed, it became accepted by the profession in a flash, so why not these technologies? Is it fear of the technologies themselves? Are they perceived to be technically demanding? Are we scared to step out of our comfort zone? Do they appear too expensive? On that note, I often wonder why U.S. dentists struggle with the perceived cost of technologies when they are profitable for me, even

Figure 4: Using the Waterlase MD, closed flap bony crown lengthening was performed to attain the desired clinical crown length and reestablish the correct biological width. Potential impingement of the fraenum on the stability of the gingival crest was relieved at the same time.

Figure 5: Image 10 days after laser surgery. This type of result cannot be achieved for the patient with conventional open flap surgery in a similar time span. Healing times are significantly reduced as is overall surgical morbidity.

Figure 6: This image one year after laser surgery shows how predictable and stable the hard and soft tissue surgery has been.

Figure 7: This image shows a 20-year-old attempt at MI adhesive porcelain. The porcelain was fused to a hydroformed gold base that was then bonded to the tooth. The tooth/gold bond has survived for 20 years; however, the feldspathic porcelain was inherently too weak to survive.

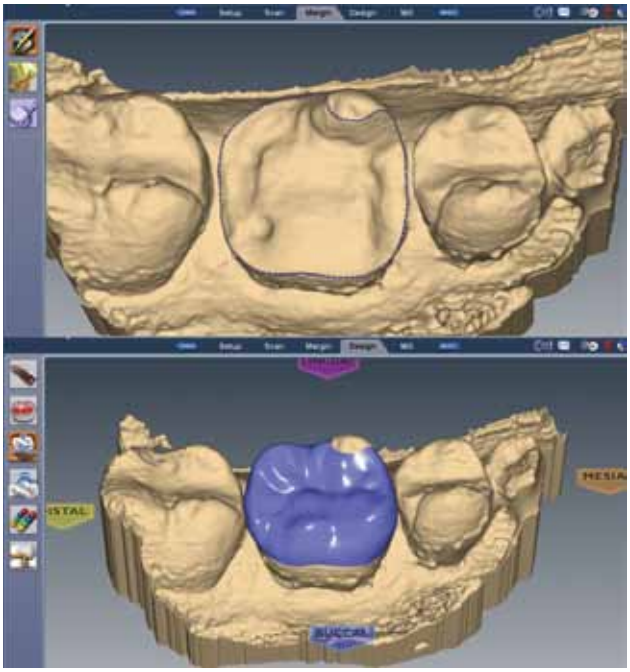


Figure 8: The new preparation for an adhesive E4D CAD/CAM e.max restoration. Temporization for two weeks would be difficult, but same-day CAD/CAM alleviated this issue. The adhesive ceramic option means the preparation is significantly more constrained compared to a preparation requiring cementation utilizing a full ferrule for retention.

when purchased at significantly more cost with the New Zealand dollar (otherwise known as the "South Pacific peso"). Sadly, many focus on the cost, rather than the return on investment. These technologies are mature and simply work, so I suppose it is more the issue that some dentists are just not yet ready for the technologies.

To look at MI dentistry from a slightly different perspective, we should really rename the whole concept, "Maximum Intervention, Minimal Invasion." The ultimate in MI is to do nothing, and this involves treating the disease, not the cavities, which are simply symptoms of the biofilm disease we call caries. Yes, it is difficult to treat, and relies on patient compliance and lifestyle choices, but simply filling holes does not make the disease go away. It reminds me of Einstein's saying that, "the height of insanity is doing the same thing over and over and expecting a different result." Looking back at my practice, that is what I was effectively doing for the first half of my career. Drilling and filling, even at the MI level, did nothing to change my patients' disease outcomes. I shudder when I read articles that state "there was no other option but to place crowns to treat the caries in the teeth." Crowning teeth does not treat caries—caries is a biofilm disease and porcelain does not do anything to bacteria!

The big practice changer for me came in the form of a caries management protocol based on pH management. The science behind this is substantial and convincing. I had tried all sorts of preventive concepts over the years with limited success. Finally, here was a systematic approach to trying to train a biofilm back to health and promote remineralization in the form of the CariFree system (Oral Biotech; Albany, OR). Rather than fight Mother Nature and try to kill all the bugs, which we all know is doomed to failure, the goal is to train a diseased biofilm back to health. Suddenly I was also a "doctor of dental health" rather than a highly skilled dental technician and began to have a success I had never known before.

As a result, I was challenged to improve my and my team's communication skills, not to close a big treatment plan, but to help patients grasp their disease problem and help them change things. When this happens, patients feel comfortable investing in quality dentistry because they understand it will last, rather than it failing from more continued decay in the not-too-distant future.

All the techniques, materials, and technologies I have incorporated over the past 15 years remain fundamental to my delivery of comprehensive MI dentistry to my patients. New technologies are constantly being explored and developed and the fun comes in assessing whether they are going to be a step forward, or simply an interesting sideways development. Care is needed to ensure we don't end up purchasing

DENTAL NEWSLETTERS
MADE EASY!

Dear DOCTOR®
Content Included!

AAD American Academy of Cosmetic Dentistry®
BUSINESS PARTNER

Member Special: **Save $100**
Call for details!

Increase Case Acceptance

- **Email Newsletters Made Easy**
  Send treatment specific email newsletters to individual patients or schedule monthly newsletters to send to your entire patient database.
- **Robust *Dear Doctor* Content Library Included**
  Writing articles for a newsletter can be a drag. With *inForm*, you have access to a patient education dental library of over 200 *Dear Doctor* articles.
- **Website Dental Library Included**
  Patients can access over 1,250 pages of educational content right from your office website and email newsletters.
- **Social Media Integration**
  Automatically post content from your newsletters to your Facebook and Twitter accounts.

"Email newsletters, Twitter and Facebook posts are coordinated from one central location. *InForm* is a social media dream come!"

John Buzza, DDS

inForm by pbhs

Learn More Today!
Call Dear Doctor at (866) 799-5014
www.DentistryNewsletters.com

something that is a fancier "me, too" rather than a true step up. Often there is what I call a "stickiness factor" (the material or technology may, on first look, appear good, or even really sexy, but the reality is you end up not using it because it is too time-consuming or just plain frustrating to use).

Q: What techniques and materials do you use in your everyday practice to bring the best of MI dentistry to your patients?

A: Patients initially go through a caries risk assessment and if anything pops up, a diagnosis of the health of their biofilm using the bioluminescence CariScreen meter (Oral Biotech). When required, the caries problem is addressed and treatment options modified to meet patient expectations and their current risk profile. This may also involve placing GIC restorations as an interim restorative option until the biofilm disease has been controlled.

Air abrasion remains a cornerstone of my practice, not only for MI restorations, but as part of my adhesive protocol. From all the SEM evidence I have been able to produce over several years of research, there is nothing that leaves the tooth surface in such good state for all current adhesive bonding protocols, so my Kreativ Mach 5 (San Diego, CA) from 1997 gets a daily workout and still continues to function well.

Glass ionomers and composites remain a cornerstone for me as MI restorative materials and combine well in the closed sandwich technique for restoring very deep cavities. Combining the closed sandwich technique with silver diamine fluoride is something recent that is proving to be very successful at maintaining pulpal vitality in deep cavities. The use of autocure GIC as a preventive restoration and sealant has proven to be one of the most successful restorative techniques I have ever adopted. However, the success lies in the detail of the technique; I will be covering this in one of my lectures at the AACD Annual Scientific Session next May.

Minimally invasive adhesive ceramics utilizing E4D CAD/CAM and e.max CAD is now one of the cornerstones of the restorative side of my practice; I just wish e.max had come along sooner in my career.

Soft tissue management and perio treatment has changed significantly since I introduced lasers. Once again, it is the combination of magnification and the technology that allows me to provide treatment options and outcomes that are not easily achieved with more conventional approaches.

Figure 9: Completed e.max CAD HT bonded restoration. This type of result is achievable from the day you start using in-house CAD.

Figure 10: The ultimate cosmetic challenge is the restoration of a single stained anterior. The patient had been told he needed a full crown to hide the color. The canal was totally sclerosed with no apical pathology 30 years after the trauma that created the problem. Internal bleaching would have meant a large cavity in the crown and the problem that bleaching these sorts of teeth might attain the correct hue and chroma, but they often end up very high in value.

From my perspective, MI is an all-encompassing concept and philosophy that extends to involve all dental specialties.

Figure 11: We negotiated the removal of half the thickness of the facial enamel to allow room to add something back on without increasing the facial thickness of the tooth.

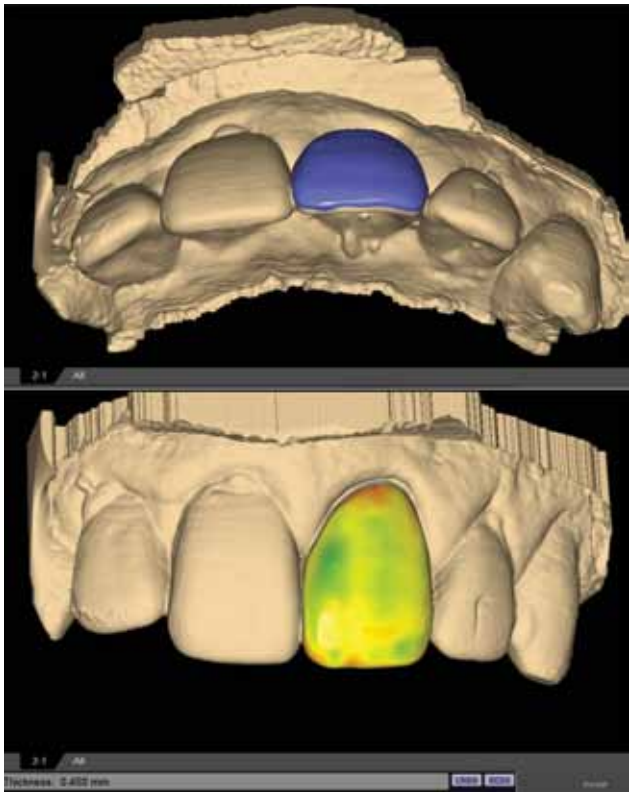


Figure 12: Cloned e.max CAD low translucency thin veneer that was milled to .3- to .45-mm thickness.

Q: What is important now for cosmetic dentists to understand when it comes to MI dentistry?

A: In one sentence? Manage the disease first. The perception is that there is no income in this approach. I beg to differ. Once the disease is controlled, patients will invest in their mouths; we have to take a longer view than just this week's turnover. Of course there are MI treatments we can do that are not totally reliant on excellent oral health—in fact, they help reduce the potential for a diseased biofilm to harm the teeth, but extensive MI restorative options should be backed up by effective biofilm management.

Q: Are there differences in approach to MI dentistry in the United States versus the rest of the world?

A: Probably the most significant would be the accurate utilization of glass ionomers. They have been effectively used in New Zealand and Australia for more than 30 years. Their poor reputation in the U.S. is possibly due to a lack of understanding regarding their effective applications. They have been touted as the cure-all in high-risk sites and mouths (when everything else has failed, slop in a GIC). Then we are faced with the clinical reality that the GIC failed too, so therefore it is no good. Spending time on DentalTown was an eye-opener for me. Dentists would ask questions about GICs and someone would chime in with some advice that I could only say was misguided at best. Something as simple as removing the cavity preparation smear layer with cavity conditioner was discounted as a waste of time. Just squirt the GIC straight in, it is quicker! Then they wondered why the restoration failed. Nothing sticks to a smear layer.

Q: What future developments do you see that will aid our members in practicing MI cosmetic dentistry?

A: Sometimes it is difficult to predict what the next breakthrough is going to be or what aspect of dentistry it is going to be focused on. There are already several technology developments out there that mainstream dentistry is struggling to adopt. Air abrasion, lasers, same-day CAD/CAM, digital imaging cavity detection, digital imaging shade selection, continuing advances in biofilm management to name a few, all still struggle to gain a significant foothold in our profession and I often wonder why this is, because I simply could not practice without them. I recall a comment my assistant, who has been in dentistry for 35 years, made recently when I was able to save a traumatically fractured tooth through the ability to do a laser closed flap bony crown lengthening: "I could not go back to assist in a practice that didn't have all

the 'toys' we have. That tooth would have been in the bucket at my last practice."

There is so much already out there. We don't really need much more. We just need to start using what is already here. Who purchased the original iPhone? Did they hesitate because they knew something better would come along soon? So they waited for the iPhone 2. Oops. iPhone 5 is now coming. That doesn't mean the previous iterations of the iPhone are bad. You have to make the leap at some point, don't hesitate, the current technologies will work for you, they do for me. The same goes for our material options—we now have some very good choices out there.

Q: What are you looking forward to when you address the AACD in Washington, D.C., in May?

A: I know I will be in the company of many like-minded colleagues who strive to do the very best for their patients and are constantly honing their skills. I love being in the presence and company of "eagles." That is why they belong to the AACD. I look forward to sharing some of my thoughts and ideas based on 35 years of practice and clinically based research, to help them raise their awareness of the impact embracing MI concepts and treatment modalities can have on their practices. Sadly, in our profession, one of the realities is that time is also money. Efficiencies in patient assessment and restorative techniques has an upside to this equation. Hopefully I will also be able to share some of the "tricks" and products that can make that little bit of difference. For some, these lectures will appear to be "common sense" dentistry and to others they have the potential to be, as one dentist recently described them, "a professional epiphany."

References

1. Magne P, Oganesyan T. CT scan-based finite element analysis of premolar cuspal deflection following operative procedures. Int J Periodont Rest Dent. 2009 Aug;29(4):361-9.

2. Milicich G, Rainey JT. Stress distribution in teeth and the significance in operative dentistry. Pract Periodont Aesthet Dent. 2000;12(7):695-700.

3. Milicich G. A resin impression SEM technique for examining the glass-ionomer cement chemical fusion zone. J Microscopy. 2005 Jan;217:44-8. **jCD**

Figure 13: The final CAD e.max veneer, created in one day. This result probably could not have been achieved with a bonded composite veneer, and composite certainly will not provide the longevity that is available from well-bonded porcelain.

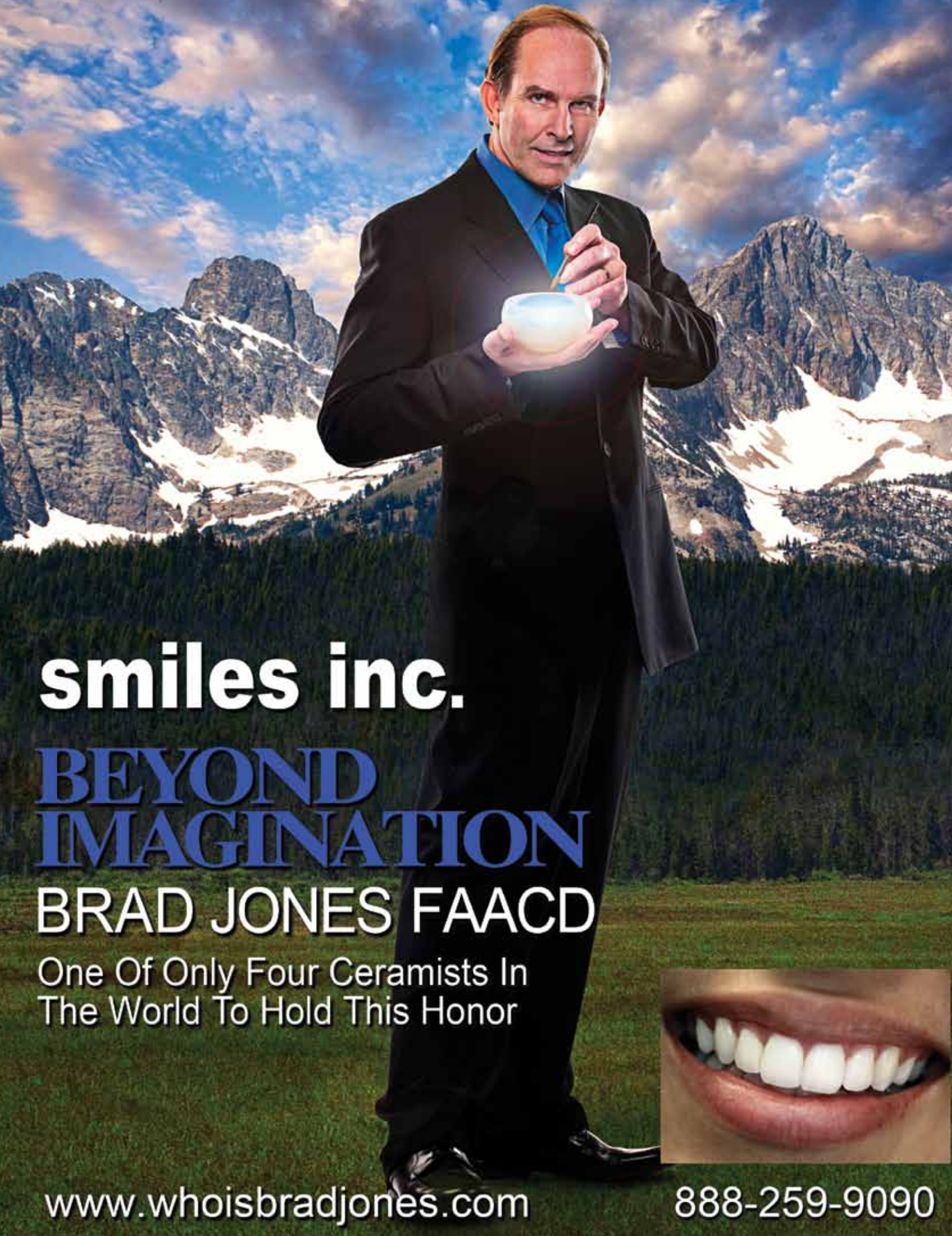
I have constantly questioned what I was doing for my patients...and if I was not satisfied with the answers I received, I would go out and try and find better ones.

Dr. Milicich earned his BDS from the University of Otago, New Zealand, in 1976. He practices at Anglesea Clinic Dental Care in Hamilton, New Zealand.

Disclosure: The author is a shareholder in Oral Biotech. He receives honoraria from D4D and Biolase.

Dr. Eshom is an Accredited Member of the AACD, and co-chair of the AACD Professional Education Committee (PEC). He has a private practice in San Diego, California.

Dr. Tysowsky is a clinical assistant professor at the State Universtiy of New York, Buffalo, School of Dental Medicine. He is an Accredited Member of the AACD, and co-chair of the AACD PEC.


smiles inc.
BEYOND IMAGINATION
BRAD JONES FAACD
One Of Only Four Ceramists In The World To Hold This Honor
www.whoisbradjones.com
888-259-9090

Getting More Than You Bargained For!

Giving Back a Smile: A Practice- and Team-Building Experience

Trish Jones, RDH, BSc

GBAS and Intimate Partner Violence

The economy has had a significant impact on dental services to consumers. Dentists often ponder how to retain existing patients, as well as how to gain patients seeking both need-based and want-based care.

The Give Back a Smile™ (GBAS) program was created by the AACD Charitable Foundation (AACDCF) to help survivors of intimate partner violence (IPV) by restoring their damaged smiles. Physical injuries from IPV include cuts, scratches, bruises, welts, and may extend to more serious injuries such as broken bones, internal bleeding, and head trauma.[1] Health-related costs of IPV exceed $5.8 billion each year. Of that amount, nearly $4.1 billion goes to direct medical and mental health care services, and nearly $1.8 billion goes to indirect costs of lost productivity or wages.[2] Injuries can lead to disability or death, and the effects of IPV are ongoing.[3] Survivors know that bruises and scars will heal in time, but broken and missing teeth will not. GBAS volunteer dentists and laboratory technicians agree to restore broken and damaged teeth in the smile zone of IPV survivors at no cost to the patient. A restored smile not only contributes to improving physical appearance, but also helps restore the person's confidence and quality of life.

Health-related costs of IPV exceed $5.8 billion each year. Of that amount, nearly $4.1 billion goes to direct medical and mental health care services, and nearly $1.8 billion goes to indirect costs of lost productivity or wages.

Did you know that a $200 donation makes it possible for one survivor of domestic violence to regain their smile through the GBAS program?

Whitening Fundraiser

Although volunteerism is crucial to the success of the GBAS program, not every dentist wants or is able to volunteer to that extent. Did you know that a $200 donation makes it possible for one survivor of domestic violence to regain their smile through the GBAS program? Compare that to the cost of a single veneer or crown!

GBAS also has created the Whitening Fundraiser as an additional way in which volunteer dentists can support the AACDCF, and every team member can participate. This fundraiser is also a practice and team builder. Discus Dental has agreed to donate whitening kits to volunteer dentists, and the dental office then offers the whitening kits to their patients for a donation to the AACDCF—patients write a check directly to GBAS. These funds help support the program and enable dentists, patients, and Discus Dental to have a greater impact on survivors of IPV.

Businesses that participate in cause-related marketing tend to experience an increase in staff motivation, which can result in employees being more enthusiastic about their jobs.[4] AACD members performed an average of 77 whitening treatments last year, and 57% said they expected this number to rise.[5]

AACD members performed an average of 77 whitening treatments last year, and 57% said they expected this number to rise.

Dr. Banks had 103 patients come into the office for whitening; this generated more than $10,000 for the AACDCF. Dr. Banks states that approximately 20 new patients who came into the office were directly related to the Whitening Fundraiser. Six patients overall needed restorative care and one of those committed to a nine-unit veneer case; 20% of the 103 patients referred others to the practice.

Rewards from Participating in GBAS Whitening Fundraiser

Dr. Kerri White and her team in Boca Raton, Florida, decided they wanted to get involved in the program. They created a sign, and told every patient about GBAS when they came into the office. They promoted the Whitening Fundraiser by placing an ad in a local magazine. What they did not anticipate was the interest that it created! The phone rang constantly and due to demand, they had to actually set a limit on how many whitening appointments they did. As the patients came in and wrote their checks to GBAS, they also went home and informed family and friends. New patients called the office to schedule new patient exams and hygiene appointments. Of all the patients who came in for whitening, 50% of them proceeded to restorative care and were able to raise more than $10,000 for GBAS. Dr. White says, "Talk about win-win! This has turned into a great practice builder!"

Dr. Ken Banks offered all patients in his Inwood, West Virginia, practice the opportunity to whiten their smiles and contribute to the AACDCF. For a fee of $125, Dr. Banks and his team were able to offer a valuable service that the patients found affordable and as an opportunity to give back: Whiten your smile, and help someone else get their smile back! Dr. Banks' team was enthusiastic and took control of the program. Dr. Banks added an incentive for his team: If they could do more whitenings than any other office participating in the Whitening Fundraiser, he would take them to the AACD meeting in Boston, May 2011. They all found this to be a fantastic team-building exercise (and yes, they all enjoyed their visit to Boston)! From July 2010 to April 2011, Dr. Banks had 103 patients come into the office for whitening; this generated more than $10,000 for the AACDCF. Dr. Banks states that approximately 20 new patients who came into the office were directly related to the Whitening Fundraiser. Six patients overall needed restorative care and one of those committed to a nine-unit veneer case; 20% of the 103 patients referred others to the practice. The remarkable thing is that this was done with an economical marketing budget. Dr. Banks' team created a poster for the office, utilized Facebook promotions and Demandforce notifications with text and e-mail messages, and his son created a video for YouTube. Dr. Banks also wrote an article for a local magazine.

Dr. White and Dr. Banks did not foresee that their initial participation in GBAS would not only bring philanthropic rewards, but would also foster great team building. Their involvement also resulted in new patients and the commitment of a few patients to elective restorative care.

October is National Domestic Abuse Awareness Month.

National Domestic Abuse Awareness Month

October is National Domestic Abuse Awareness Month. Take the time to reflect not only on how your office can give back, but on how your patients can give back, too. Sometimes it is the little things that can have the greatest impact on someone's life. Philanthropy has many positive results, as seen in the practices of Dr. White and Dr. Banks. Consider the rewards of participating in the Whitening Challenge: You can "give back a smile" and diminish the effects of domestic abuse, and build your team and practice as well!

To get involved, e-mail givebackasmile@aacd.com or call 800.543.9220.

References

1. U.S. Department of Justice, Bureau of Justice Statistics. Intimate partner violence in the United States, December 2006. Available from http://bjs.ojp.usdoj.gov/content/intimate/injury.cfm.
2. Centers for Disease Control and Prevention. Costs of intimate partner violence against women in the United States. March 2003. Available from www.cdc.gov/violenceprevention/pdf/IPVBook-a.pdf.
3. Tjaden P, Thoennes N. Extent, nature, and consequences of intimate partner violence: findings from the National Violence Against Women Survey. National Institute of Justice and the Centers of Disease Control and Prevention July 2000;41-43.
4. Cone CL, Feldman MA, DaSilva A. Causes and effects. Harvard Bus Rev. 2003 Jul;81(7):95-101.
5. American Academy of Cosmetic Dentistry Press Release [Internet]. Madison (WI): The Academy; April 2011. Wanted: whiter, brighter teeth. Available from www.aacd.com/index.php?module=cms&page=726.

Ms. Jones holds degrees in Dental Hygiene and Healthcare Management from Southern Illinois University. She serves on the AACD Charitable Foundation Board of Trustees and is on the Dental Advisory Board of *Dentistry Today*.

Disclosure: The author did not report any disclosures.

Treating a Fracture Using Direct Resin

Accreditation Clinical Case Report, Case Type IV (Class IV Fracture)

Kristi A. Crispin, DMD

Figures 1a & 1b: Preoperative smile; fractured left central incisor resulting from a traumatic incident. Postoperative smile; restored left central incisor mimicking the color and translucency of the right central incisor.

Introduction

Class IV composite bonded restorations can be one of the most challenging clinical procedures for dentists. The focus is on recreating the missing segments of tooth structure with a resin material directly in the patient's mouth in a way that harmonizes with the balance of the smile. In this endeavor, the dentist becomes the operating clinician as well as an artist in the attempt to invisibly replicate the shade as the resin is layered with a stratification technique mimicking the translucency, value, texture, form, and function.[1]

Our mission is to provide the patient with a restoration that is predictable and durable, and that supports health. Often the demand for this application is spontaneous, resulting from a traumatic injury.[2] The clinician is called upon to perform his or her magic to replace the damaged or broken segments of the individual's smile during an emotionally charged time. The options available in contemporary dental materials are exceptional and the clinician has the opportunity to combine and layer composite resins to blend shades producing natural, lifelike results. Dentists can also be aided by computer spectrophotometers to provide additional objective data in shade selection. Ultimately, through the use of deliberate technique and artistry, the clinician has the potential to erase the disfiguring damage with a restoration that is undetectable.

Patient History

The patient was a 29-year-old-female with no adverse medical history and in good overall health. She presented on an emergency basis after being involved in an incident that resulted in the fracture of tooth #9 **(Figs 1a & 1b)**. Her chief complaint was that she needed to have her broken front tooth fixed immediately; the owner of a com-

Figures 2a & 2b: Preoperative 1:2 view; visible horizontal fractured left central incisor. Postoperative 1:2 view; restored left central incisor matching the light reflective properties of #8.

The options available in contemporary dental materials are exceptional and the clinician has the opportunity to combine and layer composite resins to blend shades producing natural, lifelike results.

pany that deals with building plans and development for the city of Los Angeles, she knew that she could not meet with clients in this condition.

Findings

An emergency examination was performed, and health history, diagnostic models, inter-occlusal registration, digital radiographs, and digital photographs were recorded.[3] The patient's symptoms were fully reviewed and evaluated and all treatment options were discussed with her. The patient was also informed of the possibility of the need for endodontic management of the traumatized tooth, as well as the potential for discoloration of the remaining tooth structure. All the patient's questions were answered. The teeth were evaluated and checked for any possible fractures, pulp exposures, and mobility. A single visible fracture was observed progressing from the mesial one-third to the incisal one-half **(Figs 2a & 2b)**. The balance of her anterior teeth appeared to be structurally sound. The patient had experienced no spontaneous pain since the accident. Tooth #9 responded to cold, was negative to percussion, and did not exhibit mobility.

Her temporomandibular joint was asymptomatic and she reported no abnormal discomfort from the trauma. The radiographic findings were also within normal limits.

The following esthetic and restorative issues were discussed:

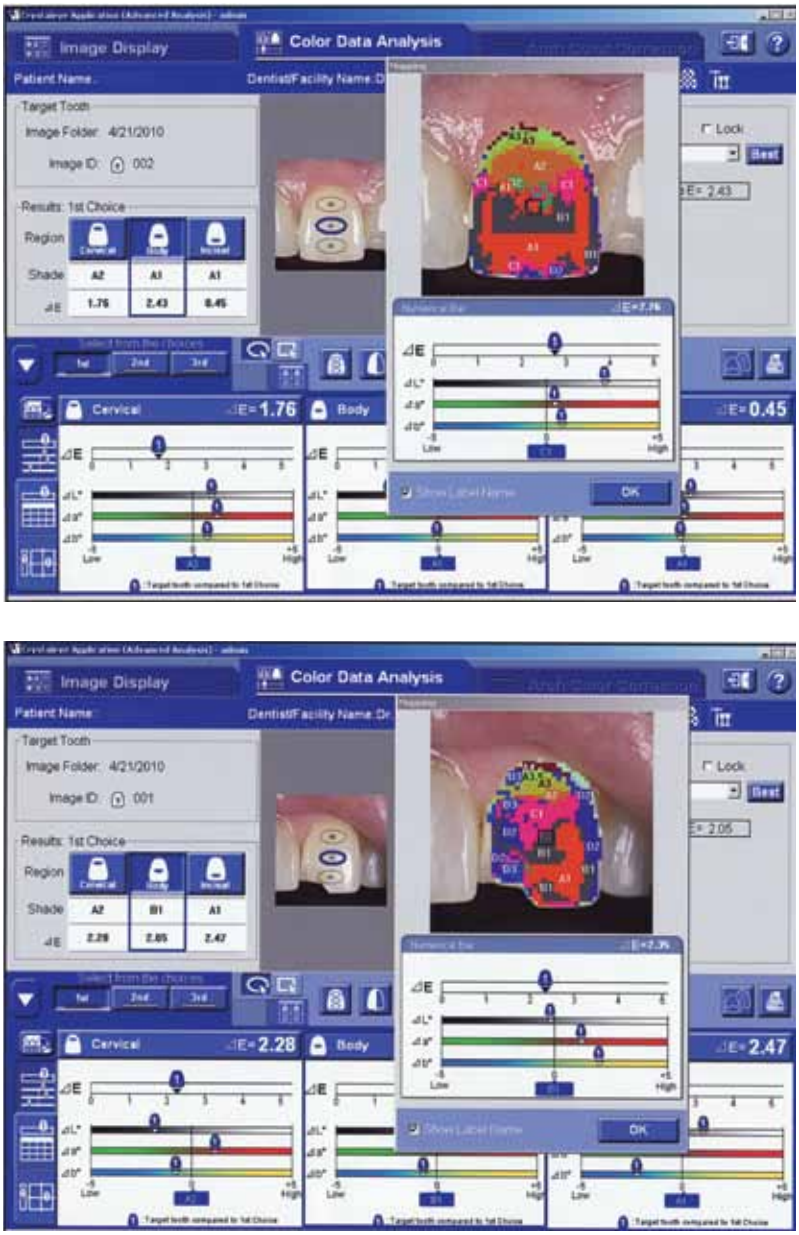
1. Shade: home bleaching prior to final restorative treatment was recommended.
2. Restorative options:
   a. porcelain versus direct bonding[4]
   b. functional issues
   c. longevity of material choices
   d. possible need for endodontic management and discoloration of the residual tooth structure and root.
3. Recare and maintenance: observation, management and evaluation.

Diagnosis and Treatment Planning

After treatment options were discussed, the patient selected a direct composite resin restoration. Tooth #9 was provisionally restored for an observation period to determine if, over the next few weeks, any symptoms developed and to complete a home whitening regime using 10% Opalescence (Ultradent; South Jordan, UT) to achieve the esthetic color that the patient desired in the final restoration. A diagnostic wax-up was completed to develop the intended final contours of tooth #9. From these diagnostic models, a matrix was fabricated to aid in the creation of the final restoration. A tray technique was utilized to whiten the patient's smile. The patient was then instructed to discontinue whitening for three weeks prior to the initiation of the definitive resin restoration. A Crystaleye Spectrophotometer (Olympus America; Center Valley, PA) was used to aid in the objective measurement of the shade

Figure 3: A Crystaleye Spectrophotometer was used to digitally color map the right central incisor. The information was transferred to computer software, analyzed, and used to assist in selecting composite materials with the correct color and translucency.

Figures 4a-4c: Diagnostic wax-up showing the proposed treatment plan (putty matrices for the definitive composite additions to the lingual and facial contours).



Figures 5a & 5b: A Crystaleye Spectrophotometer analysis on #8 showing the color mapping to be matched. An analysis was also done on #9 to compare it to #8.

When used properly, composite resin material can mimic optical properties and allow the restoration to disappear into the surrounding dentition.

of the adjacent teeth **(Fig 3)**. This provided valuable information in the selection of composite shades for the final direct resin. Further evaluation and vitality tests were done to ensure that the tooth did not require endodontic therapy.

Two sets of silicone putty matrixes using Splash Putty (Discus Dental; Culver City, CA) were created from the diagnostic wax-up[5] **(Figs 4a-4c)**: one to replicate the intended lingual contours and the incisal edge for the first layer of hybrid composite, and the other as a guide for the facial portion of the tooth to help reproduce #8.[6] A Crystaleye Spectrophotometer reading was taken on both #8 and #9 **(Figs 5a & 5b)** to help determine the appropriate shade of the final composite resin. A color mock-up was done in the patient's mouth to verify the composite "recipe" that would best mimic the colors of the adjacent intact central.[7] Renamel (Cosmedent; Chicago, IL) shades incisal light A1 and B1 were selected.

Treatment

After anesthetizing the patient, the provisional composite was removed from #9 and the tooth was prepared for final restoration. A long facial bevel was used to help blend the composite into the existing dentition. Tooth #9 was etched with phosphoric acid for 15-20 seconds, then Single Bond (3M ESPE; St. Paul, MN) bonding agent was placed and light-cured for 20 seconds. A putty matrix was brushed with wetting resin (Ultradent) to prevent the composite from adhering to the putty. Incisal light hybrid composite (Cosmedent) was then placed in the matrix to create the lingual shell of resin and positioned on the teeth. A hybrid composite was chosen due to the higher strength of the material; this would provide a guide for the incisal edge length and shape of #9. A1 and B1 microfill composites (Cosmedent) were selected as the body layer of the composite. These were placed through the body of the tooth and mamelons were formed under the final layer of composite to give the tooth a natural appearance. Incisal light microfill was then placed at the incisal one-third to create the final layer of translucency. Tooth #8 exhibited defined lobular areas of translucency in the incisal region that needed to be mirrored in #9. A microfill composite was chosen for the surface of the restoration because of the ease with which it can be polished and retain the polish. The composite was then taken to final

Figures 6a & 6b: Preoperative and postoperative 1:1 frontal images showing the esthetic result of the composite placement, finishing, and similar light-reflective properties.

Figures 7a & 7b: Preoperative and postoperative full-face images, showing the final case after bleaching and direct Class IV resin placed.

contour, defining the mesial line angle, light-reflective properties, and contour. A pencil mark was placed on the mesial facial of the tooth to help visualize the height of contour of the mesial-facial line angle.[8] Coarse and medium-grit FlexiDiscs (Cosmedent) and an ET9 bur (Brasseler USA; Savannah, GA) were then used to achieve final contour. No tints or opaquers were needed to achieve the best possible esthetics in this case.

The restoration was then taken to final finish and polish with FlexiPoints, FlexiCups, FlexiBuffs, and Enamelize (Cosmedent) **(Figs 6a & 6b)**.[9] Occlusion was adjusted and postoperative instructions—including oral hygiene directions—were given to the patient. A two-week postoperative appointment was made to check tissue health. Final digital photographs were taken several weeks after the final restoration was placed **(Figs 7a & 7b)**.

SUMMARY

Direct resins are a challenging application and require the dentist to raise their level of artistic ability. When used properly, composite resin material can mimic optical properties and allow the restoration to disappear into the surrounding dentition. The restoration can remain conservative, only augmenting the lost tooth structure, which is an enormous benefit to the patient. Direct resins are an invaluable, conservative,

and durable treatment option for all patients.[10]

Acknowledgments

The author gives special thanks to her father, Dr. Bruce Crispin, for his encouragement to pursue Accreditation and for the knowledge he has passed on. She also expresses gratitude to her mentors in bonding, Dr. James Peyton and Dr. Buddy Mopper, who taught her how to make bonding believable.

References

1. Terry D. Natural aesthetics with composite resin. Mahwah (NJ): Montage Media; 2004. p. 106-21.

2. Lambert DL. Conservative aesthetic solutions for the adolescent and young adult utilizing composite resins. Dent Clin North Am. 2006;50(1)87-118.

3. American Academy of Cosmetic Dentistry. A guide to Accreditation photography. Madison (WI): The Academy; 2009.

4. Crispin B. Restorative esthetic procedures: direct composite and glass ionomer. Contemporary esthetic dentistry practice fundamentals. Hanover Park (IL): Quintessence Pub.; 1994. p. 105-26, 241-84.

5. Spear F. The maxillary central incisal edge: a key to aesthetic and functional treatment planning. Compend Cont Educ Dent. 1999;20(6):512-6.

6. Behle C. Placement of direct composite veneers utilizing a silicone build-up guide and intraoral mock-up. Pract Periodont Aesthet Dent. 2000;12(3):259-66.

7. Peyton JH. Finishing and polishing techniques: direct composite resin restorations. Pract Proced Aesthet Dent. 2004;16(4)293-8.

8. Peyton JH. Direct restoration of anterior teeth: review of the clinical technique and case presentation. Pract Proced Aesthet Dent. 2002;14(3):203-10.

9. Miller M. Contouring and polishing resin based materials. Reality: the techniques. 2003;1:23-9.

10. Fahl N. Jr. A polychromatic composite layering approach for solving a complex Class IV/direct veneer-diastema combination. part 1. Pract Proced Aesthet Dent. 2006;18(10):641-5, quiz 646. **jCD**

Dr. Crispin graduated from Tufts School of Dental Medicine in 2003. She teaches at Esthetic Professionals, a private education center in Tarzana, California.

Disclosure: In her capacity as associate director of Esthetic Professionals, Dr. Crispin receives product support from numerous manufacturers, including Olympus, Discus Dental, Cosmedent, 3M ESPE, and Brasseler USA.

Examiners' Observations

Restoring a Tooth to Natural Form and Function

James H. Peyton, DDS, FAACD

There is no laboratory involved, so the clinician has complete control of the situation.

Case Type IV tests the dentist's clinical skill in creating an artistic and natural-looking restoration. There is no laboratory involved, so the clinician has complete control of the situation. The candidate has the choice between a Class IV fracture and a diastema closure. Case Type IV is the most conservative of all the restorations that are required for Accreditation. The AACD promotes conservative dentistry and these restorations perfectly demonstrate that standard. The procedure can be performed in a single visit, with some "touch-ups" and final photographs at a later date. There is also the advantage that the restorations can be modified, contoured, or redone without the additional expense of using a laboratory. In this case, a Class IV mesial-incisal fracture repair was performed on tooth #9. Dr. Kristi Crispin did a very nice job in restoring the tooth to natural form and function.

As an examiner, one of the major factors to evaluate is whether the restoration "stands out" in the 2:1 postoperative photographs. In other words, the best restoration is one that you can't see! In this case the restoration blends nicely into the tooth, as shown in the 2:1 postoperative view.

Five examiners grade each case. A passing grade is given when the total score is -7 or less. A case passes when three or more examiners give the case a passing grade. All five examiners passed Dr. Crispin's case.

The following is a summary of the examiners' comments:

- Criterion #42: **Is the labial anatomy (primary, secondary, and tertiary) appropriate? Are there three planes for the labial contour of the central incisor?** The labial anatomy was a little under-contoured, secondary anatomy of depression between mesial and central lobe in different spot than contralateral tooth.
- Criterion #56: **Is incisal translucency and halo effect appropriate?** The incisal translucency and halo effect were inappropriate.
- Criterion #61: **Is margin placement and design appropriate? Are the margins visible?** The margin placement and marginal design were inappropriate, the margins were visible.
- Criterion #86: **Is the cervical/incisal tooth length symmetrical from right to left?** The mesial-incisal edge was slightly short.

This Class IV fracture was an excellent case selection. A single anterior tooth was fractured, the tooth was fairly monochromatic, and the teeth had excellent gingival health. This created a very straightforward case, which Dr. Crispin handled well. There are no extra points awarded for selecting a complex case. Any tooth that is treated will be graded. Examiners are looking for a high level of excellence, not perfection. There were some minor faults noted: the incisal edge being slightly short on #9, a slight depression on the labial anatomy, and a lack of incisal translucency. Fortunately, the adjacent teeth had very little incisal translucency, so this was not a major factor. The other faults were judged to be minor and the case passed easily. This case demonstrated that Dr. Crispin created an excellent restoration worthy of Accreditation. **jCD**

Dr. Peyton is an AACD Accredited Fellow and has been an AACD Accreditation Examiner for six years. A part-time instructor at the UCLA School of Dentistry, he practices in Bakersfield, California.

Disclosure: The author did not report any disclosures.

Restored after tripping in class. At her debut, it will still be dazzling.

She'd been dancing since she was a little girl. They said she was good enough to go pro.

Her mom sewed her costumes. Her brother gave her rides to rehearsal. Her instructors pushed and praised her.

She'd trained through it all, be it broken shoes or broken toes. Then she tripped during warm-ups. And while it's hard to smile with a broken tooth, it's even harder to dance with a broken heart.

Suddenly, it was her dentist's turn to help support her dream.

To restore her smile and her confidence, he chose Filtek™ Supreme Ultra Universal Restorative, so that years from now, when she receives her bouquet and standing ovation, it will still be beautiful. Then he can also take a bow.

Restore a smile. Change a life.

www.EveryoneHasAShade.com

Share your Filtek story and get a FREE REFILL (Up to a $116 value)
www.EveryoneHasAShade.com

Filtek™
Supreme Ultra
Ultra Universal Restorative

3M ESPE

© 3M 2011. All rights reserved. 3M, ESPE and Filtek are trademarks of 3M or 3M ESPE AG. Used under license in Canada.

Choosing the Right Tools

Tips for Accreditation Case Type IV

James H. Peyton, DDS, FAACD
Illustration by Zach Turner

"Keep it simple; ideally, restore just one fractured tooth."

Figure 1: Tooth #9 immediately postoperative.

Figure 2: Several months postoperative.

SELECT A GOOD CASE FOR ACCREDITATION. Case selection is critical in giving candidates the best opportunity to succeed.[1,2] Try to avoid cases that are too complex or aberrant in tooth form or intricacies in shades and maverick colors. Be sure to select a case with healthy periodontal architecture. Keep it simple; ideally, restore just one fractured tooth. The fracture should be large enough so that it is into dentin (more than 10% of clinical crown), but not so large that the case becomes unmanageable. It is also crucial to choose a great patient (one who will come back as many times as it takes you to achieve Accreditation-level results). The patient must allow you to do what is required to achieve an excellent restoration.

READ AND STUDY ARTICLES ON ACCREDITATION Case Type IV. There are articles available from the *jCD* for free on the AACD Web site. Sign up and take some hands-on classes on Case Type IV at the annual AACD meetings. Class sizes are small and fill up fast, so register early.

TAKE A SHADE AT THE BEGINNING of the appointment before the teeth dehydrate and become higher in value. Trust this shade and do not be tempted to make last-minute changes to match the dehydrated tooth. Let the patient know that the shade match at the end of the appointment will not match exactly, but that it will by the next day **(Figs 1 & 2)**. Create a custom shade tab by using the composite material itself, cure it, and determine if that is the correct shade. Most composite shades do not match the Vita shade guide. A shade guide of the composite material itself can also be very useful.[3]

> **A midline cant will make one tooth look larger than the other and is easily seen by the patient.**

DO A DIAGNOSTIC WAX-UP and plan the case modulating those elements of esthetics and function that will ensure the case's success. The laboratory or a highly trained dental assistant can help to facilitate this. Typically, for a Class IV fracture, this is a straightforward procedure.[3] Create a putty matrix from the diagnostic wax-up or from an intraoral mock-up. A putty matrix will allow precise recreation of the lingual anatomy and the all-important facial-incisal line angle. Use of the matrix will minimize any adjustments needed at the end of the restorative appointment. The putty matrix can also be used as a final check of the incisal edge contour.

CREATE A LONG BEVEL on the facial to help hide the fracture line and blend the composite to tooth interface (Class IV fracture case). The long bevel is then thinned out to create an "infinite margin." This technique provides the best blending of composite to tooth. It also maximizes the enamel surface bond.[3]

USE A DENTIN SHADE that completely hides the fracture line **(Figs 3 & 4)**. If the fracture line is still visible at this deeper layer of stratification, an opaquer can be effective in achieving this final element of camouflage (Class IV fracture case). It generally is best to use a composite shade one or two chroma higher than the enamel shade. However, most composite restorative systems are equipped with dentin (or opaque) shades of composite to replicate the dentin substrate of the tooth. The important factor is that the fracture line should disappear prior to adding the final enamel layer.

USE A COARSE DISC (Red Sof-Lex-XT [3M ESPE; St. Paul, MN] or similar type) to shape and contour the primary anatomy **(Fig 5)**. A high-speed carbide or diamond can be used to reduce the large excess of composite, but allow the disc to do the final contour. A coarse disc can produce a nice flat surface on the facial, create a highly accurate transitional line angle, and form a sharp and well-defined facial-incisal line angle.[2]

MAKE SURE THAT ALL the necessary instruments and materials are ready at the beginning of the appointment; this will prevent you from having to stop and search or even to skip a step because that instrument/material is not at hand. Think through the entire procedure and make a list of what is needed and the procedures and steps intended to follow and this will lead to more predictable results.

Figure 3: Fracture line still visible after the lingual shelf of composite was added.

Figure 4: Dentin shade masks the fracture.

Figure 5: Coarse disk.

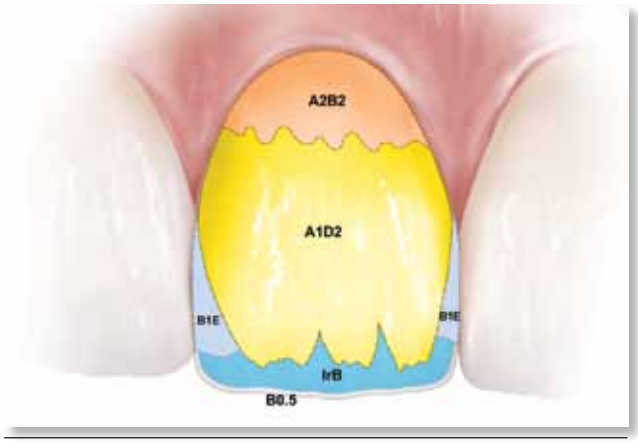


Figure 6: An example of a color map.

Figure 7: Secondary anatomy showing distinct proximal line angle.

MAKE A COLOR MAP of the restoration. Indicate the various layers of composites **(Fig 6)**. This will act as a "road map" to achieve an esthetic, polychromatic restoration.

ENSURE THAT THE PRIMARY anatomy is correct. This starts with creating the correct facial-incisal line angle (best viewed from an incisal view). Check that the light reflective surfaces match from one central to the other. This will mean that the proximal line angles are in the correct position and properly contoured **(Fig 7)**. If the tooth doesn't have the correct contour, it will look inappropriate even if the color match is perfect.[1,2,4]

CASE TYPE IV, DIASTEMA CLOSURE TIPS

FOR A DIASTEMA CLOSURE case, use a composite material that is very sculptable and can achieve a high polish. The putty matrix and lingual shelf technique allow the clinician to use almost any composite material for the Class IV fracture repair. However, the diastema closure case requires a material that is very sculptable and will hold its shape. If the material slumps, the clinician will continually be trying to keep it in place and be forced to cure the material in a rush. This will compromise the procedure and lead to unpredictable results.

MEASURE THE DISTAL-TO-DISTAL distance of the two centrals with a digital caliper, divide by two, and use that measurement to verify the width of each central. The maxillary central incisors need to be mirror images of each other in every anatomical respect. The most important factor is that final restorations must be of the same width. Make sure that a midline cant is avoided by verifying that the first restored tooth is straight up and down. A midline cant will make one tooth look larger than the other and is easily seen by the patient.

References

1. Peyton J, Arnold J. Six or more direct resin veneers case for Accreditation: hands-on typodont exercise. J Cosmetic Dent. 2008;24(3):38-48.

2. Gochar PW. Accreditation clinical case report, Case Type IV: anterior direct resin. J Cosmetic Dent. 2009;25(1):40-6.

3. Fahl N. Jr. Mastering composite artistry to create anterior masterpieces. part 1. J Cosmetic Dent. 2010;26(3):56-68.

4. Peyton J. Finishing and polishing techniques: direct composite resin restorations. Pract Proced Aesthet Dent. 2004 Jul;16(4):293-8.

Dr. Peyton is an AACD Accredited Fellow and has been an AACD Accreditation Examiner for six years. A part-time instructor at the UCLA School of Dentistry, he practices in Bakersfield, California.

Disclosure: The author did not report any disclosures.

Excellence is Never an Accident

WESTLUND DENTAL STUDIO

www.westlunddental.com | 800.728.9641

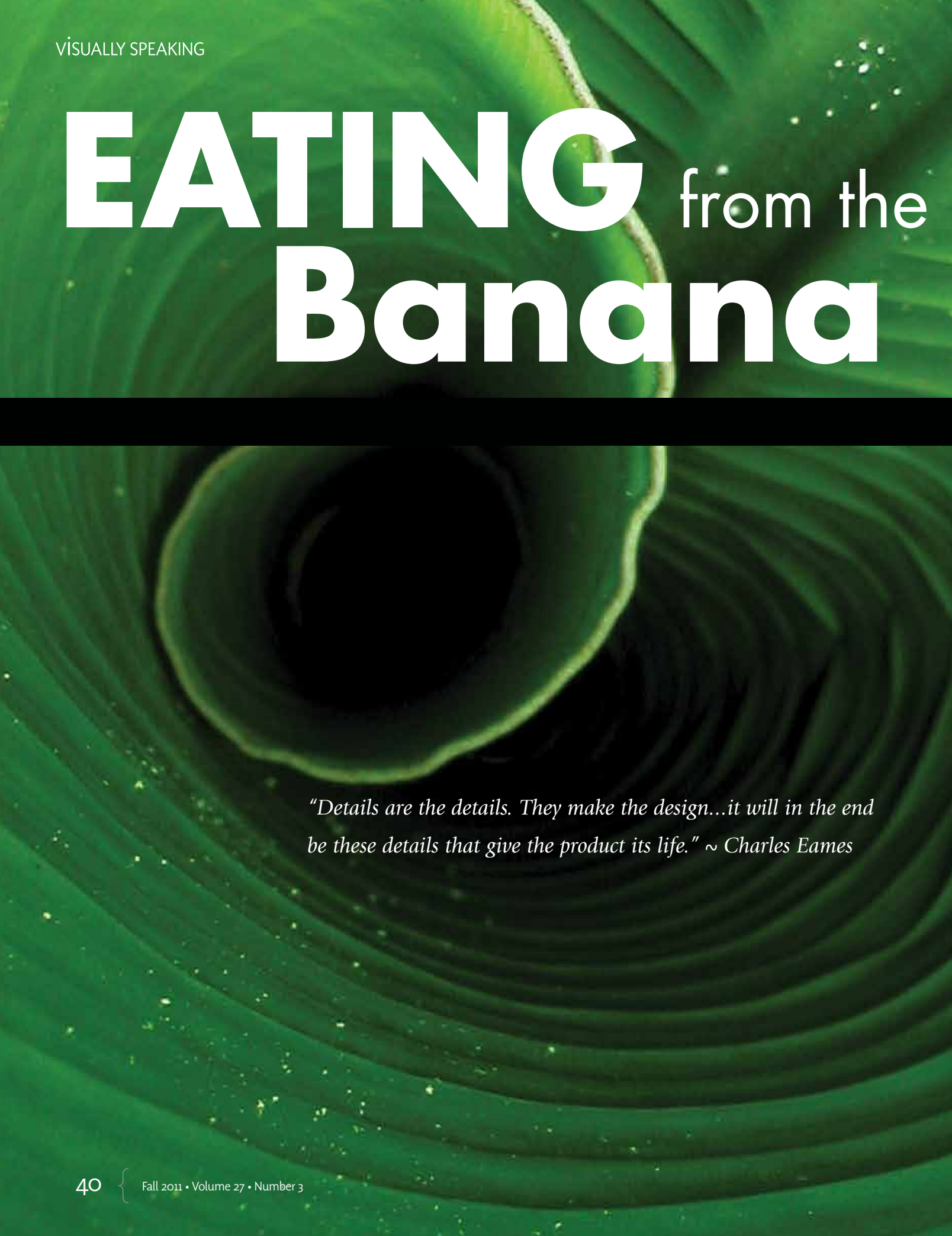
Westlund Dental Studio recommends the Strength, Durability and Esthetics of

IPS e.max® lithium disilicate

IPS emax is a registered trademark of Ivoclar Vivadent.

ivoclar vivadent:
passion vision innovation

EATING from the Banana



"Details are the details. They make the design...it will in the end be these details that give the product its life." ~ Charles Eames

Leaf

A SIMPLIFIED APPROACH FOR SUSTAINED SUCCESS

Jason Smithson, BDS, DipRestDent RCS(Eng)

INTRODUCTION

The direct posterior composite resin restoration has become one of the most widespread procedures in cosmetic dentistry. However, direct composite resin placement is very technique-sensitive and has multiple steps: isolation, preparation, bonding, resin build-up, and finishing, all of which require meticulous attention to detail to ensure success.

The great architect and furniture designer Charles Eames used to tell a story called "The Banana Leaf Parable,"[1] in which he explained that the most basic eating crockery in Southern India is the banana leaf. He related the design progression and process whereby the banana leaf is transformed into something fantastically ornate: the modern china plate. In conclusion, he explained the next stage of the design process: "But you can go beyond that and the guys that have not only means, but a certain amount of knowledge and understanding, go the next step and eat off of a banana leaf."[1]

His point was that those who have a good command of a process should revert back to the origins simplifying the process and design (his personal motivation being sustainability). He believed that eliminating extraneous embellishments may result in a process or design that is more efficient and effective and, in the eyes of some, more elegant.

In a similar way, consider the advantages of simplifying one phase of direct resin placement, the build-up, so that only the most basic of instruments are utilized: the explorer (ubiquitous on all dental tray set-ups), the humble Microbrush, and a sable brush. This article illustrates the process of simplified instrumentation via a single Class I restoration in an upper second molar.

"Those who have a good command of a process should revert back to the origins simplifying the process and design."

The simplified armamentarium: An Ash #6 probe or explorer (Dentsply; Addlestone, Surrey, UK), a Microbrush (Microbrush International; Grafton, WI), and a #1 sable brush (Cosmedent; Chicago, IL).

Preoperative situation: The patient requested replacement of the failing silver amalgam restoration in the upper left second molar; the tooth was asymptomatic and caries was diagnosed on routine radiographic survey. A Class II restoration in the first molar is planned for replacement at a later date.

Isolation in quadrants utilizing an Ash 8A clamp, latex-free rubber dam (d2d Endo; Derby, UK), and Wave-Wedges (Triodent; Los Alamitos, CA).

Removal of old dentistry revealing caries at the disto-buccal amelo-dentinal junction and on the cavity floor.

After rendering the cavity caries-free, the enamel margins were beveled[2] and air-abraded with 27-µ alumina (Micro-etcher IIA, Danville Materials; San Ramon, CA) to remove aprismatic enamel and biofilm.[3]

The cavity was etched (Ultra-Etch, Ultradent; South Jordan, UT), and a dentin-bonding agent (Optibond FL, Kerr; Orange, CA) was placed and polymerized for 30 seconds.[4]

Flowable composite (G-Aenial Flo, GC America; Alsip, IL) was placed in a layer less than 1 mm in section and adapted to the cavity with the Ash explorer. This was then polymerized for 40 seconds to achieve a high elastic modulus. This is more resistant to the deformation forces generated by polymerization contraction of the restorative composite, than the bonding agent alone.

The composite resin (Empress Direct, Ivoclar Vivadent; Amherst, NY) is laid out in 2 mm x 1 mm increments in the light well of a composite heater (Ease-It, Ronvig Dental Products; Saratoga, CA). Heating the composite resin to 40 degrees improves the handling and adaptability of the material, as well as improving the physical characteristics.[5]

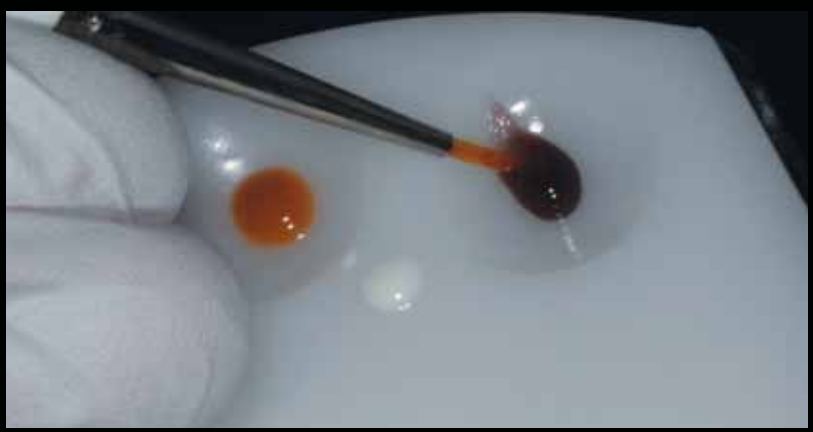
An increment of A3 dentin shade composite resin is picked up with the Ash explorer; as the composite heater is Teflon-coated, the increment instantly adheres to the instrument.

The resin increment is carried to the cavity and the Ash explorer withdrawn. As the explorer has a small surface area and the cavity has a large surface area coated with bonding agent, the increment remains in the cavity. No separating medium is required; however, the explorer should be cleaned meticulously with an alcohol wipe between increments to remove resin debris, which may result in "dragging" of the composite resin. (Technique demonstrated on a typodont model.)

Detailed image of the Microbrush. (The author uses only high-quality brushes because inferior brushes tend to shed bristles, which is frustrating and may affect the longevity of the restoration.)

The Microbrush is bent at the desired angle to aid in ergonomics and used in a "patting" motion to condense the resin. No separating medium is needed and the resin does not adhere to the brush, resulting in reduced void formation. (Technique demonstrated on a typodont model.)

Completed dentin buildup with primary fissure anatomy and cusp form. The dentin mass is modelled on a cusp-by-cusp basis, oblique layering and polymerizing each separate cusp to reduce "C-Factor" stresses.[6]



Hyperchromic tints: Ochre (Light Brown Creative Color, Cosmedent) and brown (Brown 2, Micerium S.p.A.; Avegno, Italy) are laid out in the wells of a "resin keeper" (Cosmedent) and picked up with the #1 sable brush. It is helpful to use a small amount of wetting resin (Brush and Sculpt, Cosmedent) to bring the brush to a finer point prior to picking up the tints.

The tints are applied sparingly to the fissure system: the ochre shade throughout to "warm up" the occlusal surface, whereas the brown is applied only to the main occlusal pits.

The enamel shade composite (A2 Enamel, Empress Direct) is built up in the same way as the dentin using the explorer and Microbrush. The #1 sable brush is utilized with wetting resin to adapt the composite resin to the cavo-surface margins. Care is taken to leave a little of the dentin shade exposed around the fissure pattern; this gives a sense of depth to the restoration. Attention is paid to the primary and secondary fissure anatomy and cuspal form to minimize the degree of finishing and occlusal adjustment required[7] in the spirit of "Form ever follows function."[8] Each increment is polymerized for only three seconds, according to the "pulse activation" protocol.[9]

Initial polishing using impregnated rubber tips and discs (D-Fine, Clinician's Choice Dental; New Milford, CT). Care is taken to avoid any dentin margins with rotary instrumentation.[10]

Final polish with a Jiffy brush (Clinician's Choice).

Final restoration and esthetic integration after removal of rubber dam and occlusal adjustment. KY Jelly (Johnson and Johnson; New Brunswick, NJ) was then applied to the entire restoration and polymerized for 40 seconds.[11]

CONCLUSION

It is feasible to realize esthetic, lifelike restorations, which have functional anatomy with very little requirement for polishing/occlusal adjustment, with only very basic hand instrumentation. The advantages of a reduced instrument armamentarium are numerous:

- **Economy**. Very little financial investment is required for this basic tray set-up.
- **Sterility.** The Microbrush and the sable brush are both disposable: this means less instrument cleaning for the assistant and reduced wear and tear on washer-disinfectors and autoclaves.
- **Instrument transfer.** Four-handed dentistry with very little verbal communication is possible with this technique due to the "cookbook" style approach: virtually every case is the same. As there are usually only two instruments used, when the operator passes the explorer, the assistant knows the Microbrush is required and vice versa. This is an extremely useful introductory technique for those new to four-handed dentistry.
- **Concentration and fatigue.** As only three instruments are employed, decision making by the operator is reduced, as is the need to subconsciously look up to select an instrument. This improves focus on the procedure itself and reduces operator fatigue and stress. This is particularly important for dentists working with the operating microscope, since constantly looking up and away from the operating field may produce eyestrain and headaches.
- **Efficiency.** High levels of concentration and rapid instrument transfers make this a very efficient procedure; this is seen in higher levels of production and improved quality.

To echo the words of Leonardo daVinci: "Simplicity is the ultimate sophistication."

> "This is an extremely useful introductory technique for those new to four-handed dentistry."

References

1. Eames C. Excerpt from Norton lecture #1 1970-1971. Available from: http://inspiration-item1.blogspot.com/2008/12/banana-leaf-parable-by-charles-eames.html.

2. Ben-Amar A, Metzger Z, Gontar G. Necessity of bevels for box only class II composite restorations. J Prosthet Dent. 1987;58:5-8.

3. Yazici AR , Kiremitci A, Celik C, Ozgunaltay G, Dayangac B. A two-year clinical evaluation of pit and fissure sealants placed with and without air abrasion pretreatment in teenagers. J Am Dent Assoc. 2006;137(10):1401-5.

4. Kanca J. A method for bonding to tooth structure using phosphoric acid as a dentin-enamel conditioner. Quintessence Int. 1991;22:285-90.

5. Daranch M, Rueggeberg FA, DeGoes MF. Monomer conversion of preheated composite. J Dent Res. 2005;84(7):663-7.

6. Feilzer AJ, De Gee AJ, Davidson CL. Setting stress in composite resin in relation to configuration of the restorative. J Dent Res. 1987;66:1636-9.

7. DeVreugd RT. The occlusal compass concept: a practical approach to posterior tooth morphology. Available from: http://www.idseminars.com/articles/QDT_Article_1997.pdf.

8. Triton College [Internet]. River Grove (IL): The College; 2011. Sullivan LH. The tall office building artistically considered. 1896. Available from: http://academics.triton.edu/faculty/fheitzman/tallofficebuilding.html.

9. Kanca J, Suh B. Pulse Activation: reducing resin-based composite contraction stresses at the enamel cavo-surface margins. Am J Dent. 1999 Jun;12(3):107-12.

10. Kanca J, Greitzer G. Class II restorations with margins below the CEJ. J Esthet Restor Dent. 2009;21(3):193-201.

11. Simonsen R, Kanca J. Surface hardness of posterior composite resins using supplemental polymerization after simulated occlusal adjustment. Quintessence Int. 1986 Oct;17(10):631-3. **jCD**

Other examples of posterior work by Dr. Smithson.

Dr. Smithson is a clinical lecturer at The Peninsula Dental School, Cornwall, UK, and is involved in postgraduate teaching at both the Cornwall and the Isles of Scilly and Plymouth Foundation Dental Practitioners Schemes. Dr. Smithson practices in Truro, Cornwall, UK; and in London.

Disclosure: Dr. Smithson is an "Opinion Leader" for Cosmedent (Enlighten Smiles) and Ivoclar Vivadent and is a member of the European Restorative Advisory Board for GC Europe. He did not receive financial support for this article.

IS YOUR WEBSITE Working FOR YOU?

Hiring the right online marketing and design firm can be a tough decision, and trying to manage all of the variables on your own is overwhelming. Which parts and pieces are needed? Which are the best return on your investment? Relax, we'll help you make cents of internet marketing. Contact us for a comprehensive evaluation, Today!

BUDGET

DESIGN

PROMOTE

TRACK

Performance based web strategies.

American Academy of Cosmetic Dentistry® CORPORATE MEMBER

ROSEMONT MEDIA
A MODERN AD AGENCY

1010 Turquoise Street, Suite 201, San Diego, CA 92109
Ph. 800.491.8623
www.rosemontmedia.com
info@rosemontmedia.com
www.facebook.com/rosemontmedia

Call Today:
800.491.8623

Conservative, Simple, Efficient!

No-Prep Smile Design, Using a Single Shade, Modern, Direct Material

John F. Weston, DDS, FAACD
Illustrations by Zach Turner

Introduction

The ability to restoratively correct minor spacing and wear issues in an otherwise healthy dentition can be one of the bigger challenges in cosmetic dentistry. Sometimes a smaller correction requires a greater, more delicate effort to achieve success. To create natural contours and undetectable restorations, each case requires precise planning, accurate manipulation of materials, and proper clinical training. In any case, if a restorative option is selected, it should be with the understanding that permanent changes will be made to natural teeth to properly correct the problem. As restorative dentists, our goal should always be to conserve as much tooth structure as possible while still achieving the intended outcome.

To this end, conservative "no-prep" laminate porcelain veneers and direct composite veneers can be placed to achieve functional and esthetic objectives. However, porcelain laminate veneers cannot always be placed ideally without some tooth structure removal, and parameters to ensure longevity and esthetic success include required material thickness, tooth substrate (i.e., enamel or dentin), tooth position, and angulation.[1-4] Additionally, other esthetic and functional considerations, including tooth color, occlusal relationships, and patient expectations, may also dictate the appropriateness of the porcelain laminate veneer option.[1-5]

Figure 1: Note the high luster, finish, and polish of the single shade nano-composite.

Composite Properties

In certain cases, direct composite veneers are among the options for minimally invasive treatments when altering the appearance of a patient's smile as well as restoring function and improving occlusal relationships.[5,6] When selecting a composite restorative material, it is important to understand its properties to determine its suitability for a case. Ideally, a material should demonstrate wear resistance, polishability, and strength in order to provide maximum value to the patient.

In the past, microfill composites were typically used for anterior restorative applications because they are known to demonstrate high polish and good wear properties. The drawback with these materials, however, is their strength. Microfill composites often fracture on lines between the resin matrix and the pre-polymerized particles of organic filler.[6-8] Although they may enable dentists to replicate the color, translucency, polishability, and wear resistance of natural teeth, they are not sufficiently strong for some functional requirements and may be excessively translucent.[9,10]

Nano-composites, however, demonstrate recent advances in wear properties and polishability that make them suitable for esthetic restorative dentistry (e.g., Filtek Ultra, 3M ESPE; St. Paul, MN). This material combines individual spherical nano-particles with clusters of nano-particles and the nano-clusters are lightly sintered before being blended into the composite. This sintering allows the particles to break apart during the wear process, preventing the loss of large particles and enabling the material to maintain a strong polish over time and still exhibit good strength **(Fig 1)**.[11] Some nano-filled composites (e.g., Venus Diamond, Heraeus; South Bend, IN), in addition to utilizing nano-technology for strength and polishability, demonstrate ideal natural tooth optical properties, such as opacity and translucency.[12,13]

Current trends in dental materials suggest that nano-composites are emerging as a popular choice for anterior direct restorations.[11,13,14] Although no one material or restorative option is ideal for every clinical situation, trends suggest that today's available composite materials are of high quality and, when appropriately applied into carefully selected treatments, can deliver predictable and long-term results.[15]

The case discussed here is an excellent example of how modern direct materials can provide a conservative alternative for meeting a patient's esthetic and functional goals in consideration of the time and economic constraints presented.

Patient History and Findings

The 29-year-old patient wanted his smile enhanced for his upcoming wedding. A professional athlete and model, he was aware that his smile could be improved. Clinical and radiographic examination revealed a healthy soft tissue interface. However, hard tissue and temporomandibular joint examinations revealed incisal wear and nocturnal bruxism **(Figs 2-4)**. The patient was previously treated by an orthodontist and was informed there was an arch/tooth width discrepancy.

It was agreed that placement of direct materials to close diastemas, lengthen the teeth, and rebuild anterior guidance would satisfy the esthetic goals and time constraints. When patients understand the necessity for proper maintenance, modern direct materials are a viable, long-term anterior restorative option.

Records and Smile Design

A complete AACD series of photographs was digitally recorded, including additional photographs of the lips in repose and shade reference. Maxillary and mandibular preoperative impressions were made, along with a facebow using a SAM 3 articulator (Great Lakes Orthodontics; Tonawanda, NY). Study casts were mounted with a passively obtained open bite centric relation (CR) record using an anterior deprogrammer. The mounted models were studied to determine whether any

Figure 2: Preoperative smile shows lack of balance and harmony.

Figure 3: Note incisal wear, diastemas, and improper proportions.

Figure 4: Note abraided surfaces from previous orthodontic treatment.

Figure 5: Flowable composite was used to improve the proportions of the incisors by adding length and closing the diastemas.

Figure 6: Lingual and incisal edge guides/matrices and buccal contour guides/matrices were created using injectable putty.

Figure 7: Note the retruded positioning of the incisal edges, which facilitated a "no-prep" additive process.

"Results are all that matter. I've been prescribing Lava restorations for about six years. I know from experience that when I send the case to my lab, it's going to **look and fit perfectly—and last**. I've had consistent success, even on six-unit bridges. Our patients love it so much, they actually tell their friends."

– Dr. Kyle Edlund

Why? How about 10 years, 100 studies and millions of cases.[1]

Staggering statistics aside, there are endless reasons to prescribe Lava™ Zirconia. Start with patient demand for a crown or bridge with no metal in it. Or the look of genuine satisfaction when a patient sees beautiful Lava zirconia where a large amalgam once was. Lava zirconia takes cosmetics to a whole new level. Isn't that where you want to take your practice? Start now.
Prescribe authentic Lava zirconia.

Lava™
Zirconia

Learn how you can offer Lava Zirconia.
Call 800-634-2249 or visit www.3MESPE.com/Lava

3M ESPE

© 3M 2011. All rights reserved. 3M, ESPE and Lava are trademarks of 3M or 3M ESPE AG. Used under license in Canada.
[1] Based on sales. Some indications are contraindicated for patients with bruxism. Visit www.3MESPE.com/Lava for a list of indications.

Figure 8: Note the negative space at the incisal edges compared to the lower lip, which enabled the creation of additional length for the incisors.

Figure 9: The longer canines and incisors improved functional guidance.

Figure 10: A single shade of composite (compressed into a ball to reduce air bubbles) was placed on the facial surface of one tooth at a time and gently spread out using an interproximal carver.

Figure 11: A flat brush was used to blend, contour, and shape the line angles.

Figure 12: Proper facial embrasures were created.

Figure 13: Basic contouring was completed using a red stripe flame-shaped diamond to create a smooth satiny contour; alternating between wet and dry helps to visualize the anatomy.

Sometimes a smaller correction requires a greater, more delicate effort to achieve success.

occlusal disharmonies existed. It was determined that CR and centric occlusion were compatible, and no posterior occlusal treatment was indicated.[16]

The teeth were dried and a lip retractor placed for smile design and intraoral mock-up. Intraoral smile design was utilized to visualize the case and develop contours with proper anterior guidance. The composite mock-up was a valuable tool not only for the clinician, but also to demonstrate to the patient what could be accomplished. The intraoral mock-up was completed using flowable composite while following basic smile design principles **(Fig 5)**.[17]

The mock-up was contoured with a fine diamond, and photographs were used to compare with the preoperative condition. After minor corrections to the bite and approval from the patient, an incisal edge guide and facial contour guides were made using Blu-Mousse (Parkell; Englewood, NY) prior to removing any of the mock-up **(Fig 6)**. These guides were used as a reference for final composite placement.

Treatment

The retracted angle and spacing of the anterior teeth enabled treatment using a completely "no-prep" procedure, which enhances bonding strength due to 100% enamel bonding **(Figs 7 & 8)**. This also satisfied the patient's desire to conserve tooth structure.

Direct Freehand Bonding

When utilizing no-prep procedures, several basic concepts must be followed, since not every case can be completed without preparation and still achieve the desired outcomes. Lingually inclined teeth, while simultaneously closing spaces, are ideal because they facilitate a completely additive-type procedure. It is also important to understand the limits regarding the amount of additional restorative material patients will tolerate on the facial surfaces of teeth. An increase of approximately .5 mm to the facial surfaces is generally an acceptable limit; this case allowed us to make the necessary changes while staying within those parameters.

After cleaning with a rubber cup and pumice, the teeth were etched with 35% phosphoric acid and an adhesive (Adper Single Bond Plus Adhesive, 3M ESPE) was placed and cured.

The incisal edge matrix from the mock-up was placed intraorally, and the nano-composite (Filtek Ultra, White Enamel) was placed, beginning with the central incisors.[18] The goal was to keep the case as simple as possible using a single shade and single layer

Figure 14: A cuticle file was used to accurately level the edges of #8 and #9.

Figure 15: Polishing was accomplished using a medium sand paper disc followed by pumice and Enamelize.

of composite with final focus on contours and surface luster. The ultimate goal was to close spaces and add length to improve esthetics and function **(Fig 9)**.[19]

To reduce the chance of creating voids, a single increment of composite was compressed into a ball to reduce air bubbles, placed on the facial surface of one tooth at a time, and gently spread out using an interproximal carver **(Fig 10)**. The increment was manipulated with a flat brush to ensure optimal contour, width, and line angles **(Fig 11)**. The matrix was used as a reference throughout the process by condensing the material gently into the guide and removing after curing. The restorations were completed individually and sculpted as close to ideal as possible prior to curing for 40 seconds each, using an LED curing light (Elipar S10, 3M ESPE). The selected enamel shade imparted a natural chroma and value while retaining depth and translucency.[20]

Once the composite application was completed and fully cured on all teeth, a flame-shaped diamond (Brasseler USA; Savannah, GA) was used to contour, shape, and refine the facial surfaces, refining proper line angles, embrasures, and macro anatomy **(Figs 12 & 13)**. Alternating between wet and dry modes on the electric handpiece helped to visualize the anatomy.

Occlusion was verified and lingual surfaces polished with a fine football-shaped diamond (Brasseler) and rubber points (Shofu Dental; San Marcos, CA). A 180-grit emery board was used to level the incisal edges of #8 and #9 and ensure that the laterals were .5 mm shorter than the centrals. The "nail file" emery board was wide enough to simultaneously draw along the incisal edges of #8 and #9, creating perfect alignment of the central incisal edges as it was gently pulled over the surfaces **(Fig 14)**.

Finishing was completed using a medium-grit, extra-thin disc (Sof-Lex, 3M ESPE) and water. Polishing was initiated using flour pumice and a soft rubber cup, followed by a rubber cup (Politip, Ivoclar Vivadent; Amherst, NY) **(Fig 15)** and completed with Enamelize (Cosmedent; Chicago, IL) and a purple felt wheel. Incisal embrasures were refined with a diamond disc (Brasseler). An extra-fine "yellow" perforated diamond finishing strip (Brasseler) was used between the teeth, gingival to the contact points, to complete the interproximal finishing **(Fig 16)**.

Figure 16: Note the proper placement of contacts and incisal embrasures.

Conclusion

The final result was a more natural and esthetic smile line that "fits" the patient's face. The diastemas were closed with ideal line angles and anatomy that properly supports the tissue.[21] The unique properties of this new-generation composite material were particularly useful in this case, enabling the predictable application of a single shade and thin layer of material to create the anticipated result. The nano-composite demonstrated a high-quality luster and surface polish, and the restorations blended well with the existing dentition.[22] The restorations achieved the established goals for shade, contour, and smile design **(Figs 17 & 18)**. Occlusal protection was provided via fabrication of a flat plane splint occlusal nightguard.[23]

It is the author's opinion that cases should always be designed to achieve desired restorative corrections by altering the fewest number of teeth possible; that was accomplished in this case. Educating patients about what constitutes "esthetics" is an important factor, remembering that subtle randomness in shape and contours of hard and soft tissue can help to create balance and harmony in the smile.[24] The results were dramatic for this patient, and he was exceptionally pleased with his improved smile.[25]

References

1. Giordano R. A comparison of all-ceramic restorative systems. J Mass Dent Soc. 2002;50(4):16-20.

> THE INSIDER'S GUIDE TO A SEXY SMILE | Summer/Fall 2006

> I WANT TO REMOVE STAINS | Winter/Spring 2008

> ECO-FRIENDLY DENTISTRY | Winter/Spring 2010

THE ONLY
BEAUTY MAGAZINE WITH
COSMETIC DENTISTRY
EDITORIAL
IN EVERY ISSUE

NEWBEAUTY®
& AACD | A BEAUTIFUL PARTNERSHIP

To learn more call **866-NEWBEAUTY** or visit **www.newbeauty.com**

Ideally, a material should demonstrate wear resistance, polishability, and strength in order to provide maximum value to the patient.

2. Magne P, Douglas WH. Porcelain veneers: dentin bonding optimization and biomimetic recovery of the crown. Int J Prosthodont. 1999;12(2):111-21.

3. Calamia JR. Etched porcelain facial veneers: a new treatment modality based on scientific and clinical evidence. NY J Dent. 1983;53(6):255-9.

4. Friedman MJ. A 15-year review of porcelain veneer failure—a clinician's observations. Compend Contin Educ Dent. 1998;19(6):625-30.

5. LeSage B, Milnar F, Wohlberg J. Achieving the epitome of composite art: creating natural tooth esthetics, texture, and anatomy using appropriate preparation and layering techniques. J Cosmetic Dent. 2008;24(3):132-41.

6. Fortin D, Vargas M. The spectrum of composites: new techniques and materials. J Am Dent Assoc. 2000;131 Suppl:26S-30S.

7. Lambrechts P, Vanherle G. Structural evidences of the microfilled composites. J Bio Mat Res. 1983;17:249-60.

8. Drummond. JL. Cyclic fatigue of composite restorative materials. J Oral Rehab. 1989;16:509-20.

9. Hervas-Garcia A, Martinez-Lozano MA, Cabanes-Vila J, Barjau-Escribano A, Fos-Galve P. Composite resins. a review of the materials and clinical indications. Med Oral Patol Oral Cir Bucal. 2006;11(2):E215-20.

10. Lutz F, Setcos JC, Phillips RW, Roulet JF. Dental restorative resins. types and characteristics. Dent Clin North Am. 1983;27(4)697-712.

11. Weston JF. An affordable smile makeover: providing affordable treatment with direct restorations. J Cosmetic Dent. 2011;27(1):68-78.

12. Mitra SB, Wu D, Holmes BN. An application of nanotechnology in advanced dental materials. J Am Dent Assoc. 2003;134(10):1382-90.

13. de Moraes RR, Gonçalves Lde S, Lancellotti AC, Consani S, Correr-Sobrinho L, Sinhoreti MA. Nanohybrid resin composites: nanofiller loaded materials or traditional microhybrid resins. Oper Dent. 2009;34(5):551-7.

Figure 17: The longer incisors decrease negative space by following the curve of the lower lip.

Figure 18: Note the improved balance and harmony of the new smile.

14. Christensen GJ. Categories of resin-based composite and respective brands. Clinicians Report. 2009 Jul;2(7):2-3.

15. Ferracane JL. Resin composite—state of the art. Dent Mater. 2011 Jan;27(1):29-38. Epub 2010 Nov 18.

16. Dawson PE. Determining the determinants of occlusion. Int J Periodont Rest Dent. 1983;3(6):8-21.

17. Chiche GJ, Pinault A. Esthetics of anterior fixed prosthodontics. Hanover Park (IL): Quintessence Pub.; 1994.

18. Strupp WC. Achieving predictability in anterior crown and bridge with the use of indexes. C & B Update. 1997;2(9):65-71.

19. Touati B, Miara P, Nathanson D. Esthetic dentistry and ceramic restorations. London: Martin Dunitz; 1999.

20. Kokich VG, Spear FM, Kokich VO. Maximizing anterior esthetics: an interdisciplinary approach: esthetics and orthodontics. In: JA McNamara, editor. Frontiers in dental and facial esthetics. Ann Arbor (MI): Needham Press; 2001. p. 1-18.

21. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crestal bone on the presence or absence of the interproximal papilla. J Periodontal. 1992 Dec;63(12):995-6.

22. American Academy of Cosmetic Dentistry. A guide to Accreditation criteria. Madison (WI): The Academy; 2001.

23. Dawson PE. Evaluation, diagnosis, and treatment of occlusal problems. St. Louis: Mosby; 1989. p. 47-52.

24. Kokich VO Jr., Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Rest Dent. 1999;11:311-24.

25. American Academy of Cosmetic Dentistry. Can a new smile make you appear more successful and intelligent? Available from http://aacd.com/index.php?module=cms&page=717. **jCD**

Dr. Weston is an Accredited Fellow of the AACD. He is the owner of and practices at Scripps Center for Dental Care in La Jolla, California.

Disclosure: The author receives honoraria from 3M ESPE for teaching courses that use their products.

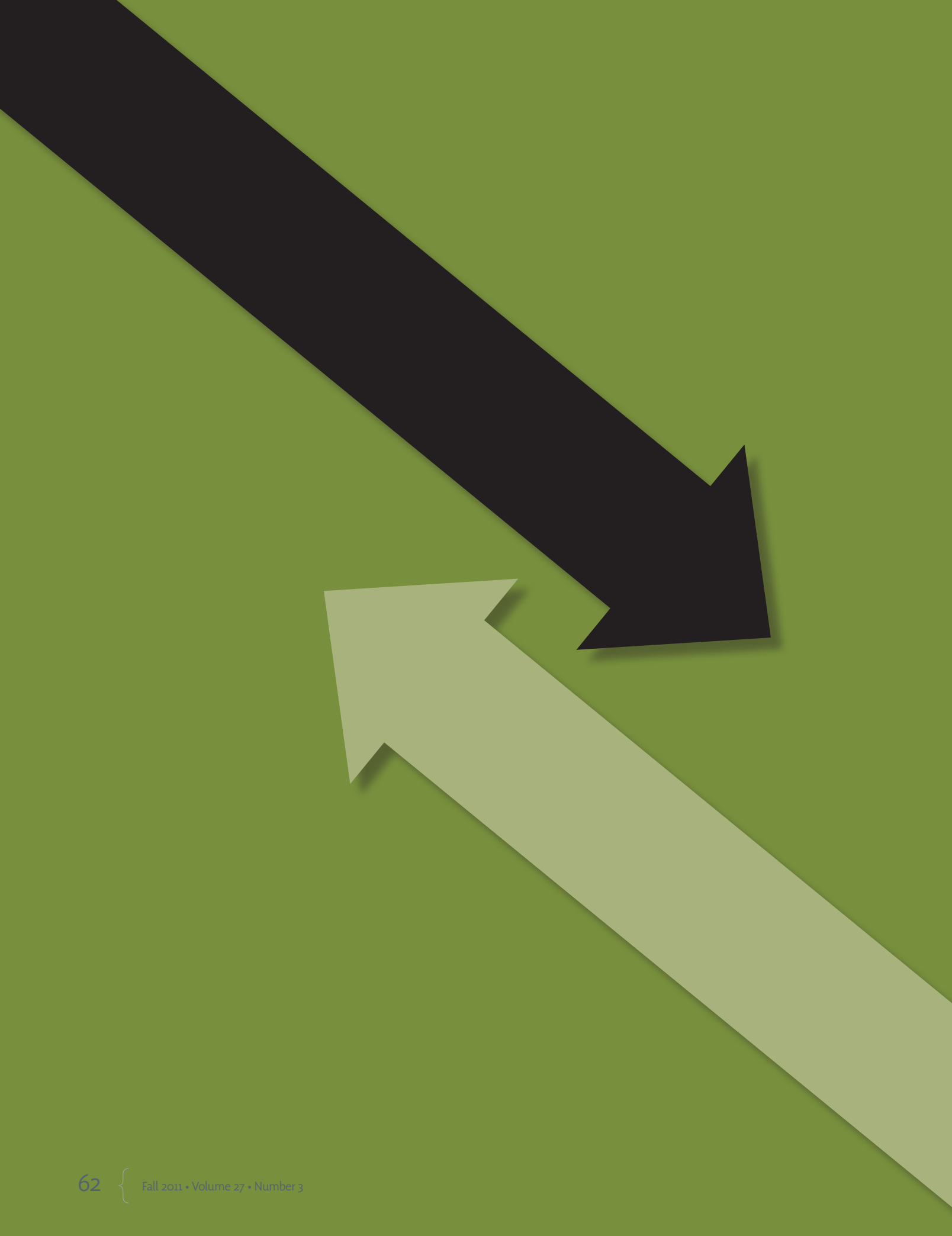
Our Average Approval is over $12,000!

Let's talk. :-)

Springstone℠
PATIENT FINANCING

Visit springstoneplan.com
Call 800-630-1663

American Academy of Cosmetic Dentistry®
CORPORATE MEMBER



Myths vs. REALITIES

State-of-the-Art Indirect Posterior Tooth-Colored Restorations

Jose-Luis Ruiz, DDS
Gordon J. Christensen, DDS, MSD, PhD

The time of the porcelain-fused–to-metal (PFM) crown being the primary esthetic posterior indirect restoration is coming to an end, as many dentists are adopting all-ceramic restoration options. However, there are mixed results with the new materials. There are two main options for all-ceramic posterior indirect restorations: full-coverage crowns and partial-coverage bonded onlays. Here, Drs. Jose-Luiz Ruiz and Gordon Christensen respond to some myths related to partial-coverage bonded onlays and full-coverage all-ceramic crowns.

Figure 1: PFM crowns needing precise taper, significant tooth structure removal, and subgingival margins, which require retraction cord placement.

Dr. Ruiz's Stance Regarding Partial-Coverage Bonded Inlays and Onlays

Supragingival partial-coverage bonded onlays and inlay/onlays are the most minimally invasive and biocompatible option for indirect restorations. The profession's first attempt at this alternative had challenges; however, over time, with increased knowledge about the specific tooth preparation required, and better understanding and use of materials, these restorations are serving well.[1-3] When properly placed, tooth-colored onlays can be as predictable as full-coverage restorative options.

Myths and Realities

Myth

PFM crowns are more predictable and easier than bonded onlays.

Reality

Because most clinicians are more familiar with the PFM full-crown technique, familiarity sometimes is confused with simplicity. Many clinicians do not use partial-coverage bonded onlays due to their unfamiliarity with them, leading to the belief that these restorations are more technique-sensitive and difficult than PFM crowns. This author does not believe this is true. Let us consider the potential complexity of a PFM crown preparation. Subgingival margins are required for acceptable esthetics; full-crown preparations can be difficult, requiring correct taper and cord placement **(Fig 1)**; impressions for restorations are more difficult, as observed by the number of poor impressions sent to laboratories. Major laboratories report that 85-90% of the impressions they receive have poor margin definition.[4] Managing soft tissues during cementation is difficult; removal of subgingival cement is also difficult **(Fig 2)**. It is the author's experience that partial-coverage bonded onlays are easier than full crowns if supragingival preparations are used.[5] The preparation of an adhesively retained restoration is easy, since a perfect taper is not important and retentive features are not needed. Excellent onlay preparations usually require five minutes **(Figs 3 & 4)**. With the use of translucent pressed porcelain, the margins of the restoration can be positioned supragingivally, making the entire procedure easier, including impressions, provisional restoration, and bonded cementation **(Fig 5)**. When specific situations require slight subgingival margins due to existing restorations or caries, tooth preparation and cementation is easier than when the entire restoration has subgingival margins.

Figure 2: Radiograph showing subgingival cement and poor marginal fit on a subgingival PFM fixed partial denture.

Figure 3: Onlay preparation of an endodontically treated tooth with supragingival margins, showing the tooth preservation and no need for retraction cord. Note that the impression and bonded cementation will not be affected by gingiva.

Figure 4: Supragingival preparation showing minimally invasive tooth preservation.

Figure 5: Observe the excellent margin blending achieved with translucent pressed porcelain, which allows for supragingival margin placement and tooth preservation.

Myth

PFM or full-zirconia crowns will last longer than a bonded porcelain onlay.

Reality

Although PFM crowns have served the profession for more than 50 years and there are anecdotal reports of restorations lasting for decades, the author believes that the average longevity of a PFM crown is much shorter. However, any full-crown preparations, including strong all-zirconia crowns, are destructive procedures requiring the removal of significant amounts of healthy tooth structure[6] to achieve the mechanical-retentive features and subgingival margins needed for optimal esthetics **(Fig 1)**. This excessive tooth removal can lead to pulp trauma and, in some cases, endodontic treatment, shortening the tooth's life.[7] As mentioned above, bonded onlays have proven their longevity, with the added benefit of less tooth destruction and supragingival margins. When patients ask about longevity, it is important to clarify whether the question is regarding the longevity of the restoration only, or the longevity of both the restoration and the tooth. If considering the longevity of the restoration only, strong materials such as gold alloy, PFM, or full zirconia are likely to last longer, but these restorations disguise secondary caries that may be present without the dentist's knowledge. We have all experienced removing PFM or gold-alloy crowns only to find that the tooth had significant secondary caries under the restoration **(Fig 6)**. An important question is, should we consider the longevity of the restoration, the longevity of the tooth, or both? The translucent metal-free, tooth-colored restorations have the advantage of showing new caries more readily because they are translucent and not opaque. Additionally, if we consider the benefits of less tooth reduction, supragingival margins, and thus healthier gums, bonded onlays are probably the best choice for the long-term conservation of the natural dentition.

Myth

Stronger lithium disilicate is needed for durability with bonded onlays.

Reality

As previously mentioned, leucite-reinforced porcelain onlays and inlay/onlay restorations have proven to be effective and durable, both in the author's personal experience, as well as recorded in available literature for well over 15 years.[8-10] Land and Hopp[10] show a 10% failure rate at 10 years, in an extensive Medline literature review of bonded inlay and onlay articles from 1993 to 2008. Lithium disilicate inlays and onlays have shown impressive short-term success and promise.[11,12] Success with bonded ceramic restorations is dependent on technique, including adequate supragingival tooth preparations, correct use of bonding materials, adequate cements, and correct occlusal adjustment. In the author's experience, considering the three "golden rules" of occlusion (equal occlusal contacts, posterior disclusion, and an unobstructed envelope of function) is very important during occlusal adjustment.[13] Having esthetic restoration margins supragingival preserves tooth structure, and the superb translucency of the restorative material can provide overall excellent esthetics. Although lithium disilicate is available in a translucent option, the author's opinion is that its translucency does not match that of a highly translucent, leucite-reinforced pressed porcelain restoration **(Figs 7-9)**. The author's experience with leucite-reinforced onlays is extensive, having placed thousands of restorations for more a decade with impressive success. Although he has used lithium disilicate for full crowns with excellent short-term results, he does not feel the need to switch to lithium disilicate until more of the possible problems are discovered. The author has some skepticism about strong ceramics, such as full-lithium disilicate or full-zirconia restorations, because they are excessively hard, not similar to nature, and difficult to remove, when necessary. In the future, dentists will have to deal with replacing these almost

indestructible, difficult-to-remove materials, which will be a major challenge to the dental professional and patients. In the author's opinion, strong materials such as gold alloy, zirconia, and lithium disilicate are preferred primarily because they usually do not break, even if occlusal interferences are present **(Fig 10)**. Unfortunately, the patient may pay the price in one way or another, with chronic tooth sensitivity, deflective interferences, muscle pain, or any of the other signs or symptoms of occlusal disease. This author's opinion is that it is preferable to utilize more biocompatible materials, used with correct occlusion.

Figure 6: Secondary caries under old gold-alloy restoration, evidently leaking for years.

Figure 7: Compare levels of translucency, from the least translucent full zirconia.

Figure 8: A more translucent monolithic lithium disilicate.

Acknowledgment

The author thanks Burbank Dental Laboratory (Burbank, CA) for providing the restorations shown in Figures 7 through 9.

References

1. Ruiz JL, Christensen GJ, Sameni A, Vargas L. Clinical performance of bonded ceramic and resin-based composite inlays and onlays using a self-etch bonding system: a 51-month report. Inside Dentistry. 2007 May;3(5):62-5.

2. Kramer N, Frankenberger R. Clinical performance of bonded leucite-reinforced glass ceramic inlays and onlays after 8 years. Dental Mater. 2005;21:267-71.

3. Posselt A, Kerschbaum T. Longevity of 2328 chairside CEREC inlays and onlays. Int J Comput Dent. 2003;6(3):231-48.

4. Christensen GJ. The state of fixed prosthodontic impressions: room for improvement. J Am Dent Assoc. 2005 Mar;136(3):343-6.

5. Ruiz JL. Supra-gingival dentistry using metal free restorations. Dent Today. 2008 Oct;27(10):104, 106, 108-9.

6. Valderhaug J, Jokstad A, Ambjornsen E, Norheim PW. Assessment of the periapical and clinical status of crowned teeth over 25 years. J Dent. 1997;25(2):97-105.

7. Edelhoff D, Sorensen JA. Tooth structure removal associated with various preparation designs for posterior teeth. Int J Perio Rest Dent. 2002;22(3):241-9.

8. Frankenberger R, Taschner M, Garcia-Godoy F, Petschelt A, Krämer N. Leucite-reinforced glass ceramic inlays and onlays after 12 years. J Adhes Dent. 2008;10(5)393-8.

Figure 9: Maximum translucency with leucite-reinforced feldspathic pressed porcelain.

Figure 10: A recent dental graduate had complained of tooth sensitivity since a gold alloy onlay was placed a year earlier. Sensitivity almost disappeared the day after interference was removed.

9. van Dijken JW, Hasselrot L. A prospective 15-year evaluation of extensive denti-enamel-bonded pressed ceramic coverage. Dent Mater. 2010;26(9):929-39.

10. Land MF, Hopp CD. Survival rates of all-ceramic systems differ by clinical indication and fabrication method. J Evid Based Dent Pract. 2010 Mar;10(1):37-8.

11. Silva N, Thompson VP, Valverde GB, Coelho PG, Powers JM, Farah JW, Esquivel-Upshaw J. Comparative reliability analyses of zirconium oxide and lithium disilicate restorations in vitro and in vivo. J Am Dent Assoc. 2011 Apr;142 Suppl 2:4S-9S.

12. Fasbinder DJ, Dennison JB, Heys D, Neiva G. A clinical evaluation of chairside lithium disilicate CAD/CAM crowns: a two year report. J Am Dent Assoc. 2010 Jun;141 Suppl 2:10S-14S.

13. Ruiz JL. The 3 golden rules of occlusion. Dent Today. 2010 Oct;29(10):92-3.

When properly placed, tooth-colored onlays can be as predictable as full-coverage restorative options.

Figure 1: Zirconia crowns, coping, and veneering ceramic are nearly the same color, allowing for maximum esthetics.

Dr. Christensen's Position on Full-Coverage All-Ceramic Crowns

PFM crowns have some undesirable characteristics, including the need for significant tooth structure removal, the desirability for subgingival margins, potential ceramic fracture, and often unesthetic results. Nevertheless, PFM crowns comprised approximately one-half of the indirect crowns placed in the U.S. in 2010, and most dentists use them with significant success. They have served the profession well for decades. All-ceramic crown options have some advantages over PFM crowns. Tooth preparation for some forms, such as all full-zirconia, can be less aggressive. Additionally, most dentists agree that they can provide better esthetics. There is less need for subgingival margins. However, because some all-ceramic crowns are new, and there are several options, some clinicians may be less aware of each restoration's specific requirements and the different techniques needed for predictable success with each of these materials.

Figure 2: Failed alumina all-ceramic posterior crown.

Myths and Realities

Myth

Lithium disilicate is becoming more popular than zirconia.

Reality

At this time, the largest laboratory in the U.S., Glidewell, reports that full zirconia and zirconia-based crowns comprise approximately 35% of indirect units, and lithium disilicate is about 12%.[1] Zirconia-based crowns (zirconia coping + external ceramic) have been used in the profession for about 10 years. Clinical usage has allowed the profession the opportunity to observe the challenges associated with these restorations.[2-4] At their introduction, the failure rate of zirconia-based restorations was higher than PFM crowns. Over the past decade, most of the weaknesses of zirconia-based restorations have been identified and overcome by the respective manufacturers and researchers.[5] Zirconia-based crowns, when fabricated by knowledgeable and competent technicians, can have excellent translucency and better esthetics than PFM and full-zirconia restorations **(Fig 1)**. Full or monolithic zirconia and lithium-disilicate crowns are newer options, and both are growing at a very fast rate. Full lithium-disilicate monolithic crowns have been used longer than full-zirconia crowns, and they have been accepted with optimism by the dental community. They have shown good short-term clinical results and in vitro studies show promise.[6-9] Dentistry has had a significant number of tooth-colored crowns that have come on the market with great promotions, only to fail after a few years **(Fig 2)**. To avoid expensive failures, it is desirable to observe any new concepts, including new all-ceramic restorations, for a period of at least five years before substituting them for clinically successful techniques.

Myth

Full-contour zirconia crowns will replace the zirconia-based crown concept.

Reality

Full-zirconia crowns have been received with much excitement and are growing at a rapid pace. Full-zirconia restorations without the placement of external ceramics appear to be very strong. This increased strength makes clinicians feel more comfortable when using full-zirconia in areas of high stress. Additionally, research related to wear of both full-zirconia restorations and opposing tooth structure is promising. Full-zirconia restorations are newer than zirconia-based crowns, which have been used long enough to allow some of their problems to be identified and improved. Currently the main problem with full-zirconia restorations is the lack of esthetics, as the material is opaque, and most characterization is accomplished with external staining, which may be temporary **(Fig 3)**. Significant research and development is ongoing to improve this problem, and it is promising. A major challenge that exists is removal of the restoration when failure occurs or making endodontic access. At this time, because of current esthetic concerns about full zirconia, zirconia-based crowns should be used in any area requiring optimum esthetics **(Figs 4-6)**. It is anticipated that significant improvements in full-zirconia restorations are forthcoming.

Myth

The PFM concept is dead.

Reality

Although great improvements have been achieved with all-ceramic restorations, and they have significant advantages when used correctly, PFM crowns are well-proven and used routinely. They are still important for any restorative practice. Let us not forget that the PFM crown has been proven for over 50 years.[10] The percentage of failure is very low, and is often estimated to be just 1 or 2% over many years. That has certainly been this author's experience. The long-term esthetic acceptability of PFM crowns is less than perfect, after a period of service **(Figs 7 & 8)**. The gingival tissues recede, exposing tooth structure that is a different color than the crown, making them esthetically challenged. This author suggests that PFM restorations should be considered when fixed-partial dentures are needed, or in any areas where the long-term success of PFM restorations makes them more appropriate than the still-to-be-proven newer materials.

References

1. Christensen GJ. The all-ceramic restoration dilemma: where are we? J Am Dent Assoc. 2011;142(6):668-71.

2. Christensen RP, Ploeger BJ, A clinical comparison of zirconia, metal and alumina fixed-prosthesis frameworks veneered with layered or pressed ceramic: a 3 year report. J Am Dent Assoc. 2010;141(11):1317-29.

Figure 3: Opacious zirconia margins exposed after gingival recession.

Figure 4: Before; patient with alumina-based restorations wanting to replace them.

Figure 5: After; zirconia-based restorations showing improved translucency and esthetics.

Figure 6: Zirconia-based translucent restorations.

Figure 7: Clinically functional 10-year-old PFM crown. Although in good clinical condition, the patient wanted it replaced due to the unesthetic dark margin.

Figure 8: This patient reported that the #30 PFM crown, which is in good clinical condition, has been in her mouth for 30 years.

3. Girodano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010;31(9):682-8.

4. Groten M, Huttig F. Performance of zirconium dioxide crowns: a clinical follow up. Int J Prosthodont. 2010;23(5):429-31.

5. Keough BE, Kay HB, Sage RD, Keen E. Clinical performance of scientifically designed, hot isostatic-pressed (HIP'd) zirconia cores in a bilayered all-ceramic system. Compend Contin Educ Dent. 2011;32(6):58-68.

6. Culp L, McLaren EA. Lithium disilicate: the restorative material of multiple options. Compend Contin Educ Dent. 2010;31(9):716-25.

7. Etman MK, Woolford MJ. Three-year clinical evaluation of two ceramic crowns systems: a preliminary study. J Prosthet Dent. 2010;103(2):80-90.

8. Guess PC, Zavanelli RA, Silva NR, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: comparison of failure modes and reliability after fatigue. Int J Prosthodont. 2010;23(5):434-42.

9. Albashaireh ZS, Ghazal M, Kern M. Two body wear of different ceramic materials opposed to zirconia ceramics. J Prothet Dent. 2010;104(2):105-13.

10. Cho GC, Donovan TE, Chee WW. Rational use of contemporary all-ceramic crown systems. J Calif Dent Assoc. 1998 Feb;26(2):113-20. **jCD**

...because some all-ceramic crowns are new, and there are several options, some clinicians may be less aware of each restoration's specific requirements...

Dr. Ruiz is the director of the Los Angeles Institute of Clinical Dentistry and a continuing dental education instructor for the University of Southern California in Los Angeles. He also maintains a private practice in Burbank, California.

Disclosure: Dr. Ruiz did not report any disclosures.

Dr. Christensen is the director of Practical Clinical Courses, an international continuing education organization. He also is an adjunct professor at Brigham Young University and the University of Utah. A Diplomate of the American Board of Prosthodontists, Dr. Christensen has a private prosthodontics practice in Provo, Utah.

Disclosure: Dr. Christensen is cofounder of and senior consultant for the CR Foundation, which publishes *Clinician's Report*.

V.1 SPR '10 AACD TopFin AD 3/4/11 4:36 PM Page 1

• COMPLETELY INTEGRATED • COLOR CODED • WEAR RESISTANT • TOP RATED

Top Finishers™

Every Patient. Any Restoration.

- **FlexiDiscs® (regular and mini)** are Better, Easier and Cheaper! Thin, highly flexible and resilient discs recommended as top choice for over 20 years.
  "Rates even with leading disc but half the price."
- **FlexiStrips™** contour and polish all interproximal surfaces exceptionally.
  "Ultrathin modification makes these strips easy-to-use."
- **FlexiCups™ and FlexiPoints™** are very wear resistant. These rubber cups and points polish gingival margins and hard to reach areas and impart labial characterization.
  "#1 rated rubber polishing instruments."
- **Enamelize™ and FlexiBuff™** The Final Polish! Doctors are amazed at the highly polished surface after using Enamelize, FlexiBuff and Felt FlexiPoint.
  "Great choice and a terrific value."
- **And More Top Finishers:** FlexiDiamond Strips®, NANO/Microhybrid Diamond Polishing Kit®, Porcelain Diamond Polishing Kit®, Porcelize® Diamond Polishing Paste, and mandrels.

TRY OUR 30 DAY RISK-FREE GUARANTEE.

to order Top Finishers
800-621-6729
WWW.COSMEDENT.COM

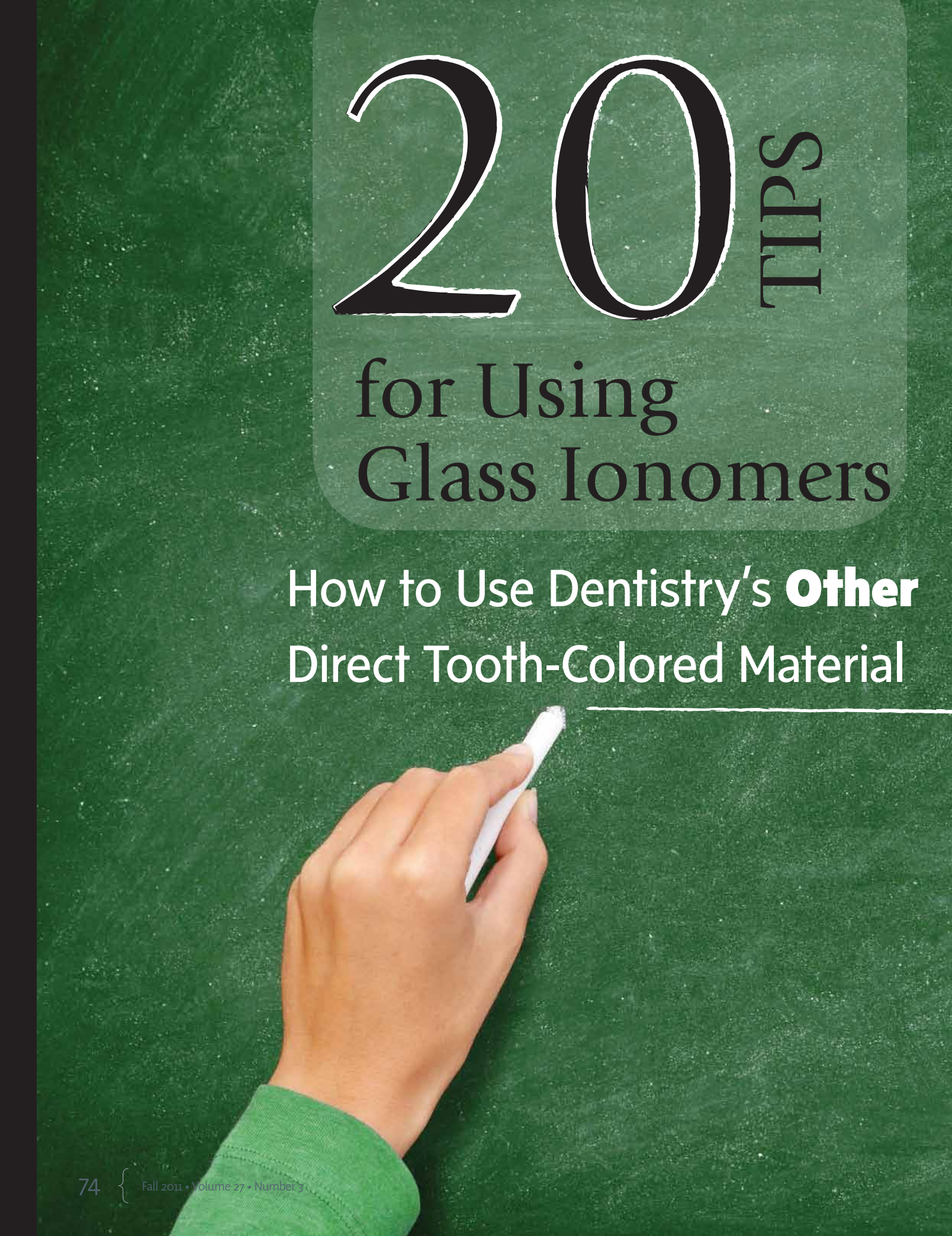
COSMEDENT®
Spreading Smiles™

© 2011 Dentistry and photography by: Bud Mopper, D.D.S., M.S. and Robert Margeas, D.D.S., F.A.G.D.

#1852 11.02.03 AACD SPRING ISSUE MARCH-APRIL 2011 — Full Bleed AD (Trim: 8.375" x 10.875" Bleed: 8.875" x 11.375" Live: 7.5" x 10" WITH 0.25" BLEED.) COSMEDENT, Inc. (312) 644-9586
Design/production: COSMEDENT, INC., Contact Carol Cornyn (312) 644.9395 (x118)

20 TIPS for Using Glass Ionomers

How to Use Dentistry's **Other** Direct Tooth-Colored Material



to Solve Restorative Problems

Daniel H. Ward, DDS

INTRODUCTION

Dentists who reduce the use of metallic restorations in favor of composite restorative materials are reporting challenges. Placement techniques are more demanding and less forgiving. Maintaining the proper moisture of the tooth surface is critical.[1] Polymerization shrinkage requires cumbersome layering techniques to reduce the resulting stress.[2] Increased immediate postoperative sensitivity is reported.[3] Marginal leakage resulting in recurrent decay can be more prevalent.[4]

Another class of tooth-colored direct restorative materials deserves consideration to solve these challenges. Glass ionomer (GI) restorative materials are easier to place and are less technique-sensitive. Surface moisture conditions are less critical.[5] Self-curing GI materials exhibit no shrinkage during setting, which allows for bulk placement.[6] Immediate postoperative sensitivity is reported to be less.[7] Fluoride release helps to reduce recurrent decay.[8] In addition, GI materials are antibacterial.[9]

Uncertainty about the selection of the appropriate material to use and the proper technique prevents many dentists from placing glass ionomers. The early materials had shortcomings that alienated initial users.[10] Manufacturers have not helped by selecting product names that often do not adequately describe the product.

Glass ionomers comprise two different formulations: self-curing GI's and resin-modified glass ionomers (RMGI's). The following tips may help to better differentiate and identify their use in the modern dental practice. These are materials that can and should be used in every practice.

1

Prepare butt joint margins around the preparation in both dentin and enamel (Figs 1 & 2). GI's do not work well in feather edge or beveled margins. In thin increments, they have a tendency to chip. Although not mandatory, undercuts help to better retain the restoration. Enamel margins can be pre-treated with phosphoric acid for better adhesion.

Figure 1: Class V lesions.

2

Prepare all dentin to be covered and pre-treat with polyacrylic acid conditioner. The use of a conditioner prior to placing the GI significantly increases the ionic bond to dentin. Polyacrylic acid is a very weak acid and does not significantly demineralize dentin nor increase the likelihood of postoperative sensitivity.

Figure 2: Preparations for Class V restorations.

3

Do not over-dry dentin following rinsing of polyacrylic acid conditioner; leave it moist. GI absorbs water during the setting reaction. If the tooth surface is left too dry, fluid from within the dentinal tubules may be drawn out, resulting in postoperative sensitivity. As long as the surface is not covered with water, GI materials can set under varying moisture conditions.

Figure 3: Covering unset glass ionomer with resin sealant.

4

Cover setting GI with a curable resin coating and then polymerize the resin with a curing light (Fig 3). GI is susceptible to desiccation during setting. Applying the resin with a micro-brush can be a convenient way to shape the material before it sets. The placement of a resin coating over the setting restoration prevents early water loss and deterioration of the restoration.

Figure 4: Completed Class V glass ionomer restorations.

5

Use copious water spray when shaping set GI. GI's are susceptible to desiccation. Use a light touch to shape the set restoration with a very fine diamond bur. GI's are much softer during the first 24 hours prior to final set. Go over the surface with a fine finishing carbide to remove scratches and blend the restoration margins. Polish lightly with a coated abrasive prior to placing a resin sealant.

6

Following finishing and polishing, place a filled resin coating. GI's continue to set over an extended period of time, especially during the first 24 hours **(Fig 4)**. A resin coating helps to prevent desiccation and improves the physical properties of the set restoration. The resin also helps to fill in microscopic porous areas, leaving a smoother and harder surface. Wear on the occlusal surface of posterior restorations is reduced during the lifetime of the resin sealant.

7

Do not acid-etch set GI. Placing phosphoric acid over set GI obliterates the surface and results in very poor bonding to resin. Practitioners are accustomed to routinely acid-etching prior to resin placement in most procedures, but this is deleterious to self-curing GI's. Simply wash the set restoration, dry the surface, coat the restoration with resin, and light-cure.

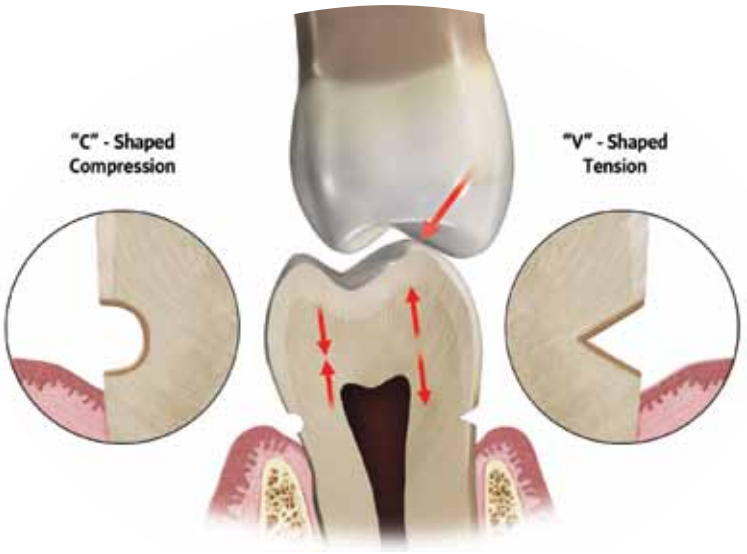


Figure 5: Abfraction forces indicator.

8

Following completion of Class V GI restorations, check for possibility of abfraction. If initial lesion was "c"-shaped, the defect may have been caused by compression. Adjust the cusp opposite to the site. If initial lesion was "v"-shaped, the defect may have been caused by tension and the cusp on the same side should be adjusted **(Fig 5)**. Carefully analyze and adjust harmful lateral interferences.

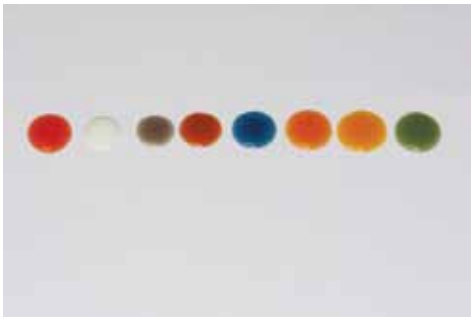


Figure 6: Tints to be mixed with surface sealants.

9

Mix a little composite stain into resin sealer to better blend color. Self-cured GI's generally are more opaque than most composite resin restorative materials. To decrease the value of the color, various composite tints can be mixed into the filled resin sealant prior to placement **(Fig 6)**. Grays and browns are especially useful in better matching the color of the adjacent tooth.

Figure 7: Long-term interim glass ionomer restoration.

10

Use self-curing GI materials as long-term interim restorations (Fig 7). In today's challenging economic climate, patients cannot always afford to immediately place a crown on severely decayed teeth. GI's can quickly be placed in bulk and do not shrink upon setting. Even though the occlusal surface wears more than composite, the elimination of internal shrinkage stresses may prevent the fracturing of entire cusps, ultimately maintaining more tooth structure for future crown preparation.

11

Use GI restorative materials when restoring cervical lesions of patients taking multiple medications. Patients taking four or more medications have a 50% chance of experiencing dry mouth symptoms. Xerostomia is the most commonly listed side effect of prescription medications. Saliva acts as a buffer to neutralize acidic attacks. Placing GI's helps to reduce recurrent decay.

12

Use self-curing GI's as sealants in decay-prone teeth that are not fully erupted. Waiting until the tooth is fully erupted to adequately control moisture for the placement of a resin sealant may result in the need to place a definitive composite restoration. Even though the GI sealant wears more than composite resin, it has been observed that the tooth structure under the sealant is significantly less susceptible to decay once the sealant has worn away. Etch the enamel with phosphoric acid, wash, and dry. Place the GI and use a micro-brush dipped in resin to spread the material. Light-cure and wait for the material to set.

13

Use self-curing GI's as core build-ups underneath crowns (Figs 8-10). With no shrinkage upon setting, GI's can reduce postoperative sensitivity in cracked teeth being restored with crowns. Fluoride release under the crown can help reduce recurrent decay. The ionic bond to tooth structure, though not as strong initially as resin, remains stable for years and is not prone to hydrolyzation or matrix metallo-protease breakdown. Compressive and tensile strengths are less than resin but long-term retention is excellent and ease of use makes it a viable alternative in small- to medium-sized build-ups.

14

Use self-curing GI's in deciduous tooth Class II restorations. Prime teeth with polyacrylic acid, rinse, and remove excess moisture. Place in bulk and hold down with thumb while material sets. There is no need to use layering techniques or a curing light. Restorations are fairly well retained and the incidence of recurrent decay is reduced. GI restorations allow conservative removal of decay, which is often near the large pulps of deciduous teeth.

15

Use GI's to repair decay around faulty crown margins that are readily visible and approachable. First remove the decay and prep into the crown if necessary to visualize the extent of the decay. It is important to be able to see the entire area and control moisture. This is not recommended in interproximal areas with an existing adjacent tooth. Repairing with GI's is especially useful for older patients who can no longer tolerate lengthy procedures.

Figure 8: Crown excavation.

Figure 9: Glass ionomer crown build-up.

Figure 10: Crown preparation with glass ionomer core build-up.

16

Use RMGI's as bases under deep composite restorations to reduce postoperative sensitivity (Fig 11). Pre-treat with polyacrylic acid, rinse, and remove excess moisture. Mix material and quickly fill restoration two-thirds full. Light-cure for 20-40 seconds. You do not have to wait to re-prepare tooth to ideal depth **(Fig 12)**. You can safely etch set RMGI and enamel, giving the preferred etched pattern for enamel bonding with reduced dentinal sensitivity. Fluoride is great insurance under composite restorations since margins have been shown to often leak **(Fig 13)**.

17

Use RMGI's in Class V restorations that require better appearance. RMGI's are more translucent and esthetic than self-curing GI's. The fluoride release is less than self-curing GI's but they have proven release of fluoride ions during acidic attack and can be recharged with exposure to external sources of fluoride. In several studies, RMGI's had better retention rates than composites placed with dentin bonding agents.

18

Use a pre-encapsulated RMGI dispensing system if possible. Proper proportions of powder and liquid are important to obtain the optimal physical properties. Capsules offer consistency of mix as well as ease of use. Triturators oscillate at different rates, so experiment to determine the proper mixing time. Powder/liquid mixes generally offer superior physical properties compared to paste/past configurations.

19

Use RMGI's in situations where a dry field cannot be maintained for more than a minute. Pre-treat the area with polyacrylic acid. Rinse thoroughly and remove excess moisture. Mix the material and quickly dispense into area. Light-cure for 20-40 seconds. Contamination once the material has been light-cured does not affect the bond to dentin or the physical properties of the material.

20

Use RMGI's for short-term temporaries. Patients often fracture entire cusps and desire a temporary prior to scheduling the time necessary to perform a full crown preparation. Lightly dry the area, mix material, and place material over the deficient area. Light-cure for 20-40 seconds. Use a high-speed handpiece to blend the restoration into tooth. The only disadvantage to this technique is that it may hold for several years and the satisfied patient may not return to have definitive treatment performed until it finally breaks or wears down.

Figure 11: Excavated tooth needing a deep restoration.

Figure 12: Set and re-prepared RMGI base.

Figure 13: Restored tooth using "sandwich technique" of RMGI base and composite outer surface.

DIFFERENCES BETWEEN GI's AND RMGI's

GI materials wear less than RMGI's and should be used in areas exposed to occlusion. RMGI's are better when covered by a composite resin or when not in occlusion. GI's require control of fluid contamination during the extended setting time (two and a half to five minutes). RMGI's need control only during placement and the light-curing phase. RMGI's should be used when re-preparation and subsequent acid etching with phosphoric acid will be performed. GI's should not have phosphoric acid placed on their surface once set. GI's exhibit no shrinkage or shrinkage stress and have the highest release of fluoride. RMGI's are more translucent and esthetic. Both materials are invaluable in the modern dental practice. Glass ionomers will never replace composite resin materials but are a useful adjunct in the field of tooth-colored direct restorative materials. Time and experience with the materials will ultimately help the practitioner decide the appropriate uses for these bioactive dental materials.

References

1. Gwinnett AJ. Dentin bond strength after air drying and rewetting. Am J Dent. 1994;7:144-8.
2. Braga RR, Ballester RY, Ferracane JL. Factors involved in the development of polymerization shrinkage stress in resin-composites: a systematic review. Dent Mater. 2005;21:962-70.
3. Opdam NJ, Feilzer AJ, Roeters JJ, Smale I. Class I occlusal composite resin restorations: in vivo post-operative sensitivity, wall adaptation, and microleakage. Am J Dent. 1998;11(5):229-34.
4. Irie M, Suzuki K, Watts DC. Marginal gap formation of light activated restorative materials: effects of immediate setting shrinkage and bond strength. Dent Mater. 2002;18:203-10.
5. Browning WD. The benefits of glass ionomer self-adhesive materials in restorative dentistry. Compend Contin Educ Dent. 2006;27:308-14.
6. Albers HA. Tooth-colored restoratives. 9th ed. Hamilton (ONT): BC Decker Inc.; 2002. p. 43-55.
7. Akpata ES, Sadiq W. Post-operative sensitivity in glass-ionomer versus adhesive resin-line posterior composites. Am J Dent. 2001;14(1):34-8.
8. Mitra SB. In vitro fluoride release from a light-cured glass ionomer liner/base. J Dent Res. 1991;70:75-8.
9. Menon T, Kumar CP, Dinesh K. Antibacterial activity of glass-ionomer restorative cements and polyacid modified composite resin against cariogenic bacteria. Indian J Med Microbiol. 2006;24:150-1.
10. Sturdevant CM, Roberson TM, Heymann HO, Sturdevant JR. The art and science of operative dentistry. 3rd ed. St Louis: Mosby; 1995. p. 264-5. **jCD**

Dr. Ward has a full-time practice in Columbus, Ohio.

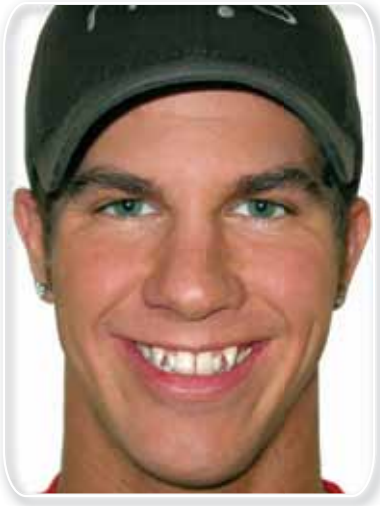
Disclosure: The author did not report any disclosures.

Glass ionomer restorative materials are easier to place and are less technique-sensitive.

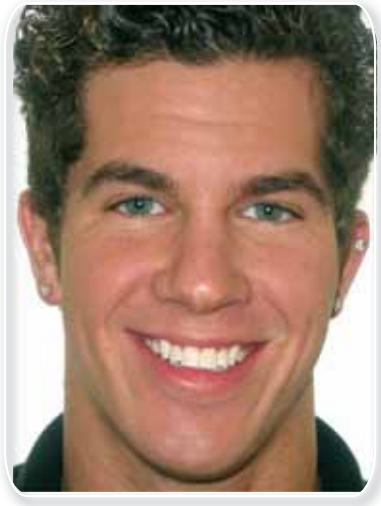
SIX MONTH SMILES®

Short Term Ortho System

GENERAL DENTISTS CAN EASILY DO ORTHO



Before



After Six Month Smiles®

That's because Six Month Smiles makes it easy to straighten teeth - from start to finish

- Starts with **cosmetically-focused** treatment goals (no major changes to bite)
- Expertly positioned brackets come set in custom bonding trays - ***ready for 1-step seating***
- Shape memory of tooth-colored wires gently guide teeth into position
- ***More predictable movements*** and **shorter treatment times** than aligners (and ***lower lab fees*** too!)
- Unique, clear braces gives patients the smiles they want quickly

The 2 Day Seminar will equip you with the skills and confidence needed to start treating right away
Register now and your first case is free ($518 value)

"Six Month Smiles has changed my practice dramatically. I never thought I could do fixed ortho, but the Seminar was so thorough and the system is so easy, I did 25 cases in the first six months! My team's morale is at an all-time high, and my patients leave every appointment with a smile."

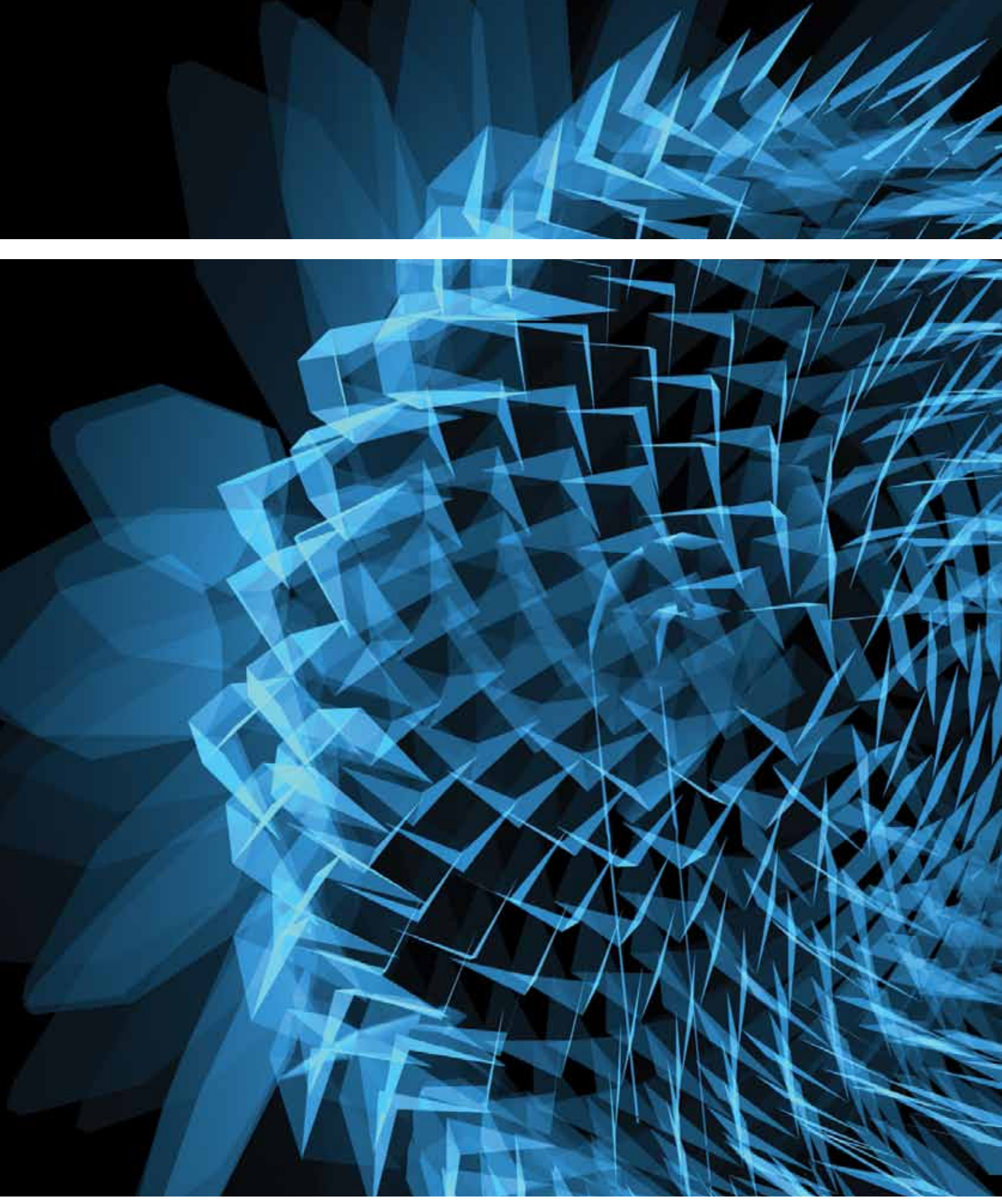
- Dr. Tony Soileau, General Dentist

Columbus, OH	Sept. 30-Oct 1
Nashville, TN	Oct. 7-8
Portland, OR	Oct. 28-29
Los Angeles, CA	Nov. 4-5
San Antonio, TX	Nov, 11-12
Las Vegas, NV	Nov. 18-19
Orlando, FL	Dec. 2-3

REGISTER NOW & RECEIVE $100 OFF SEMINAR TUITION!
USE PROMO CODE AACD100

Hands On Training • Case Selection • Treatment Planning • Marketing to Patients • Practice Integration

Register at www.SixMonthSmilesJCD.com or Call 866-957-7645



Successive generations of dentin adhesives have sought to decrease the number of steps for placement without sacrificing clinical results.

Advances in Composite Restorations: recreating nature's blueprint

Robert A. Lowe, DDS, FAGD

INTRODUCTION

No material in the history of dentistry has undergone as much of an evolution as composite resin. The face of restorative dentistry changed forever when successful bonding to dentin was achieved. However, the placement of composite requires many more steps than dental amalgam (the "forefather" of direct restoratives), and exacting technique to achieve the best results. The process of adhesion, conditioning the tooth surface, application of primers and adhesives, followed by the layering of composite resins to complete the restorative process, involves many independent steps that must be properly executed to ensure good results. As a result, the dental marketplace has been searching for materials and/or techniques to help simplify the process of delivering a composite resin restoration.

Manufacturers and dental materials researchers have responded by looking at different approaches to this problem and have developed products to help the dentist achieve this goal. It must be stated that while many of these materials are based on proven technologies, they are very new and further clinical trials are needed to determine whether they indeed perform as designed.

The purpose of this article is to give a "glimpse" into these new technologies and how they can potentially simplify the placement of composite resins without sacrificing clinical performance. It should also be noted that the success of bonded restorative materials depends on good isolation of the operating field to prevent moisture contamination during placement. Rubber dam isolation is a common way to accomplish this goal, although there are other devices available that can be used for effective isolation. An alternative form of isolation, Isolite (Isolite Systems; Santa Barbara, CA), was used in the cases discussed here. Isolite conveniently isolates a maxillary and mandibular quadrant in a matter of seconds and helps maintain a dry field during the restorative process.

Self-Adhering Flowable Composites

Successive generations of dentin adhesives have sought to decrease the number of steps for placement without sacrificing clinical results. The seventh-generation self-etching dentin bonding systems have helped to decrease technique and postoperative sensitivity issues while still yielding clinically acceptable restorations. It is also true that many clinicians use flowable resins as the first layer of composite resin after the placement of adhesive to ensure precise wetting of the adhesive surface, while creating a layer with less polymerization stress because of a lower modulus of elasticity (< .5-mm thickness). A new composite material, Vertise (Kerr; Orange, CA) combines the adhesive and flowable steps into one.

Mechanism of Adhesion

According to the manufacturer, there are two distinct mechanisms of adhesion for self-etching materials: chemical and micro-mechanical. The primary bonding mechanism for Vertise is chemical bonding between the calcium ions in the hydroxyapatite crystals and the phosphate groups in the glycerol diphosphate dimethacrylate (GPDM), which is the adhesive monomer common to all adhesives in the Optibond (Kerr) family of dentin adhesives. Vertise flow also bonds to tooth structure via micro-mechanical retention, which is the result of the interpenetrating network formed between the polymerized monomers in Vertise Flow and the collagen fibers and hydroxyapatite crystals within the smear layer. Brushing this first layer of material vigorously into the tooth surface enhances this penetration of adhesive resin through

Figure 1: This preoperative occlusal view shows a carious lesion visible on the mesio-proximal surface of #15. A Class II direct composite was chosen to restore this area.

Figure 2: A common problem faced when preparing a Class II cavity is that the interproximal gingival tissue can be traumatized mechanically, causing bleeding. This must be controlled prior to beginning the adhesive process to ensure a predictable result.

Figure 3: After cavity preparation, Vertise is brushed onto all prepared surfaces, both enamel and dentin, for about 20 seconds.

the smear layer and creates a bond to the calcium ions in the dentin that is comparable to that achieved by a majority of the available seventh-generation dentin bonding agents[1-5] **(Figs 1-6)**.

Bulk Fill Flowable Composite Base for Posterior Composite Restorations

In many instances, restoring a tooth with a posterior composite restoration may require more time than a dental amalgam due to the number of steps involved in placement. Most manufacturers and clinicians agree that when placing composite into a deep cavity preparation, it should be done in increments of no more than 2 mm to limit the effects of polymerization shrinkage stress and to ensure complete curing of the material. Therefore, the introduction of any dental material that can reduce the amount of time required to place a composite restoration by allowing the dentist to place material in larger increments would benefit the dentist and decrease the time and steps required to complete the restorative process.

SureFil SDR Flow (Dentsply Caulk; Milford, DE), a flowable composite resin, is intended to be used as a base beneath posterior composite resin restorations. Certainly, the use of a flowable composite as a liner or base beneath posterior composite restorations is not a new concept. A survey by the American Dental Association indicated that 90% of dentists have used a flowable composite resin in the past 12 months and that 82% of flowable users apply them as bases or liners.[6] Such use has been claimed to increase marginal adaptation in the gingival marginal area of Class II composite restorations, thereby reducing microleakage. It also has been claimed to counter the polymerization shrinkage stress of overlying composite resins due to the more elastic nature of flowable composites. Neither of these perceived advantages has been validated, but there is relatively broad consensus that the use of flowable composites does help achieve optimal adaptation of overlying composite to the intricacies of cavity preparations.

SureFil SDR Flow is intended for use as a bulk fill base beneath posterior composite restorations as a "dentin replacement" and can be bulk filled in layers up to 4 mm in depth. Being able to place that amount of material in a single increment is a significant time saver, and while the concept sounds simple, there are several important requirements a material must meet for this particular indication. According to the manufacturer, these include the following:

- Increased Depth of Cure. This is perhaps the most obvious requirement for the material. It is essential that the flowable composite cure from top to bottom to a minimal depth of 4 mm. The manufacturer

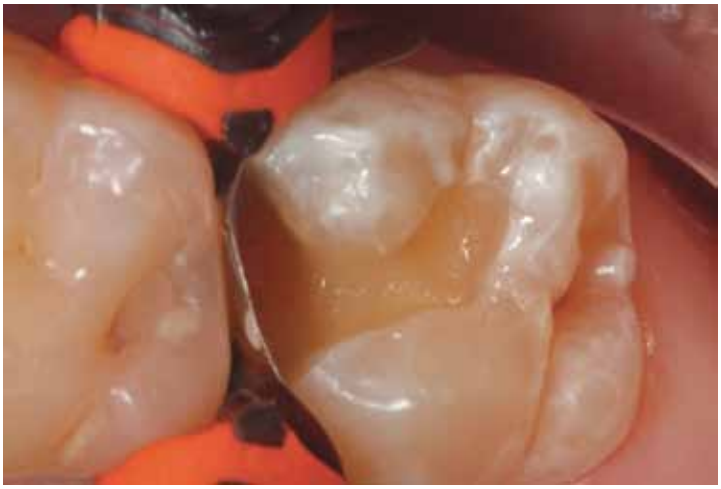


Figure 4: An occlusal view of the preparation surface after application of Vertise and light-curing. Note the "textured" appearance of the dentin surface.

Figure 5: Once Vertise is light-cured, placement of a nano-microhybrid composite material (Herculite Ultra, Kerr) is done in a 2-mm incremental fashion to completely fill the cavity.

Figure 6: An occlusal view of the completed restoration after contour and polishing. One-year clinical observation shows excellent marginal integrity, with no visible evidence of microleakage.

Trying to recreate nature's blueprint with man-made materials is no simple task.

Figure 7: Post-preparation view of #18 and #19 after caries removal. Note the depth of excavation, particularly in the distal area of #19. There is no affected dentin left in this preparation.

Figure 8: A compule of Surefil SDR. The very low polymerization stress allows for bulk dentin replacement in high C-Factor preparations without overstressing the composite-adhesive interface.

reports that Surefil SDR meets this requirement because of its polymerization initiating process and its optical properties that enhance light transmission. It should be noted that while this material is radio-opaque, it would appear more translucent in color than many composite "dentin replacements." This is to allow for light penetration and a greater depth of cure. It is important to pay attention to what manufacturers claim regarding the depth of cure for their materials and to have an idea as to how those claims were substantiated. It may be possible to realize a certain depth of cure in the laboratory where the light can be positioned only a millimeter from the surface of the material being cured, but not in a clinical situation where the light can be several millimeters removed.

- Specialized Handling. This requirement is essential if the material is to offer true convenience and performance. Surefil SDR, being a flowable material, is designed to be placed in bulk quantities very quickly because it readily adapts to the internal configuration of cavities without the need for manipulation after dispensing. In addition, the material levels itself (self-leveling) after only seconds to form a uniform base for subsequent placement of composite, again obviating the need for further manipulation. Without the rheological properties this material possesses it would not be possible to bulk fill while ensuring optimal adaptation to all aspects of the cavity preparation. Compule delivery also seems to have fewer problems with incorporated air when compared to syringe type of delivery.
- Low Polymerization Shrinkage Stress. Composite resins all shrink to some extent upon photo-polymerization. Flowable composites shrink to a greater extent due to a lower filler loading. If not allowed to shrink, as when bonded to tooth surfaces, stress will be created on the bonded surfaces, which can lead to marginal defects and is thought to be a potential cause of postoperative sensitivity. Reduction of this polymerization shrinkage stress, as might be expected, is the most difficult requirement to meet for a bulk fill material. The manufacturer reports that Surefil SDR meets this requirement by incorporating a unique curing process that builds very little stress as the material is forming the bonds of polymerization. The net effect of this is very little stress being created on bonded surfaces after the material has polymerized[7-27] **(Figs 7-11)**.

Other Types of Resin Chemistries in the Evolution of Tooth-Colored Restorative Materials

Using yet another approach, dental resin polymer chemists have looked at substituting the existing composite chemistries to find an improved resin monomer system. Researchers at the University of Colorado have developed a unique monomer chemistry based on dimer acid monomers that significantly reduces polymerization shrinkage and shrinkage stresses, as well as increases the initial double-bond concentration of the monomer and degree of double-bond conversion achieved during polymerization. This increased conversion rate can lead to better physical properties (i.e., wear resistance) in the polymerized resin. The changes in this material were accomplished by synthesizing a unique diluent monomer based on a dimer acid chemistry derived from soy, which was radically different from conventional diluents used in conjunction with typical Bis-GMA resin systems. The end result is a new low-shrinkage, high-monomer conversion nano-hybrid composite resin (N'Durance, Septodont; Lancaster, PA). The volumetric shrinkage of Bis-GMA based nano-hybrid composites has a range of 1.85-3.00%, while the dimer acid chemistry has reported polymerization shrinkage of 1.27%. A composite resin also requires good radiopacity (for clinical diagnostic purposes) and wear resistance. With N'Durance, the use of optimized nano-fillers of Ytterbium fluoride, barium glass, and silica make this material easy to distinguish in radiographs, while providing a wear resistance comparable to existing nano-filled composites. With this significantly lower volumetric shrinkage and a non-stick formulation, optimal adaption to the cavity preparation is readily achieved. It is important to mention that the same dimer acid, high conversion chemistry is used for the N'Durance Dimer Flow flowable composite resin as well.[28-37] **(Figs 12-17)**. **Figure 12** shows that #15 has been prepared for a mesio-occlusal direct composite restoration. A Tofflemire-type matrix band (Slick Band, Garrison Dental Solutions; Spring Lake, MI) is placed with the retainer on the palatal aspect of the tooth. For a maxillary molar, this type of placement will better conform to the rhomboid outline form of the tooth. Note that the band has been crimped in areas using a curved hemostat to better "anatomize" the outline form of the matrix. The goal is to have a tightly adapted band to the vertical cavo-surface margins of the proximal box to eliminate flash in the buccal and palatal embrasures during the placement process. This "anatomic" placement limits the amount of

Figure 9: After etching with 37% phosphoric acid for 15 seconds, rinsing, and application of dentin adhesive (XP Bond, Dentsply Caulk), Surefil SDR is syringed into the cavities. Note the "self-leveling" of the material prior to light-curing. Surefil SDR has been placed in these cavities up to the dentino-enamel junction.

Figure 10: The restorations are shown after placement of the enamel layer using a nano-microhybrid composite material (Esthet-X HD, Dentsply Caulk).

Figure 11: An occlusal view of the completed restorations of #18 and #19 using Surefil SDR and Esthet-X HD restorative materials.

Figure 12: Tooth #15 has been prepared for a mesio-occlusal direct composite restoration.

Figure 13: A bucco-proximal view after matrix placement.

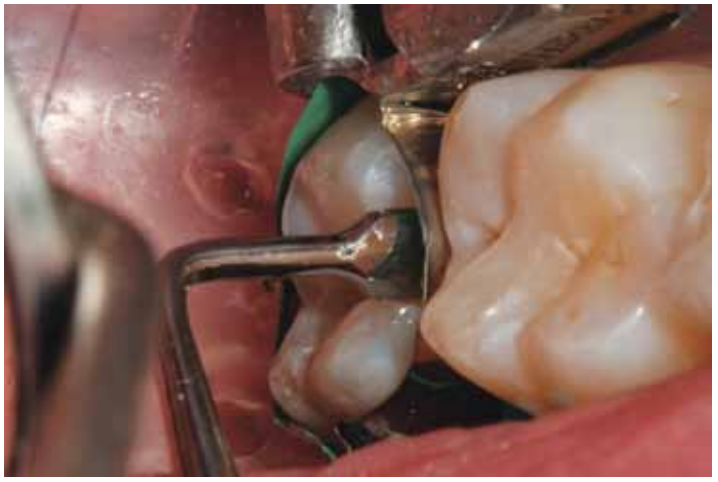


Figure 14: Proximal contact-forming instrument.

Figure 15: Occlusal view after withdrawal of the OptraContact instrument.

Figure 16: Occlusal view after the restoration is completed.

Figure 17: Occlusal view of the completed mesio-occlusal composite restoration in #15.

rotary finishing of these areas, resulting in a more anatomically contoured proximal surface. An Isolite is used for isolation during the restorative process. **Figure 13** shows a bucco-proximal view after matrix placement. Note the crimp in the band on the facial to pull the proximal part of the band closer to the cavo-surface margin of the preparation. Also, the matrix extends no more than 1 mm above the height of the marginal ridge on the adjacent tooth to aid in more precise cervico-occlusal positioning of the marginal ridge of the restoration, and to allow for proper contouring of the occlusal embrasure during the finishing process. A proximal contact-forming instrument (OptraContact, Ivoclar Vivadent; Amherst, NY), is shown in **Figure 14**, pushing the matrix toward the adjacent proximal surface. When using this type of instrument, composite material is first expressed into the proximal box. The instrument is pushed into the uncured composite and simultaneously leaned into the band and pushed toward the adjacent proximal surface. While holding this position, the composite in the proximal box is light cured. Then, the instrument is withdrawn. **Figure 15** shows an occlusal view after withdrawal of the OptraContact instrument. A "composite bridge" is formed from the axial wall of the preparation to the matrix band holding the band tightly in contact with the adjacent tooth. In this case, N'Durance was chosen as the restorative material. For posterior composites, enhanced wear resistance due to higher monomer conversion rates and radiopacity are both very desirable characteristics for a direct composite placed in these clinical situations. **Figure 16** offers an occlusal view after the restoration is completed with N'Durance. Note the marginal ridge has both a facial and palatal component with a small groove separating the two. This is how an anatomically correct marginal ridge is constructed. Avoid following the top of the band in the facial-palatal direction as a guide to marginal ridge height. Most of the time, marginal ridge area will be in hyper-occlusion if it is not constructed in two distinct planes. **Figure 17** provides an occlusal view of the completed mesio-occlusal composite restoration in #15 using N'Durance as the restorative material.

CONCLUSION

Trying to recreate nature's blueprint with man-made materials is no simple task. However, advances are being made to enable dentists to create excellent, esthetic tooth replacements using direct tooth-colored restorative materials that can give the patient an optimal, long-lasting result. Again, it should be emphasized these materials are still very new. More time and more clinical trials are needed to prove the efficacy of these innovative approaches in materials science that can potentially lead to a more simplified approach to the placement of composite resin restorations.

References

1. Inoue S, van Meerbeek B, Vargas M, Yoshida Y, Lambrechts P, Vanherle G. Adhesion mechanism of self-etching adhesives. In: Tagami J, Toledano M, Prati CA, editors. Advanced adhesive dentistry. Proceedings of the 3rd International Kuraray Symposium; 1999 Dec 3-4; Granada, Spain. Cirimido, Italy: Grafiche Erredue; 2000. p. 131-48.

2. Turkun E. The clinical performance of one- and two-step self-etching adhesive systems at one year. J Am Dent Assoc. 2005;136(5):656-64.

3. Unemori M, Matsuya Y, Akashi A, Goto Y, Akamine A. Self-etching adhesives and postoperative sensitivity. Am J Dent. 2004;17(3):191-5.

4. De Munck J, van Meerbeek B, Satoshi I, Vargas M, Yoshida Y, Armstrong S, Lambrechts P, Vanherle G. Microtensile bond strengths of one- and two-step self-etching adhesives to bur cut enamel and dentin. Am J Dent. 2003;16(4):414-20.

5. Ramos RP, Chinelatti MA, Chimello DT, Dibb RG. Assessing microleakage in resin composite restorations rebonded with a surface sealant and three low viscosity resin systems. Quintessence Int. 2002;33(6):450-6.

6. American Dental Association Council on Scientific Affairs. Getting the most out of flowable composites: a panel looks at strengths and weaknesses. ADA Professional Product Rev. 2009;4(2):9-14.

7. He Z, Shimada Y, Sadr A, Ikeda M, Tagami J. The effects of cavity size and filling method on the bonding to Class I cavities. J Adhes Dent. 2008 Dec;10(6):447-53.

8. Nayif MM, Nakajima M, Foxton RM, Tagami J. Bond strength and ultimate tensile strength of resin composite filled into dentine cavity; effect of bulk and incremental filling technique. J Dent. 2008 Mar;36(3):228-34.

9. Félix SA, González-López S, Mauricio PD, Aguilar-Mendoza JA, Bolanos-Carmoña MV. Effects of filling techniques on the regional bond strength to lateral walls in Class I cavities. Oper Dent. 2007 Nov-Dec;32(6):602-9.

10. Ilie N, Hickel R. Quality of curing in relation to hardness, degree of cure and polymerization depth measured on a nano-hybrid composite. Am J Dent. 2007 Aug;20(4):263-8.

11. Lazarchik DA, Hammond BD, Sikes CL, Looney SW, Rueggeberg FA. Hardness comparison of bulk-filled/transtooth and incremental-filled/occlusally irradiated composite resins. J Prosthet Dent. 2007 Aug;98(2):129-40.

12. Chikawa H, Inai N, Cho E, Kishikawa R, Otsuki M, Foxton RM, Tagami J. Effect of incremental filling technique on adhesion of light-cured resin composite to cavity floor. Dent Mater J. 2006 Sep;25(3):503-8.

13. Quellet D. Considerations and techniques for multiple bulk-fill direct posterior composites. Compend Contin Educ Dent. 1995 Dec;16(12):1212, 1214-6.

14. Hirabayashi S, Hood JA, Hirasawa T. The extent of polymerization of Class II light-cured composite resin restorations; effects of incremental placement technique, exposure time and heating for resin inlays. Dent Mater J. 1993 Dec;12(2):159-70.

15. Puckett A, Fitchie J, Hembree J Jr., Smith J. The effect of incremental versus bulk fill techniques on the microleakage of composite resin using a glass-ionomer liner. Oper Dent. 1992 Sep-Oct;17(5):186-91.

16. Tjan AH, Bergh BH, Lidner C. Effect of various incremental techniques on the marginal adaptation of class II composite resin restorations. J Prosthet Dent. 1992 Jan;67(1):62-6.

17. Wieczkowski G Jr., Joynt RB, Klockowski R, Davis EL. Effects of incremental versus bulk fill technique on resistance to cuspal fracture of teeth restored with posterior composites. J Prosthet Dent. 1988 Sep;60(3):283-7.

18. Clifford SS, Roman-Alicea K, Tantbirojn D, Versluis A. Shrinkage and hardness of dental composites acquired with different curing lights. Quintessence Int. 2009 Mar;40(3):203-14.

19. Park J, Chang J, Ferracane J, Lee IB. How should composite be layered to reduce shrinkage stress: incremental or bulk filling? Dent Mater. 2008 Nov;24(11):1501-5.

20. Muñoz CA, Bond PR, Sy-Muñoz J, Tan D, Peterson J. Effect of pre-heating on depth of cure and surface hardness of light-polymerized resin composites. Am J Dent. 2008 Aug;21(4):215-22.

21. Cunha LG, Alonso RC, de Souza-Junior EJ, Neves AC, Correr-Sobrinho L, Influence of the curing method on the post-polymerization shrinkage stress of a composite resin. J Appl Oral Sci. 2008 Jul-Aug;16(4):266-70.

22. Gerdolle DA, Mortier E, Droz D. Microleakage and polymerization shrinkage of various polymer restorative materials. J Dent Child (Chic). 2008 May-Aug;75(2):125-33.

23. Lopes LG, Franco EB, Pereira JC, Mondelli RF. Effect of light-curing units and activation mode on polymerization shrinkage and shrinkage stress of composite resins. J Appl Oral Sci. 2008 Feb;16(1):35-42.

24. Pereira RA, Araujo PA, Castañeda-Espinosa JC, Mondelli RF. Comparative analysis of the shrinkage stress of composite resins. J Appl Oral Sci. 2008 Feb;16(1):30-4.

25. Ilie N, Hickel R. Quality of curing in relation to hardness, degree of cure and polymerization depth measured on a nano-hybrid composite. Am J Dent. 2007 Aug;20(4):263-8.

26. Tanoue N, Murakami M, Koizumi H, Atsuta M, Matsumura H. Depth of cure and hardness of an indirect composite polymerized with three laboratory curing units. J Oral Sci. 2007 Mar;49(1):25-9.

27. Ilie N, Kunzelmann KH, Visvanathan A, Hickel R. Curing behavior of a nanocomposite as a function of polymerization procedure. Dent Mater J. 2005 Dec;24(4):469-77.

28. Bowen RL, inventor. Silica-resin direct filling material and method of preparation. United States patent US 3066112. 1962 Nov 27.

29. Sensi LG, Strassler HE, Webley W. Direct composite resins. Inside Dent. 2007;3(7):76-9.

30. Strassler HE, Goodman HS. Restoring posterior teeth using an innovative self-priming etchant/adhesive system with a low-shrinkage hybrid composite resin. Restor Quarterly. 2002;5(2):3-8.

31. Uno S, Shimokobe H. Contraction stress and marginal adaptation of composite restorations in dentinal cavity. Dent Mater J. 1994;13(1):19-24.

32. Van Meerbeek B. Mechanism of resin adhesion: dentin and enamel bonding. Funct Esthet Restor Dent. 2008;2(1):18-25.

33. Strassler HE, Sensi LG. Applications of etch-and-rinse adhesive bonding for esthetic restorative dentistry. Funct Esthet Restor Dent. 2008;2(1):26-32.

34. Terry DA. Mastering the technique of direct posterior composite resins. Cont Esthet Rest Pract. 2001;5(6):14-26.

35. Ferracane JL. Using posterior composites appropriately. J Am Dent Assoc. 1992;123(7):53-8.

36. Peutzfeldt A. Resin composites in dentistry: the monomer systems. European J Oral Sci. 1997;105(2):97-116.

37. Gerdolle DA, Mortier E, Droz D. Microleakage and polymerization shrinkage of various polymer materials. J Dent Child. 2008;75(2):125-33. **jCD**

Editor's Note: This article is based on the author's lecture, "Composite Restorations: Recreating Nature's Anatomic Blueprint," which was presented at the 26th Annual AACD Scientific Session in Grapevine, Texas, on April 27 (sponsored by SDI, North America) and April 30 (sponsored by Voco America, Inc.), 2010.

Dr. Lowe is part of the visiting faculty in the Department of Continuing Dental Education at New York University and an adjunct professor at the University of North Carolina. He also maintains a private practice in Charlotte, North Carolina.

Disclosure: Although this article was based on a sponsored lecture, the author did not receive any financial remuneration for the article.

Experience the next generation of Aesthetic Dentistry

Ultimate Artistry
Ultimate Technology
Ultimate Service

- Delivering the optimum in esthetics, precision, innovation and creativity on every case.
- Dedicated to taking the time to develop a **one-on-one partnership with you** - understanding and implementing your unique preferences, style and standards.
- Technical expertise, craftsmanship and consistent quality through our experienced and talented Advanced Esthetic specialists.
- Special requests welcomed! We want to surpass your expectations.
- A commitment to excellence that simplifies the restorative process while ensuring incredibly beautiful, superbly precise restorations – every time.

Experience the quality, precision and accuracy of the Aurum Ceramic AE (Advanced Esthetic) Team™

We welcome the opportunity to demonstrate how Aurum Ceramic's personalized service and proven technical capabilities can compliment your clinical skills. Contact us today.

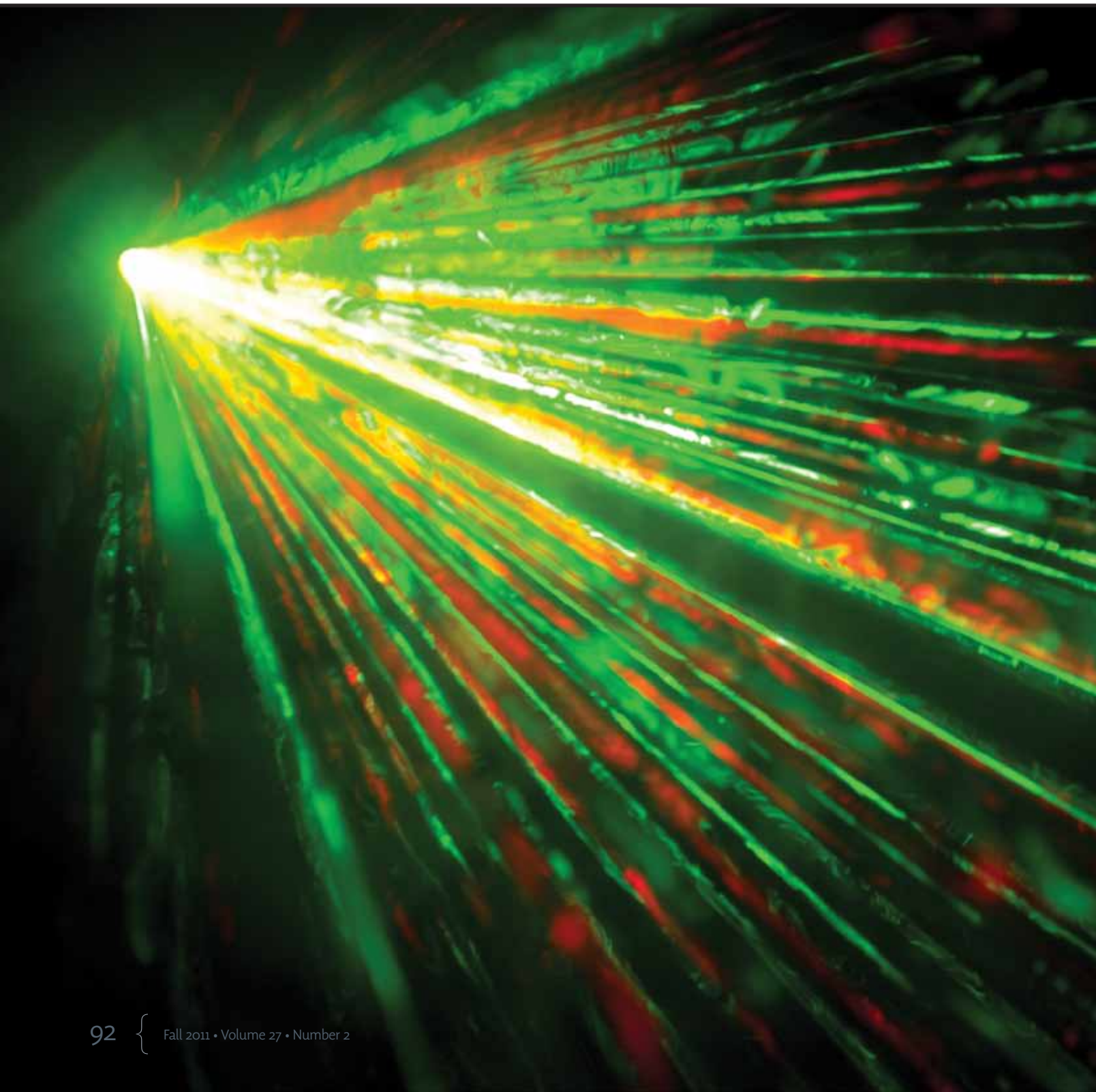
AURUM CERAMIC® DENTAL LABORATORIES LLP

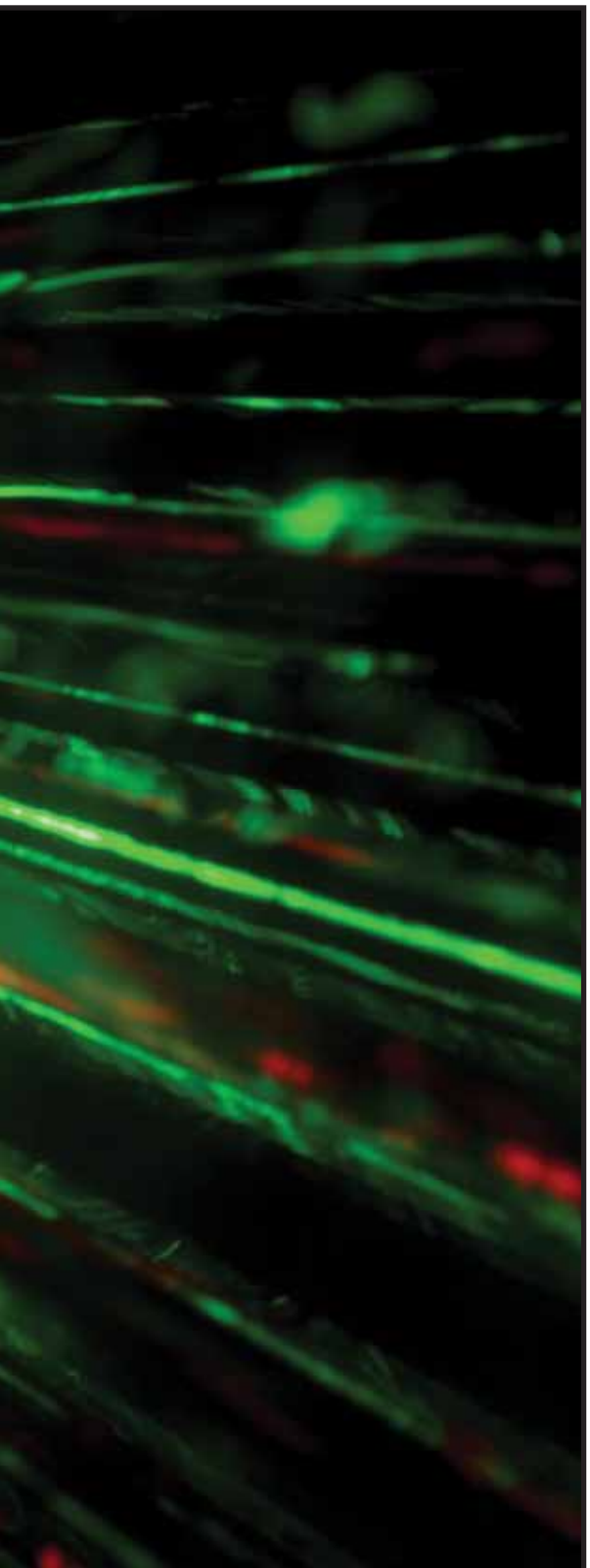
Call TOLL FREE

IN NEVADA, UTAH, COLORADO AND ARIZONA: 1-877-254-5334
IN WASHINGTON, OREGON, MONTANA AND IDAHO: 1-800-423-6509
OTHER NORTH AMERICAN LOCATIONS: 1-800-661-1169

www.aurumgroup.com

CREATING OPTIMUM
Composite Restorations





Combining Glass Ionomer and Laser Technology

Hugh D. Flax, DDS, AAACD

Introduction

The evolution of high-quality direct resin restorations has spanned almost five decades. Innovations in filling materials have led to stronger, more esthetic, and wear-resistant restorations. Several generations of bonding agents include: filled systems, release of fluoride and other agents, unit dose, self-cured catalyst, option of etching with either phosphoric acid or self-etching primer, and pH indicators. Studies have shown that a number of factors that can affect the bond strength to human dentin include substrate (superficial dentin, deep dentin, permanent versus primary teeth, artificial carious dentin), phosphoric acid versus acidic primers, preparation by air abrasion and laser, moisture, contaminants, desensitizing agents, astringents, and self-cured restorative materials. Results show that bond strengths can be reduced by more than 50% when bonding conditions are not ideal.[1]

Editor's Note: As a part of the AACD's sister relationship with the Japan Academy of Esthetic Dentistry (JAED), this article has been translated into Japanese and published in JAED's journal.

Glass ionomer chemistry and modalities have been tremendous assets in allowing dentistry to make tooth structure more resistant to bacteria and

Literature Review

Glass ionomer chemistry and modalities have been tremendous assets in allowing dentistry to make tooth structure more resistant to bacteria and decalcification processes. Composite restorations have become more predictable because of this. Beginning with the research efforts of Wilson and McLean in the 1970s and 1980s,[2-4] clinicians such as Mount[5] reported that long-term decreases in microleakage could be achieved by taking advantage of the chemical adhesion between glass ionomer cement and dentin, as well as the mechanical union between composite resin and glass ionomer cement. This led to the development of the so-called "sandwich technique," in which glass ionomer cement is used as a lining under composite resin restorations, particularly where the cavo-surface margin is in dentin.[5] Peutzfeldt and Asmussen, as well as Knight, found that an additional advantage was that glass-ionomer cement lining reduced wall-to-wall contraction and intercuspal stress would lead to decreased postoperative sensitivity to chewing.[6,7] Suzuki and Jordan introduced this to America in 1990 and reconfirmed that the marriage of these two dissimilar materials was synergistic and extremely beneficial to teeth.[8] Davidson and Abdalla's research noted that the lack of glass ionomer lining under resin dentin bonding system/resin composite restorations resulted in a significant deterioration of marginal integrity under occlusal loading.[9] Manufacturers' changes in viscosity and strength have improved handling and durability over the years. Modifying glass ionomers with resins (glass ionomer composites [GICs]) has proven to be a great adjunct to the "sandwich technique."[10] This is especially noteworthy in separate studies by Ngo and colleagues, and Knight and colleagues, who demonstrated with electron probe microanalysis (EPMA) and scanning electron microscopy (SEM), that both fluoride and strontium ions had penetrated deep into underlying hypocalcified dentin consistent with a remineralization process of the hydroxyapatite crystals.[11,12]

The introduction of lasers to restorative dentistry in the last 10 to 15 years has been a result of advances in the strength of erbium wavelengths and better delivery systems that are compact, efficient, minimally invasive, and user/patient friendly. Research on laser irradiation of enamel has demonstrated structural changes that resulted in a decrease in acid dissolution of the enamel. Dentin irradiation produced changes in surface morphology that improved bonding of restorative resins.[13] Moldes and colleagues have demonstrated lower microleakage scores with composite bonding on teeth prepared by erbium laser compared to conventional drills.[14] However, many studies have found more optimal bond strengths with added acid etching of 20 to 40 seconds with 37% phosphoric acid.[15,16]

The cause and prevention of dental caries also must be considered. Per Hurlbutt, Novy, and Young:[17] "Science suggests it is pH, rather than sugar, which is the selective factor for cariogenic plaque biofilms. Low salivary pH promotes the growth of aciduric bacteria, which then allows the acidogenic bacteria to proliferate creating an inhospitable environment for the protective oral bacteria. This allows for a shift in the environmental balance to favor cariogenic bacteria, which further lowers the salivary pH and the cycle continues. Simple chemistry dictates at what pH enamel and cementum/dentin will demineralize. By controlling pH it is possible to alter the plaque biofilm, remineralize existing lesions, and perhaps prevent the disease altogether." This is critical in managing risk of current and future dental caries. Therefore, having a management system that follows the caries management by risk assessment (CAMBRA) guidelines is essential clinically and medico-legally.[18]

With the confluence of these technologies, very predictable and efficient modalities can be used to serve patients. The following case reports demonstrate caries management and modern implementation of the sandwich technique.

Case Presentation #1

A 52-year-old male patient, who had always feared dentists, presented for a continuing care visit that was two years overdue. His dental history involved numerous restorations including fillings, veneers, and crowns. Following updated medical history and radiographs **(Figs 1a & 1b)**, an initial caries assessment was done using a CariScreen test (Oral Biotech; Albany, NY), which uses adenosine triphosphate (ATP) bioluminescence to identify oral-bacterial load and has been proven to correlate with patients' risk for decay.[19] A swab sample of the plaque from the patient's teeth, combined with special bioluminescence reagents within the swab, creates a reaction that is then measured with the meter. The CariScreen gives a score between 0 and 9,999. A score under 1,500 is considered relatively healthy, while a result above that shows considerable risk for decay. This patient scored 2,590 **(Fig 2)**, indicating the need for more proactive modalities, including the use

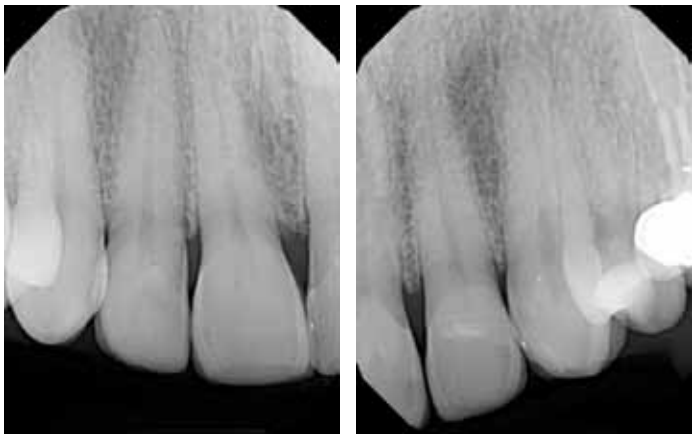
decalcification processes.

of CariFree rinses to lower the pH, alter the biofilm, and remineralize any low-risk lesions.

All unrestored existing enamel pits and fissures **(Fig 3)** were evaluated with laser fluorescence using the DIAGNOdent Classic system (Kavo Dental; Charlotte, NC) **(Fig 4)**. With a diagnostic threshold of 20-25, #7 and #10 scored 64 and 55 respectively. Given the high caries risk, restorative measures were indicated. The conservative nature and pain control of the laser allowed for an ideal minimally invasive treatment to serve this patient's clinical and emotional needs.

After managing the patient's expectations for care (i.e., discussing the laser experience), lip retraction was applied to improve isolation in a comfortable manner. A 90-second "laser analgesia" application was performed with a laser tip (usually a 600 µm glass quartz tip) defocused from and perpendicular to the enamel surface at a height of 10 mm, with a setting at 4.5 Watts, 60% water, and 30% air. When the analgesia cycle was completed, the laser tip was brought within .5 to 1.0 mm of the enamel and pointed at a perpendicular angle to the lingual pit, which works well on smooth surface lesions. Carefully dissecting and ablating the decalcified and carious areas along the grooves and trying to preserve tooth structure, the enamel was cleansed at this setting, while the less mineralized, carious dentin was ablated at 3.5 Watts, 60% water, and 30% air. Since the laser tip is only end-cutting, any small areas undermining enamel can be removed with spoons or a sharp slow-speed round bur, that patient tends not to object to **(Fig 5)**. Any white "cratering" caused on the cavo-surface or esthetic areas was smoothed with a medium diamond to avoid any shine-through in the future bonding.

The laser tooth treatment was followed by a chlorhexidine scrub with Consepsis (Ultradent; South Jordan, UT). Fuji Lining LC (GC America; Alsip, IL), a flowable glass ionomer composite, was placed and cured **(Fig 6)**. A layered etching of the enamel and liner was performed with 37% phosphoric acid at 15- and 5-second intervals respectively **(Fig 7)**. The preparation was rinsed thoroughly and excess moisture removed, but the tooth was not dried. After resin bonding of the enamel, G-Aenial Universal Flo composite (GC America) was placed in the prepared area because of its high strength, higher wear resistance, and high gloss retention **(Fig 8)**. It was cured using the Radii Plus (SDI Dental; Bayswater, Australia) LED light for 20 seconds. Final polishing was minimal after the occlusion was checked **(Figs 9 & 10)**.



Figures 1a & 1b: Pretreatment radiographs provide only a small measure of the decalcification of the teeth.

Figure 2: CariScreen results provide numerical measurements helpful in identifying risk.

Comprehensive Aesthetics Center

Uncompromised Excellence

Commitment, focus
& passion mean
everything...

Especially when *everything* counts.

To learn how we can help you
reach the ultimate Accreditation,
contact us on **Facebook**
or via the Web at:
knightdentalgroup.com
or call us at:

800-359-2043

Cosmetic Solutions

Knight Dental Group
K
40 Years of Quality 1972-2012

Barbara Knight Wilson, CDT, AAACD

AACD American Academy of Cosmetic Dentistry®
ACCREDITED MEMBER

An exclusive Division of Knight Dental Group, CDL, DAMAS | (800) 359-2043 | www.knightdentalgroup.com

Figure 3: Preoperative intraoral conditions show the decay in the lateral incisor pits.

Figure 4: DIAGNOdent readings provide more helpful information than using just an explorer in determining the degree of decalcification beneath the enamel.

Figure 5: Using an ErCr:YSGG laser to remove decay and condition the dentin.

Figure 6: Laser preparation of teeth is often done without anesthesia.

Figure 7: Fuji Liner LC glass ionomer can be precisely applied in tight preparations.

Figure 8: Total etch technique conditions enamel and dentin.

Figure 9: Flowable composite seals the glass ionomer to complete the sandwich.

Figure 10: Immediate post-treatment photograph demonstrates healthier-looking teeth that reflect the benefits of combining the technologies employed.

Case Presentation #2

This 37-year-old male patient had not been to a dentist in six years. After full records (digital radiographs, photographs, and models) and a complete examination, he was diagnosed with early periodontitis and occlusal trauma. Various carious lesions also were detected on the DIAGNOdent **(Fig 11)**. Fortunately, his CariScreen results indicated he was at low risk in terms of salivary pH and biofilm.

Following conservative periodontal care and occlusal therapy with a Kois deprogrammer and equilibration, the decayed areas were treated in a minimally invasive manner with no anesthesia. After isolation with a rubber dam, laser therapy of the lesions was performed as mentioned earlier **(Fig 12)**. Preparation preserved proximal enamel and was about 1 mm into dentin **(Fig 13)**.

When the decay was removed, the tooth was restored using a "closed sandwich technique"—with the glass ionomer composite sealing/replacing the dentin and protected from oral fluids by composite that acts as an "enamel replacement" **(Fig 14)**. Composite materials are chosen based on the remaining tooth structure available, particularly in the critical biomechanical areas of the peripheral rim of enamel and triangular ridges.[20] Following a Consepsis rinse, a layered etching of the enamel and liner was performed with 37% phosphoric acid at 15- and 5-second intervals respectively **(Fig 15)**. The preparation was rinsed thoroughly and excess moisture removed, but the tooth was not dried.

A capsule of a thick GIC (Fuji IX) was activated and triturated for placement into the deeper parts of the preparation **(Fig 16)**. This layer was further adapted with a Microbrush (Grafton, WI) painted with G-Bond (GC America), which also primed the self-curing GIC and the enamel substrate. The resin was left undisturbed for 10 seconds and air-thinned under suction. To seal the "sandwich," a flowable composite (G-Aenial) was precisely placed on top of the GIC while contacting the enamel walls and then cured for 10 seconds **(Fig 17)**.

The evidence-based findings of the past, in addition to current advances in know-how and materials, have built a brighter future for our profession.

Figure 11: Preoperative image of demineralized teeth.

Figure 12: Laser and bonding treatment are best done with isolation for better control of the oral environment.

Figure 13: Maintenance of the peripheral rim of enamel is more easily done with laser care.

Figure 14: Layered diagram of the closed sandwich restoration (printed with permission from GC America).

As an enamel replacement, a compule of Kalore (GC America) was carefully layered over the flowable and adapted to the enamel walls using "gold" instruments (Cosmedent; Chicago, IL) that were helpful in burnishing the restorative materials to the cavo-surface margins **(Fig 18)**. After curing multi-directionally for 20 seconds, gross finishing and occlusal adjustments were done with a 12-bladed OS carbide bur (Brasseler USA; Savannah, GA) **(Fig 19)**. This was made easier with a patient who was more aware of his occlusion with no anesthesia and a predictable closing pattern.

Final polishing was performed with Pre-Shine and Dia-Shine points and Dia Polisher paste (GC America) using a light buffing pressure with a Robinson bristle brush. A natural-looking result that preserved the structural integrity and esthetics of the tooth was achieved **(Fig 20)**.

Conclusion

The synergistic combination of updated technologies by means of lasers, glass ionomers, and composites has allowed for new standards to be achieved in restoring teeth. In addition, improved criteria for prevention and risk assessment have created even more minimally invasive methods of preserving natural enamel and creating an anti-aging theme in contemporary dental care.

Greater levels of strength and marginal seal, remineralization of remaining tooth structure, and color mimicking are creating better biomimetic results that allow patients to receive greater value for their commitment to improved health. Furthermore, dental professionals have a better opportunity to achieve more predictable posterior composites with fewer postoperative complications and greater peace of mind. The evidence-based findings of the past, in addition to current advances in know-how and materials, have built a brighter future for our profession.

Academy of General Dentistry™

Your voice for excellence through education and advocacy

Top Seven Ways That the AGD Gives Members More

The AGD:

1. Offers high-quality continuing education (CE) opportunities locally, online, and through monthly publications.
2. Advocates exclusively for the general dentist at the state and federal levels.
3. Tracks CE, both toward relicensure requirements and toward the AGD Fellowship (FAGD) and Mastership (MAGD) Awards.
4. Provides members with both print and digital versions of the award-winning publications, *General Dentistry* and *AGD Impact.*
5. Keeps patients informed through the interactive dental education website KnowYourTeeth.com.
6. Offers hands-on participation courses, informative lectures, and an innovative Exhibit Hall at the AGD Annual Meeting & Exhibits.
7. Assists your practice with insurance contract analysis, help with third-party payer issues, and patient referrals through the Find an AGD Dentist program.

Join the AGD Today!

Call toll-free at 888.AGD.DENT (888.243.3368) or visit *www.agd.org.*

Figure 15: Total etch takes advantage of the micro-anatomy of enamel and dentin.

Figure 16: Fuji IX as a dentinal replacement.

Figure 17: G-Aenial Flow has a precise delivery system.

Figure 18: Kalore is a hybrid composite with very low shrinkage properties.

References

1. Powers JM, O'Keefe KL, Pinzon LM. Factors affecting in vitro bond strength of bonding agents to human dentin. Odontology. 2003 Sep;91(1):1-6.

2. Wilson AD, Kent BE. A new translucent cement for dentistry. The glass ionomer cement. Br Dent J. 1972 Feb 15;132(4):133-5.

3. McLean JW, Wilson AD. The clinical development of the glass-ionomer cements. i. Formulations and properties. Aust Dent J. 1977 Feb;22(1):31-6.

4. McLean JW, Powis DR, Prosser HJ, Wilson AD. The use of glass-ionomer cements in bonding composite resins to dentine. Br Dent J. 1985 Jun 8;158(11):410-4.

5. Mount GJ. Clinical requirements for a successful 'sandwich'—dentine to glass ionomer cement to composite resin. Aust Dent J. 1989 Jun;34(3):259-65.

6. Peutzfeldt A, Asmussen E. Bonding and gap formation of glass-ionomer cement used in conjunction with composite resin. Acta Odontol Scand. 1989 Jun;47(3):141-8.

7. Knight GM. The co-cured, light-activated glass-ionomer cement-composite resin restoration. Quintessence Int. 1994 Feb;25(2):97-100.

8. Suzuki M, Jordan RE. Glass ionomer-composite sandwich technique. J Am Dent Assoc. 1990 Jan;120(1):55-7.

9. Davidson CL, Abdalla AI. Effect of thermal and mechanical load cycling on the marginal integrity of Class II resin composite restorations. Am J Dent. 1993 Feb;6(1):39-42.

Figure 19: Adjusting the composite and occlusion is much easier when the patient is not anesthetized.

Figure 20: Natural coloration is an added benefit to minimally invasive and biocompatible restorative materials.

10. Koubi S, Raskin A, Dejou J, About I, Tassery H, Camps J, Proust JP. Effect of dual cure composite as dentin substitute on marginal integrity of class II open-sandwich restorations. Oper Dent. 2009 Mar-Apr;34(2):150-6.

11. Ngo HC, Mount G, McIntyre J, Tuisuva J, Von Doussa RJ Chemical exchange between glass-ionomer restorations and residual carious dentine in permanent molars: an in vivo study. J Dent. 2006 Sep;34(8):608-13. Epub 2006 Mar 15.

12. Knight GM, McIntyre JM, Craig GG, Mulyani, Zilm PS, Gully NJ. An in vitro investigation of marginal dentine caries abutting composite resin and glass ionomer cement restorations. Aust Dent J. 2007 Sep;52(3):187-92.

13. Myers ML. The effect of laser irradiation on oral tissues. J Prosthet Dent. 1991 Sep;66(3):395-7.

14. Moldes VL, Capp CI, Navarro RS, Matos AB, Youssef MN, Cassoni A. In vitro microleakage of composite restorations prepared by Er:YAG/Er,Cr:YSGG lasers and conventional drills associated with two adhesive systems. J Adhes Dent. 2009 Jun;11(3):221-9.

15. Ergucu Z, Celik EU, Turkun M. Microleakage study of different adhesive systems in Class V cavities prepared by Er,Cr:YSGG laser and bur preparation. Gen Dent. 2007 Jan-Feb;55(1):27-32.

16. Obeidi A, Liu PR, Ramp LC, Beck P, Gutknecht N. Acid-etch interval and shear bond strength of Er,Cr:YSGG laser-prepared enamel and dentin. Lasers Med Sci. 2009 25(3):363-9.

17. Hurlbutt M, Novy B, Young D. Dental caries: A pH mediated disease. CDHA J. 2010 Jan;25(1):9-15.

18. Featherstone JD, Adair SM, Anderson MH, Berkowitz RJ, Bird WF, Crall JJ, Den Besten PK, Donly KJ, Glassman P, Milgrom, Roth JR, Snow R, Stewart RE. Caries management by risk assessment: consensus statement. J Calif Dent Assoc. 2002 Apr;31(3):257-69.

19. H Fazilat, R Sauerwein, J McLeod, T Finlayson, E Adam, J Engle, P Gagneja, T Maier, C Machida. Application of adenosine triphosphate-driven bioluminescence for quantification of plaque bacteria and assessment of oral hygiene in children. Pediatric Dentistry. 32(3):195-204.

20. Milicich GW, Rainey JT. Clinical presentations of stress distribution in teeth and the significance in operative dentistry. Pract Perio Aesthet Dent. 2000:12(7). **jCD**

Dr. Flax has been an Accredited Member of the AACD since 1997. He is the immediate past president of the AACD Board of Directors and is on the editorial review board of the *jCD*.

Disclosure: The author is a consultant and lecturer for Biolase and GC America, but did not receive any financial remuneration for this article.

ENA HRi

HIGH TECHNOLOGY
PASSION FOR ESTHETICS

Ena HR*i* is the first and only composite material to possess the same refractive index as natural enamel

RESTORATION MADE BY DR. LORENZO VANINI

Only $ 249.00

Ref. EHR6
TRIAL KIT ENA HR*i* 6x2,5g
including 6 syringes 2,5 g with holder
4 dentin: UD1 (A1), UD2 (A2),
UD3 (A3), UD4 (A4)
2 universal enamel:
UE2, UE3

To order contact our dealer today: Optident USA • Tel. 855 549 4511 • Fax 855 549 4512 • hri@optident.com

Special offer form: ❑ — Trial Kit ENA HRi • Ref. **EHR6** **$ 249.00**

Dr. ..... Zip .....

Phone .....

Address .....

City .....

State .....

Date and Signature .....

estetica GRUPPO MICERIUM

Micerium S.p.A.
Via G. Marconi, 83
16036 Avegno (Ge) Italy
Tel. +39 0185 7887870
hfo@micerium.it

optident LTD

To order contact our dealer today:
Optident USA
Tel. 855 549 4511 • hri@optident.com

Additive Feldspathic Chips: A Strong Choice

Indications, Study, and Application

Joshua Polansky, MDC
Barry Polansky, DMD

The digital version of this article features a technique video providing an artistic view of key concepts in the article. 

Introduction

Occasionally we are faced with a situation that calls for an ultra-conservative technique to satisfy what the patient sees as a fast and easy solution to a simple problem. The use of additive feldspathic chips has the potential to achieve many of the doctor and patient's goals. Both want the longest-lasting, most esthetically pleasing restoration while reducing minimal tooth structure. When indicated, these tiny chips can provide the perfect solution to a very common problem.

Figure 1: Our treatment should always be the most conservative in thought and application; the goal is to "protect" what is in our care.

Case Presentation

Indications

The patient was a young man with an exceptional dentition. His main concern was to preserve his smile in the most conservative way, just as we wish to protect nature **(Fig 1)** and "do no harm." His dental history revealed no restorative procedures and his oral hygiene could not have been better. Unfortunately, he had experienced a serious surfing accident. **Figure 2** shows the damage to the distal incisal corner of tooth #9.

Figure 2: Initial situation; the patient lost natural tooth structure from a surfing accident.

DIAGNOSIS AND TREATMENT PLANNING

STUDY

Restoring an incisal chip requires the dentist to ensure that the area will not be exposed to stresses that will cause the restoration to fail through fracture or debonding. This patient was examined for occlusal harmony and smooth crossover. This was achieved by guiding the patient through lateral and protrusive movements to ensure that the proposed restoration would not meet any interferences in everyday function. The area was not exposed to interferences, so the authors believed that the restoration would survive normal function. Ceramic is the most biomimetic material in terms of replacement of tooth structure because of its ability to simulate and restore crown rigidity.[1] Due to their high thermal expansion and elasticity, composite veneers cannot achieve this goal.[2]

Figure 3: The first step is to transfer all information from an intraoral environment to a bench-top working environment.

Figure 4: An alveolar model is created to simulate exactly the given situation. The alveolar model should replicate to the detail mouth to model.

Treatment

Application

The first requirement, after the occlusal analysis, was to transfer the information from the mouth to the laboratory bench. Minimal preparation was done to smooth off sharp angles. The impression was taken and the die to be treated was duplicated, creating an alveolar model. The die was poured using refractory metal ceramic veneering material (Orbit Vest, Fuji Rock, GC America; Alsip, IL). The resulting alveolar model was an exact duplicate of the oral conditions **(Figs 3 & 4)**. Digital photography helped to recreate a plan to match the shading of the untouched distal of #8 **(Fig 5)**.

Figure 5: Once all information is transferred to a working environment, thought should begin on how to go about restoring utilizing a ceramic medium.

Observation of natural teeth reveals the complex nature of the dentin and the enamel, even in the smallest of chips. Note in **Figures 6 and 7** the complexity of the dentin and enamel. With the aid of hydrochloric acid it is possible to study the underlying structure by de-enamelizing the natural tooth **(Fig 8)**. Through this process of "reverse engineering" we can discover how the dentin should be restructured and how the enamel should be overlaid. The hydrochloric acid will strip the enamel from the tooth structure, leaving only the dentinal makeup.

Figure 6: By observing a natural extracted tooth put into the same clinical environment at hand, one can clearly see the complexities of nature.

Figure 7: By observing nature, one can understand that although it is only a small "chip" to be layered, the complexities of dentins and enamels are apparent.

Figure 8: With the aid of hydrochloric acid it is possible to study nature by "de-enamelizing" a natural tooth.

Figure 9 reveals the layering process (GC Initial MC ceramic system). As in nature, every detail must be replicated in the layering process. The layering started with a combination of dentins A1 and A2 (GC Initial MC), and a mixture of opacious a1 dentin with a translucent dentin in a1, and a fluorescent dentin 91 (GC Initial MC) to recreate the internal distal mamelon structure. Translucent opal and opal effect blue (GC Initial MC) were then overlaid, covering the wet mamelon structure created. Finally, light enamel and clear (E58 and CL, both CG Initial MC) were overlaid before firing.

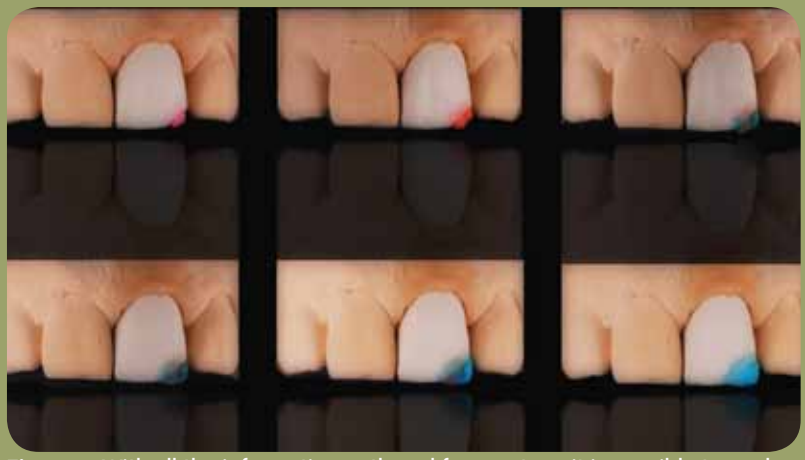


Figure 9: With all the information gathered from nature, it is possible to apply this knowledge directly to layering techniques.

Figure 10: With the refractory die technique the "chip" is fixed onto the die. This allows for the "chip" to be treated like any other restoration.

The ceramist should not attempt to create an exact margin or fit of the chip; rather, a thin contact lens effect should be feathered over the junction to lay over the tooth structure that is present. The margin will be finished once the chip is fitted and bonded to the natural tooth. With the refractory die technique the chip is fixed onto the die, allowing the chip to be treated like any other restoration. Rotary instruments, markings, and additions are all easily used/applied before the chip is to be devested **(Fig 10)**.

The devestment phase can be somewhat tricky. The die is split from the rest of the cast and submerged in a thin patty of laboratory putty (GC America). This allows for the chip to be sandblasted (at less than 2 bars of pressure from a sandblasting unit [Renfert USA; St. Charles, IL]) with support. With the chip fixed in putty it also allows for control of the ceramic, as they can easily blow away. Once devested, the chip can be placed directly on the solid cast **(Fig 11)**.

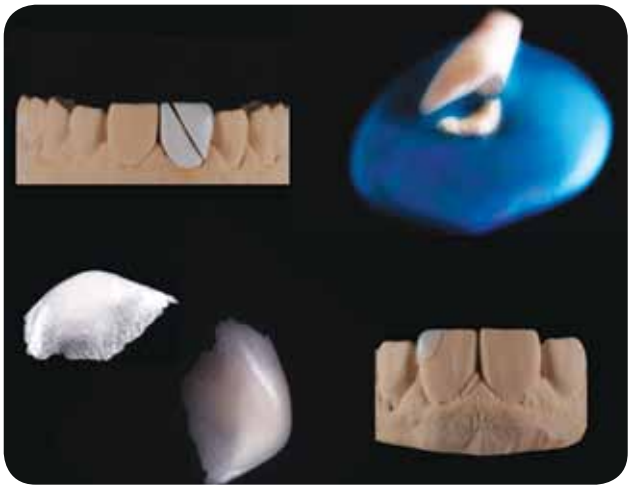


Figure 11: The skill and delicacy of this technique really comes into play during the devesting phase of fabrication.

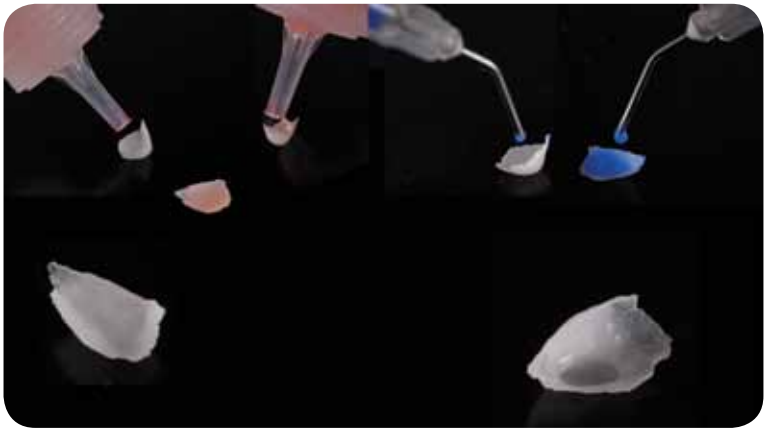


Figure 12: Because of the sensitive nature and size of these chips a steamer is not recommended as the chip can easily be blown away. Phosphoric acid is used instead to clean the chip to give a nice clear appearance.

Care must be taken during the etching phase. Because these chips are quite fragile, steaming is not recommended. Once devested, the chip was treated with etchant (Tri-Dynamics; Cherry Hill, NJ) for 90 seconds, after which a white chalky film became evident. Phosphoric acid was then applied to clean the chip and give it a clear appearance **(Fig 12)**.

The chip was delivered to the dentist for placement. Extra care should be exercised due to the delicate nature of the chip. Pick-up sticks were used to transfer the chip to the tooth. Once the chip is on the site, a finger can be used to adjust it into place. Water can be sprayed to hydrate the chip. This is the time to see if any adjustments should be made **(Fig 13)**.

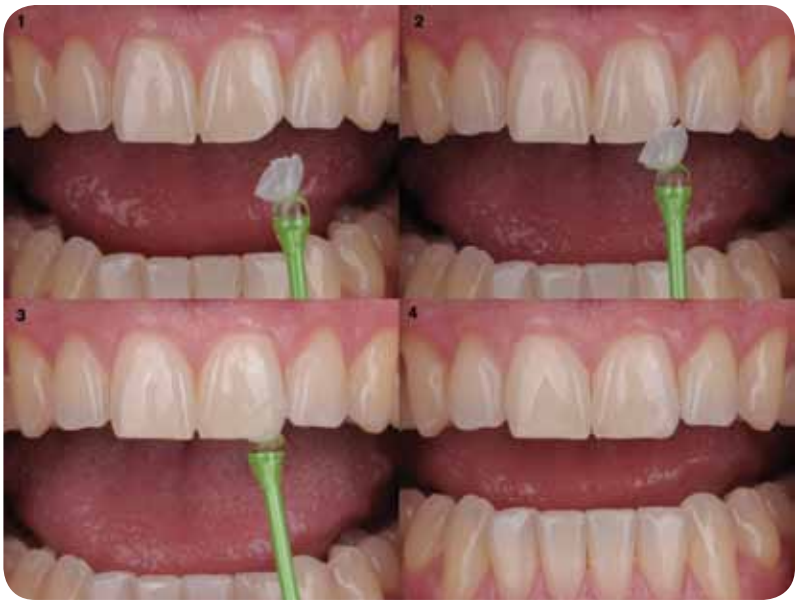


Figure 13: The chip should be handled with care during insertion and fitting. A stick with a sticky side can be used to insert onto the tooth.

A flowable cement should be used to bond the chip to the tooth. Stiff cements are contraindicated due to the resistance they may impart. The chip was passively placed over the preparation, so it was possible to visualize the extended contact lens. The dentist cured the restoration in place and proceeded to finishing. Finishing was accomplished with Dialite wheels (Brasseler USA; Savannah, GA), in a descending order from strong grit for abrading to a fine grit for smoothing and polishing **(Fig 14)**. Once the chip was bonded and finished intraorally, a diamond paste (GC America) was applied to achieve a finish similar to the adjacent natural dentition **(Fig 15)**. The final chip should mimic the surrounding dentition so as to be imperceptible **(Fig 16)**.

Figure 14: Once the chip has adhered, the over-extended marginal contact lens can clearly be seen.

Figure 15: Once the chip has adhered and been finished intraorally, a diamond paste can be applied to get a finish similar to the adjacent natural dentition.

Figure 16: The final additive feldspathic chip in situ.

Conclusion

The final restoration should demonstrate an overall balance of form, value, and harmony with the opposing and adjacent dentition. Additive feldspathic chips can serve as an excellent alternative to more aggressive techniques and direct bonding techniques. The advantages include strength and color stability. Occlusal forces should be considered prior to using this technique. Using minimally invasive dentistry builds trust with patients **(Figs 17 & 18)**. With the ability to restore as conservatively as possible, we take away many variables that could disrupt an overall harmonious smile. The only way to achieve this result is through a deep understanding of materials and clinical/laboratory applications, and overall trust and appreciation between the dentist, technician, and patient.

Figure 17: The overall analysis of the restoration in situ should demonstrate an overall balance of form, value, and harmony with the opposing dentition.

Figure 18: With the ability to restore as conservatively as possible, we take away many variables that could disrupt an overall harmonious smile.

References

1. Magne P, Douglas WH. Porcelain veneers: dentin bonding optimization and biomimetic recovery of the crown. Int J Prosthodont. 1999;12(1):111-21.
2. Reeh ES, Ross GK. Tooth stiffness with composite veneers: a strain gauge and finite element evaluation. Dent Mater. 1994;10(4):247-52. **jCD**

Joshua Polansky owns and operates Niche Dental Studio in Cherry Hill, New Jersey.

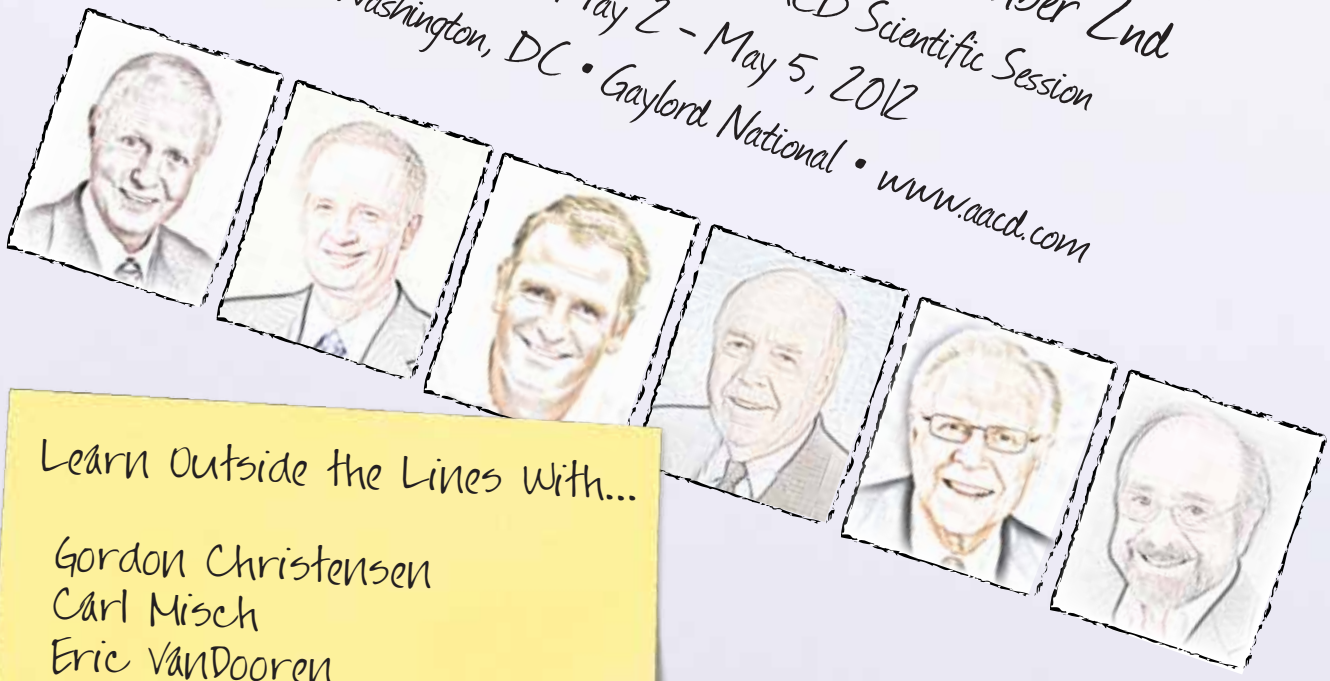
Dr. Barry Polansky is a visiting faculty member at the Pankey Institute and has a private practice in Cherry Hill, New Jersey.

Disclosure: Mr. Polansky is a Key Opinion Leader for GC America and received support for this article. Dr. Polansky did not report any disclosures.

With the ability to restore as conservatively as possible, we take away many variables that could disrupt an overall harmonious smile.

Learn Outside the Lines

Course Selection Opens on December 2nd
for the 28th Annual AACD Scientific Session
May 2 - May 5, 2012
Washington, DC • Gaylord National • www.aacd.com



Learn Outside the Lines With...

Gordon Christensen
Carl Misch
Eric VanDooren
Pete Dawson
Ronald Goldstein
David Garber

Learn more at
www.aacdconference.com

AACD American Academy of Cosmetic Dentistry®

CURRENT STATUS & FUTURE PERSPECTIVES FOR THE USE OF COMPOSITE RESINS IN THE Smile Frame

Methods Following the "Bio-Esthetic Concept"

Didier Dietschi, DMD, PhD

Abstract

The use of composites in the smile frame has evolved and gained maturity. However, ceramics remain the preferred esthetic option for many clinicians because direct bonding techniques are still considered intricate, sensitive and, to a certain extent, unpredictable. These drawbacks, essentially related to the complexity of former composite systems and their application methods, can be overcome today. Among the many improvements achieved through newer technologies and obvious refinements of clinical protocols, one can mention the effective use of composite to treat more complex esthetic deficiencies and tooth wear. The rejuvenation of composite prefabricated veneers is another example of the recent ways explored to further implement the successful indications of composite resins in the context of "bio-esthetics," to be considered as a modern philosophy of esthetic restorative dentistry with strong focus on biomechanics and biology. This article reviews some of the most prominent and current successes of adhesive dentistry.

CE CREDIT

Learning Objectives:
After reading this article, the participant should be able to:

1. Recognize the parameters that guide the clinician toward direct or indirect restorations.
2. Be aware of the main restorative sequence for the treatment of wear due to abrasion, attrition, erosion, or parafunction (bruxism).
3. Understand the main indication for prefabricated composite veneers versus porcelain veneers.

"The rejuvenation of composite prefabricated veneers is another example of the recent ways explored to further implement the successful indications of composite resins in the context of "bio-esthetics"..."

Introduction

Composite resins occupy a paramount position among restorative materials today because they offer excellent esthetic potential and acceptable longevity, with a much lower cost than equivalent ceramic restorations for the treatment of both anterior and posterior teeth.[1-3] In addition, composite restorations allow for minimally invasive preparations or no preparation at all when assuming the replacement of decayed or missing tissues. This thinking is part of a new concept called "bio-esthetics," giving priority to additive, minimally, or micro-invasive procedures to preserve tooth biology and biomechanics. Although logical, this treatment approach's potential still is under-exploited.

There are three areas of particular interest as it comes to the present and future use of composite resin in the smile frame, which are the classical freehand bonding, the use of adhesive techniques for the functional and esthetic rehabilitation of patients with severe tooth wear and, last but not least, veneering techniques. Besides classical indications such as Class III, IV, and V fillings, many other esthetic or functional problems can be corrected by simple, direct composite restorations providing satisfactory and fully documented short- and medium-term behavior **(Figs 1a-1c)**.[2,3] Actually, recent developments in composite optical properties have definitely simplified application technique, positively impacting practicability, efficiency, and predictability of the esthetic treatment outcome.[4-6] Next to this traditional and main indication field for composite resins, the increasing incidence of tooth wear due to erosion and attrition phenomenon has called the profession to develop new, interceptive restorative solutions that meet patients' esthetic needs as well as functional, biological, and biomechanical requirements.[7,8] Composite resins were also used practically since their conception as a cosmetic, veneering material; however, despite the obvious promise of this method

Figure 1a: Pre-treatment image of a 50-year-old patient with lateral incisor aplasia and subsequent diastemas and front teeth misalignment.

Figure 1b: Smile following a "no-prep" treatment, consisting of additive freehand composite correction (Miris 2, Coltène/Whaledent).

Figure 1c: The patient after four and a half years, showing the satisfactory behavior of modern resin composites, even when used in rather extensive restorations.

Parameters	Direct Option	Indirect Option
Age of Patient	younger	older
Size of Decay	smaller	larger
Tooth Vitality	vital	non-vital
Tooth Color	normal	non-treatable* discoloration
Facial Anatomy	normal	altered
Number of Restorations	unrelated	unrelated

Table 1
*using chemical treatments (vital and non-vital bleaching or microabrasion)

in terms of cost and tissue conservation, it proved technique-sensitive and time-consuming, potentially leading to disappointing esthetic results if not meticulously applied. Recently, the idea of prefabricated composite veneers was rejuvenated, taking advantage of modern technologies.[9] This can be regarded as one of the first attempts to use in the smile frame a "noble" composite system, free of all possible material imperfections such as bubbles, insufficient curing or polishing, or even surface contamination by modeling resins, to mention only the most frequent ones. Here, a molding process under heat and pressure enabled the fabrication of high-quality but inexpensive dental restorations, which represent an attractive alternative to direct composite veneers.

This article presents three features of particular interest and confirms the various applications of composite as a modern restorative and esthetic dental material. They are:

- esthetic freehand restorations
- comprehensive functional and esthetic rehabilitations in patients with tooth wear
- prefabricated composite veneers.

Composite and Freehand Bonding

The main issue when it comes to restoring a smile is whether we should consider a direct or indirect option; besides minor esthetic corrections or extensive decays in non-vital teeth, many cases lie within a "gray zone" where almost all possible techniques and materials can be considered. A simple, yet effective approach to this dilemma is to use the decision process shown in **Table 1**, after a comprehensive biological, functional, and esthetic diagnosis

Apart from classical indications such as Class III, IV, and V fillings, many esthetic or functional deficiencies can be corrected by simple, direct composite restorations; these indications are reviewed below.

Indications

Post-Orthodontic Conditions

Lateral incisor aplasia or incorrigible canine impaction are frequent findings that often are approached by an orthodontic solution; however, different anatomical, functional, and esthetic anomalies may result from the orthodontic approach. Other orthodontic conditions (e.g., tooth size discrepancy) can also lead to the persistence of diastemas or sub-optimal tooth position, despite an appropriate treatment. Our patients' increasing concern for esthetics obliges the dental team to correct potential deficiencies such as unusual crown dimensions, unusual root diameter, unusual shape of the crown, difference in color, and difference in gingival contour or level **(Figs 1a-1c)**.

Congenital Esthetic Deficiencies

Numerous congenital conditions, including dysplasia/discolorations, hypoplasia, and unusual tooth forms or dimensions, require correction at a relatively early stage and therefore mandate a conservative approach **(Figs 2a-2m)**.

Acquired and Other Esthetic Deficiencies

Several other conditions that impact smile balance and esthetics can develop at different ages. These include discolorations (i.e., traumatized non-vital tooth); tooth movement; abrasion, abfraction, and erosion lesions; tooth fractures; caries; and functional deficiencies **(Figs 3a-3l)**. These conditions are also potential indications for conservative, additive procedures, according to preexisting tissue loss and functional status.

A New Shading Approach: The Natural Layering Concept

The creation of perfect direct restorations has long been an elusive goal because of the imperfect optical properties of composite resins and complicated clinical procedures, due mainly to the attempt to mimic shades and layering techniques of ceramic restorations. The use of the natural tooth as a model and


Figures 2a & 2b: Preoperative views of a 16-year-old patient with front teeth hypoplasia and moderate fluorosis.


Figures 2c & 2d: A wax-up made to evaluate foreseen enhancements using a direct mock-up, with self-curing resin (Protemp Garant, 3M ESPE; St. Paul, MN).

Figure 2e: Shade recording made prior to rubber placement, using a special dual shade guide, combining both dentin and enamel samples (Edelweiss Direct); this step is simplified by the "Natural Layering Concept."

Figure 2f: Rubber dam applied from premolar to premolar to provide a full-smile view, which is mandatory to allow the placement of the silicone index, as well as to visualize the full smile line during treatment.

Figure 2g: A caliper serves, along with silicone index, to monitor tooth dimensions, proportions, and symmetry.

Figure 2h: Central incisors are always restored first to establish midline and tooth axis; lateral teeth can then be modified with better control of anatomy and function.

"Besides classical indications such as Class III, IV, and V fillings, many other esthetic or functional problems can be corrected by simple, direct composite restorations providing satisfactory and fully documented short- and medium-term behavior."

Figure 2i: The four incisors are completed; the new smile line is developing progressively. Here, both conventional bucco-lingual and centrifugal layering techniques were applied.

Figures 2j & 2k: The reconstruction of both cuspids completes the treatment; however, due to the important space excess, small diastemas remain but are invisible in a frontal view. This was considered crucial to preserve adequate proportions and dimensions.

Figures 2l & 2m: Completed smile rehabilitation, again using a "no-prep," ultra-conservative approach. This treatment option has obvious advantages due to the young age of the patient. However, it requires a precise clinical protocol to ensure satisfactory esthetic and functional outcomes.

the identification of respective dentin and enamel optical characteristics (tristimulus L*a*b* color measurements and contrast ratio) have been landmarks in developing better direct tooth-colored materials.[10-12] The "natural layering concept" is a simple and effective approach to creating highly esthetic direct restorations that has become a reference in the field of composite restorations.

Dentin Optical Features

Variations in a* and b* dentin values between A and B VITA shades seemed not to justify the use of distinct dentin colors, at least for a direct composite restorative system.[12] Likewise, the variations of the contrast ratio (opacity-translucency) within a single shade group did not support the use of different dentin opacities (i.e., translucent, regular, or opaque dentins). However, a large chroma scale covering all variations of natural dentitions, plus some specific conditions such as sclerotic dentin, proved to meet all clinical conditions.

Therefore, the ideal material aimed to replace dentin exhibits the following characteristics:

- single hue
- single opacity
- large chroma scale (beyond the four chroma levels of the VITA system).

Enamel Characteristics

As regards enamel, differences in tissue lightness and translucency proved generally to vary in relation with tooth age and therefore confirmed the clinical concept of these three specific enamel types:[13]

- young enamel: white tint, high opalescence, less translucency
- adult enamel: neutral tint, less opalescence, intermediate translucency
- old enamel: yellow tint, higher translucency.

Typical brand names include Edelweiss Direct (Edelweiss Dentistry; Hörbranz, Austria), Miris and Miris 2 (Coltène/Whaledent; Cuyahoga Falls, OH), Ceram•X duo+ (Dentsply; York, PA), and Enamel HFO/HRi (Micerium S.p.A.; Avegno, Italy).

Layering Technique and Clinical Application

Composites can be applied following different incremental techniques for esthetic or practical reasons, as well as for better management of polymerization stresses.[14-16] For advanced cases, a modification of the classical centrifugal technique is needed, the linguo-buccal technique. It makes use of a silicone key made from either a freehand mock-up (simple cases) or wax-up (advanced cases) **(Fig 2c)**. It provides the anatomical and functional references required for an optimal esthetic result, mimicking color, translucency, opalescence, and halo effects.

The aforementioned techniques allow a precise three-dimensional placement of composite masses **(Figs 2f-2k)**. Last but not least, a methodical, gentle finishing and polishing technique will give the restoration its final beauty. The natural layering concept enables this objective to be achieved in a much more predictable way, helping a larger number of our patients to receive conservative and highly esthetic restorations **(Figs 2l & 2m)**.

Composite and Conservative Adhesive Restorations for Early Intervention on Severe Tooth Wear

Excessive abrasion (attrition) and erosion are two common "diseases" of dental hard tissues, which affect an increasing number of patients.[7,8] They can be considered as a growing challenge in dentistry, because with such patients and severe parafunctions, the etiology can rarely be successfully and permanently eliminated.[17-19] It therefore implies continuous monitoring to control related pathologies. The most frequent causes of erosion are unbalanced dietary habits with high consumption

of acidic foods/beverages as well as abnormal intrinsic acid production such as in bulimia nervosa, acid regurgitation, and hiatal hernia. Insufficient saliva flow rate or buffer capacity and, in general, saliva composition changes induced by various diseases, medications, and aging are other etiological co-factors.[20-23] As regards abrasion/attrition, awake and sleep bruxisms are two different forms of parafunctional activities that can severely impact tooth integrity;[17-19] preventive and restorative measures are therefore mandatory to correct and limit the extent of further tissue and restoration destruction. An important clinical finding is that a large number of patients concerned with hard tissue loss present combined etiologies, challenging the dental team to develop a multifactorial preventive and restorative approach.

Symptoms or complaints reported by patients include a shortening of teeth, discolorations, tooth displacement, dentin sensitivity and, finally, an increased risk for decay and premature loss of restoration marginal adaptation **(Figs 3a-3d)**. Due to the significant impact of tooth wear on occlusion, function, and esthetics, patients seek advice and intervention. The biomechanical challenge involves different specialties, starting with preventive measures and ending with full-mouth rehabilitation; intermediate stages (slight to moderate erosion/abrasion), however, require other clinical measures, such as various forms of adhesive, and partial restorations, which have the potential to restrict ongoing tissue destruction and restore function and esthetics **(Figs 3e-3l)**.[24-27]

A Comprehensive Treatment Approach

The modern approach to the treatment of tooth wear aims to stop the progression of disease before a full prosthetic rehabilitation is needed, implying large amounts of additional tooth substance to be removed with known potential biological complications[28,29] and rather inadequate biomechanical rationale. A modern treatment model involves three steps:

1) A comprehensive etiological clinical investigation, including diet analysis and identification of general/medical and local risk factors.
2) Treatment planning and execution, including proper functional and esthetic wax-up defining the new smile line and tooth anatomy, transferred then to the mouth with a combination of adhesive direct and indirect restorations.
3) A maintenance program, including protective nightguard wear and potential repair or replacement of restorations over a medium or long-term time frame **(Figs 3a-31)**.

> Composites can be applied following different incremental techniques for esthetic or practical reasons, as well as for better management of polymerization stresses.

Treatment Outline and Restorative Options

Increasing the vertical dimension of occlusion is in fact a key parameter to reversing the consequence of pathological wear and erosion.[29-34] Actually, the passive eruption that accompanies the continuous tissue destruction and loss tremendously restricts the space available for restorations, which due to their limited thickness would be very fragile or otherwise should invade unnecessarily residual tooth structure. Recent clinical reports have largely validated this treatment rationale **(Figs 3a & 3b, 3k & 3l)**.[32-34]

The therapeutic scheme is also logically oriented toward re-establishing first a proper central incisor length and anterior guidance, governing thereafter the new vertical dimension of occlusion (VDO). The proper anterior tooth anatomy and function is designed according to objective esthetic guidelines, existing and former tooth anatomy, and functional and phonetic components. The first step is made on study casts in the form of a partial (moderate posterior tissue loss) or full-mouth wax-up (advanced generalized tooth wear/erosion) **(Figs 3e & 3f)**. The optimal restorative choice is usually based on pre-existing dental conditions (presence of decay, restorations, vital or non-vital status) as well as the amount and localization of tissue loss. This means that various restorative options have to be considered and that treatment planning is highly individual (tooth-specific).

Direct composite. The direct composite option is logically indicated for all forms of moderate to intermediate tissue loss/destruction. Among other benefits of direct composite, one can cite the highly conservative approach, the possibility to replace/re-shape small portions of the tooth, the repairability the simplified replacement, and relatively limited cost. Conversely, it is more technique-sensitive and might create thin layers of material over some surfaces, which are mechanically "at risk." When using a sculpting technique, a correct anatomy can also be created with a direct technique, favoring the selection of a "firm consistency," highly filled material **(Figs 3g & 3h)**.[35-37]

Indirect composite. The indirect option is logically preferred when larger restorations or more severe tissue destruction are present. It also provides more control of anatomy and occlusion in complex or advanced cases. Nevertheless, one should not neglect the direct option only in favor of these later parameters, in consideration of the fact that occlusion seems not to play a major role in the origin of parafunctions.[18,19,38-40] Since direct and indirect techniques can be used together to treat the same patient, the indirect restorations have to be fabricated first, at the new VDO, and then direct composites placed.

Figures 3a & 3b: Preoperative images of a patient showing irregular smile line due to attrition of anterior teeth in relation to a deep bite and sleep bruxism.

Figures 3c & 3d: Parafunctional movements are mainly of a protrusive nature, as revealed by clinical evaluation of posterior teeth that show little wear.

Figures 3e & 3f: Due to the occlusal context and limited loss of hard tissue in the posterior areas, only an anterior wax-up was prepared to define the new VDO and an appropriate space for restoring anterior teeth.


Figures 3g & 3h: Intra-operative view of mandibular posterior teeth showing the new occlusal anatomy created by direct composite restorations.


Figures 3i & 3j: The choice was made to restore/reshape only the mandibular teeth because of the supra-eruption of anterior mandibular teeth. This approach aimed to reduce the overbite and, at the same time, provided the space needed to restore esthetic and functional maxillary anterior teeth.

Figure 3k. Maxillary anterior teeth following the correction of the smile line made with direct composites, after VDO correction.

Figure 3l. The restored smile three years after treatment, showing no sign of recurrent wear or mechanical degradation; the patient wears a nightguard regularly.

Parameters	Partial Facial Coverage	Full Facial Coverage (Veneers)
Size of Decay	smaller	larger
Tooth Color	normal	non-treatable* discoloration
Facial Anatomy	normal	altered
Number of Restorations	unrelated	unrelated

Table 2
*using chemical treatments (vital and non-vital bleaching or microabrasion)

Longevity of Restorations Placed to Correct Severe Tooth Wear and Erosion

Clinical studies have shown that the performance of composite to treat advanced tooth wear is adequate and that partial fractures represent the most likely complication, which can be corrected by a repair or uncomplicated restoration replacement.[41-43] The 10-year survival rate of porcelain-fused-to-metal (PFM) crowns proved slightly superior to composite restorations, but with much more severe complications. Actually, PFM failures led mainly to endodontic treatments or also to extractions, while composite failures/fractures could be either repaired or replaced.[43] This again is why the conservative and adhesive approach is favored in all kinds of initial-to-moderate forms of tooth wear and erosion.

Composite for Prefabricated Veneers: The Technique Rejuvenated

Historical Perspectives and Development

While the concept of veneering anterior teeth was presented in 1937 by Dr. Charles Pincus,[44] it became more popular in the mid-1970s, using three different approaches: direct bonding using resin composites; prefabricated composite veneers; and indirect, custom-made porcelain veneers.[45,46] The prefabricated composite veneer (Mastique, Caulk; Milford, DE) was explored about 35 years ago, using a methyl-methacrylate matrix and large glass fillers, such as those used in resin composites,[47] but with limited success due to technological limitations and poor surface qualities.[48] The rapid loss of surface gloss and surface degradation of prefabricated resin veneers linked to some interfacial defects led the system to be soon abandoned and definitively replaced by bonded porcelain veneers, which also had the advantage of an individual fabrication process.[49,50]

The concept of prefabricated composite veneers was, however, recently revitalized, taking advantage of new technologies:[9] the Direct Venear system (Edelweiss Dentistry and a planned partnership with Edelweiss by Ultradent; South Jordan, UT), was recently launched and is based on high-pressure molding and heat-curing processes, followed by laser surface vitrification **(Figs 4a-4g)**. This enables the veneers to exhibit a hard and glossy surface **(Figs 4c & 4f)**, with a texture to fit the majority of dentitions. The system is actually designed to facilitate the esthetic restoration of decayed or discolored single and multiple anterior teeth.

Indications

The aforementioned direct composite veneer system does not aim to systematically replace the well-established individualized porcelain veneer technique. Rather, it offers an alternative to directly (or freehand) built-up composite veneers, which is a delicate and time-consuming technique. As it comes to define the clear demarcation between partial and full coverage, the selection process might be facilitated by the clinical parameters noted in **Table 2**.

Composite prefabricated veneers present an obvious potential in the following indications:

1) For single facial restorations **(Figs 4a-4g)**:
- large restorations/decays with loss of natural tooth buccal anatomy/color
- non-vital, discolored teeth
- traumatized, discolored teeth (without endodontic treatment)
- severe/extended tooth fracture
- extended tooth dysplasia or hypoplasia.

2) In full-smile facial rehabilitations **(Figs 5a & 5b)**:
- moderate to severe discolorations (i.e., tetracycline staining and fluorosis)
- generalized enamel hypoplasia/dysplasia (i.e., amelogenesis imperfecta IIIA)
- large serial restorations/decay with loss of natural tooth buccal anatomy/color
- attrition of incisal edges (after proper occlusal and functional management)
- financial limitations
- young patients with immature gingival profile.

In fact, the aforementioned indications cover the accepted application field of "traditional" veneers, while other mere cosmetic indications are to be considered controversial with this technique. Actually, this veneering system is micro-invasive (minimal tooth

preparation is mandatory); it should not be considered for the esthetic enhancement of virgin, healthy teeth. But when properly indicated and applied, the advantage of this "different" veneering approach is a relatively cost-effective and straightforward solution featuring a "one-appointment" treatment. Likewise, this new, alternative treatment option falls fully under the aforementioned "bio-esthetic concept."[11]

Clinical Application

The case preparation for prefabricated composite veneers does not differ from other functional and esthetic treatments. First comes bleaching of neighboring teeth and/or antagonist arch, followed by replacement of all defective Class III, IV, and IV fillings. The veneering treatment per se involves four main steps: tooth preparation, veneer adjustment, adhesive procedures (on tooth and veneers), followed by cementation **(Figs 4b-4e)**. For cementation, either a dentin or enamel shade can be used, depending on the desired final shade.

This "rejuvenated" technique does not, however, replace conventional "custom-made" ceramic veneers, but rather allows clinicians to offer patients a one-visit, cost-effective alternative to directly (or freehand) built-up composite veneers. This system may also allow clinicians to fill in gaps within their treatment armamentarium with obvious and interesting application potentials, such as the treatment of young patients with localized or generalized hypoplasia/dysplasia or discoloration; and in general when a long-term temporary and highly esthetic solution is needed. With the exception of the need for a meticulous adaptation of the cervical profile and possibly the proximal and incisal edges, the overall preparation and cementation procedures are for the most part very similar to those for indirect porcelain veneers or composite inlays and onlays. Another advantage for both the patient and the dental team is, of course, that no temporaries are needed.

Conclusion

Traditional restorative objectives have not changed over time; they were simply implemented due to the esthetic demands of an increasing number of patients as well as new forms of pathologies. Composite resins then became the material of choice for young patients and cost-conscious patients, or all those who require a strictly conservative approach. These indications embrace highly conservative cosmetic enhancements to comprehensive functional and esthetic rehabilitation of patients suffering from severe tooth wear. We are now also exploring new types of restorations such as prefabricated veneers made of enhanced composite materials.

Composite techniques have benefited from advances in their optical characteristics, such as the "Natural Lay-

Figure 4a: Initial view showing a severely discolored left incisor, which had not improved despite extended bleaching. Due to the patient's financial limitations, a chair-side prefabricated composite veneer was selected (Edelweiss Venear).

Figure 4b: A preparation slightly deeper than usual (micro-invasive) is mandated by the dental substrate darkness.

Figure 4c: Set of veneers showing a very smooth and shiny surface, resulting from surface vitrification.

Figures 4d & 4e: The veneers needed to be adapted in different zones (cervical, proximal, and incisal) in order to follow the preparation outline. Conventional adhesive procedures (sand-blasting, priming, and bonding) were performed on the veneers' internal surfaces.

Figures 4f & 4g: Postoperative views of both central incisors restored during a single session; the advantage of these prefabricated composite veneers are numerous. They provide an ideal tooth anatomy, a high restoration gloss (due to laser vitrification), and reduced treatment time.

ering Concept," enabling more predictable esthetic results to be achieved for all forms of anterior indications. Then, application techniques were refined and made possible the use of composite where we previously would have considered more invasive prosthetic solutions. Finally, the rejuvenation of the "old" concept of prefabricated veneers has again expanded our treatment options; even though this later option does not replace conventional "custom-made" ceramic veneers, it offers a one-visit, cost-effective alternative to direct (freehand) composite veneers and is probably one of the first attempts to use "noble" composite resins, with obvious physical and clinical advantages.

Composite techniques undoubtedly have matured and offer a wide range of successful applications; however, it remains our duty to select their indications with proper judgment without exaggerating or neglecting their many advantages and qualities. And last but not least, one should never forget that dedication and meticulous handling remain the keys to success….no matter what the selected technique is.

Acknowledgment

The author thanks Stephan Lampl, MDT (Edelweiss Dentistry), for providing the images of the case presented in Figures 4 and 5.

Figure 5a: Preoperative view of a patient showing severe tooth wear.

Figure 5b: Following the necessary occlusal anatomy and function changes, this patient's front teeth were restored with heat-pressed, laser-vitrified composite prefabricated veneers.

> "Composite techniques undoubtedly have matured and offer a wide range of successful applications; however, it remains our duty to select their indications with proper judgment without exaggerating or neglecting their many advantages and qualities."

References

1. Macedo G, Raj V, Ritter AV. Longevity of anterior composite restorations. J Esthet Restor Dent. 2006;18:310-1.

2. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. The 5-year clinical performance of direct composite additions to correct tooth form and position. II. marginal qualities. Clin Oral Investig. 1997;1(1):19-26.

3. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. The 5-year clinical performance of direct composite additions to correct tooth form and position. I. esthetic qualities. Clin Oral Investig. 1997;1(1):12-8.

4. Dietschi D, Ardu S, Krejci I. A new shading concept based on natural tooth color applied to direct composite restorations. Quintessence Int. 2006;37:91-102.

5. Magne P, So WS. Optical integration of incisoproximal restorations using the natural layering concept. Quintessence Int. 2008;39:633-43.

6. Dietschi D. Optimizing smile composition and esthetics with resin composites and other conservative esthetic procedures. Eur J Esthet Dent. 2008;3:14-29.

7. Van't Spijker A, Rodriguez JM, Kreulen CM, Bronkhorst EM, Bartlett DW, Creugers NH. Prevalence of tooth wear in adults. Int J Prosthodont. 2009;22(1):35-42.

8. Lussi A, Jaeggi T. Erosion––diagnosis and risk factors. Clin Oral Investig. 2008 Mar;12 Suppl 1:S5-13.

9. Dietschi D, Devigus A. Prefabricated composite veneers: historical perspectives, indications and clinical application. Eur J Esthet Dent. 2011;6:178-87.

10. Cook WD, McAree DC. Optical properties of esthetic restorative materials and natural dentition. J Biomat Mat Res. 1985;19:469-88.

11. Dietschi D, Ardu S, Krejci I. Exploring the layering concepts for anterior teeth. In: Roulet JF, Degrange M, editors. Adhesion: the silent revolution in dentistry. Hanover Park (IL): Quintessence Pub.; 2000. p. 235-51.

12. Dietschi D, Ardu S, Krejci I. A new shading concept based on natural tooth color applied to direct composite restorations. Quintessence Int. 2006;37:91-102.

13. Ubassy G. Shape and color: the key to successful ceramic restorations. Berlin: Quintessenz Verlag; 1993.

14. Dietschi D. Free-hand composite resin restorations: a key to anterior aesthetics. Pract Periodont Aesthet Dent. 1995;7(7):15-25.

15. Dietschi D. Free-hand bonding in esthetic treatment of anterior teeth: creating the illusion J Esthet Dent. 1997;9:156-64.

16. Dietschi D. Layering concepts in anterior composite restorations. J Adhesive Dent. 2001;3(1):71-80.

17. Litonjua LA, Andreana S, Bush PJ, Cohen RE. Tooth wear: attrition, erosion, and abrasion. Quintessence Int. 2003;34:435-46.

18. Lavigne GJ, Khoury S, Abe S, Yamaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. J Oral Rehabil. 2008;35:476-94.

19. Lavigne GJ, Kato T, Kolta A, Sessle BJ. Neurobiological mechanisms involved in sleep bruxism. Crit Rev Oral Biol Med. 2003;14(1):30-46.

20. Lussi A, Hellwig E, Zero D, Jaeggi T. Erosive tooth wear: diagnosis, risk factors and prevention. Am J Dent. 2006;19:319-25.

21. Zero DT, Lussi A. Erosion—chemical and biological factors of importance to the dental practitioner. Int Dent J. 2005;55(4 Suppl 1):285-90.

22. Lussi A, Jaeggi T, Zero D. The role of diet in the aetiology of dental erosion. Caries Res. 2004;38 Suppl 1:34-44.

23. Mahoney EK, Kilpatrick NM. Dental erosion: part 1. Aetiology and prevalence of dental erosion. NZ Dent J. 2003;99:33-41.

24. Ibsen RL, Ouellet DF. Restoring the worn dentition. J Esthet Dent. 1992;4:96-101.

25. Christensen G. A new technique for restoration of worn anterior teeth. J Am Dent Assoc. 1995;126:1543-7.

26. Marais JT. Restoring palatal tooth loss with composite resin, aided by increased vertical height. J South African Dent Assoc. 1998;53:111-9.

27. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. J Prosthet Dent. 2003 Jul;90(1):31-41.

28. Scurria MS, Bader JD, Shugars DA. Meta-analysis of fixed partial denture survival: prostheses and abutments. J Prosthet Dent. 1998 Apr;79(4):459-64.

29. Satterthwaite JD. Indirect restorations on teeth with reduced crown height. Dent Update. 2006;33:210-2, 215-6.

30. Cutbirth ST. Increasing vertical dimension: considerations and steps in reconstruction of the severely worn dentition. Pract Proced Aesthet Dent. 2008;20:619-26.

31. Robinson S, Nixon PJ, Gahan MJ, Chan MF. Techniques for restoring worn anterior teeth with direct composite resin. Dent Update. 2008;35:551-2, 555-8.

32. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 1. Eur J Esthet Dent. 2008;3:30-44.

33. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 2. Eur J Esthet Dent. 2008;3:128-46.

34. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 3. Eur J Esthet Dent. 2008;3:236-57.

35. Hemmings KW, Darbar UR, Vaughan S. Tooth wear treated with direct composite restorations at an increased vertical dimension: results at 30 months. J Prosthet Dent. 2000;83:287-93.

36. Bartlett D, Sundaram G. An up to 3-year randomized clinical study comparing indirect and direct resin composites used to restore worn posterior teeth. Int J Prosthodont. 2006;19:613-7.

37. Gow AM, Hemmings KW. The treatment of localised anterior tooth wear with indirect Artglass restorations at an increased occlusal vertical dimension. Results after two years. Eur J Prosth Restor Dent. 2002;10:101-5.

38. Luther F. TMD and occlusion part II. damned if we don't? functional occlusal problems: TMD epidemiology in a wider context. Br Dent J. 2007;202:38-9.

39. Michael JA, Townsend GC, Greenwood LF, Kaidonis JA. Abfraction: separating fact from fiction. Aust Dent J. 2009;54(1):2-8.

40. Van 't Spijker A, Kreulen CM, Creugers NH. Attrition, occlusion, (dys)function, and intervention: a systematic review. Clin Oral Implants Res. 2007;18:117-26.

41. Redman CD, Hemmings KW, Good JA. The survival and clinical performance of resin-based composite restorations used to treat localised anterior tooth wear. Brit Dent J. 2003;194:566-72.

42. Poyser NJ, Briggs PF, Chana HS, Kelleher MG, Porter RW, Patel MM. The evaluation of direct composite restorations for the worn mandibular anterior dentition––clinical performance and patient satisfaction. J Oral Rehabil. 2007;34:361-76.

43. Smales RJ, Berekally TL. Long-term survival of direct and indirect restorations placed for the treatment of advanced tooth wear. Eur J Prosthodont Restor Dent. 2007;15(1):2-6.

44. Pincus CL. Building mouth personality. Paper presented at California State Dental Association, San Jose, California, 1937.

45. Faunce FR, Myers DR. Laminate veneer restoration of permanent incisors. J Am Dent Assoc. 1976;93:790-2.

46. Helpin LM, Fleming JE. Laboratory technique for the laminate veneer restoration. Pediatr Dent. 1982;4:48-50.

47. Haas BR. Mastique veneers: a cosmetic and financial alternative in post-periodontal care. J NJ Dent Assoc. 1982;53:25-7.

48. Jensen OE, Soltys JL. Six months clinical evaluation of prefabricated veneer restorations after partial enamel removal. J Oral Rehabil. 1986;13:49-55.

49. Rochette AL. A ceramic restoration bonded by etched enamel and resin for fractured incisors. J Prosthet Dent. 1975;33:287-93.

50. Calamia JR. Etched porcelain facial veneers: a new treatment modality based on scientific and clinical evidence. NY J Dent. 1983;53:255-9. **jCD**

Dr. Dietschi is a senior lecturer, Department of Cariology & Endodontics, School of Dentistry, University of Geneva, Switzerland. He also is an adjunct professor, Department of Comprehensive Dentistry, Case Western Reserve University. Dr. Dietschi is in private practice at the Geneva Smile Center, in Geneva, Switzerland.

Disclosure: The author has financial interest in and/or material support from Coltène/Whaledent.

AACD Self-Instruction Continuing Education Information

3 Hours Credit

General Information

This continuing education (CE) self-instruction program has been developed by the American Academy of Cosmetic Dentistry (AACD) and an advisory committee of the *Journal of Cosmetic Dentistry*.

Eligibility and Cost

The exam is free of charge and is intended for and available to AACD members only. It is the responsibility of each participant to contact his or her state board for its requirements regarding acceptance of CE credits. The AACD designates this activity for 3 continuing education credits.

Testing and CE

The self-instruction exam comprises 10 multiple-choice questions. To receive course credit, AACD members must complete and submit the exam and answer at least 70% of the questions correctly. Participants will receive tests results immediately after taking the examination online and can only take each exam once. The exam is scored automatically by the AACD's online testing component. The deadline for completed exams is one calendar year from the publication date of the issue in which the exam appeared. The exam is available online at www.aacd.com. A current web browser is necessary to complete the exam; no special software is needed.

Note: Although the AACD grants these CE credits, it is up to the receiving governing body to determine the amount of CE credits they will accept and grant to participants.

Verification of Participation (VOP)

VOP will be sent to AACD members via their MyAACD account upon pass completion. Log onto www.aacd.com to sign into your MyAACD account.

For members of the Academy of General Dentistry (AGD): The AACD will send the AGD proof of your credits earned on a monthly basis. To do this, AACD must have your AGD member number on file. Be sure to update your AGD member number in your AACD member profile on MyAACD.com.

All participants are responsible for sending proof of earned CE credits to their state dental board or agency for licensure purposes.

Disclaimer

AACD's self-instruction exams may not provide enough comprehensive information for participants to implement into practice. It is recommended that participants seek additional information as required. The AACD Self-Instruction Program adheres to the guidelines set forth by the American Dental Association Continuing Education Recognition Program (CERP), and the AGD Program Approval for Continuing Education (PACE).

Questions and Feedback

For questions regarding a specific course, information regarding your CE credits, or to give feedback on a CE self-instruction exam, please contact the AACD Executive Office by e-mailing meetings@aacd.com or by calling 800.543.9220 or 608.222.8583.

Academy of General Dentistry
PACE Program Approval for Continuing Education

ADA C·E·R·P Continuing Education Recognition Program
American Academy of Cosmetic Dentistry is an ADA CERP Recognized Provider

CDT CONTINUING APPROVED EDUCATION

ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP does not approve or endorse individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry. AACD designates this activity for 3 continuing education credits. Concerns or complaints about a CE provider may be directed to the provider or to ADA CERP at www.ada.org/goto/cerp.

(CE) Exercise No. JCD05

Operative (Restorative) Dentistry

AGD Subject Code: 250

The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article, "Current Status & Future Perspectives for the Use of Composite Resins in the Smile Frame," by Didier Dietschi, DMD, PhD. This article appears on pages 112-127.

The examination is free of charge and available to AACD members only. AACD members must log onto www.aacd.com to take the exam. **Note that only Questions 1 through 5 appear here in the printed version of the jCD; they are for readers' information only.** The complete, official self-instruction exam is available online only—completed exams submitted any other way will not be accepted or processed. A current web browser is necessary to complete the exam; no special software is needed. The AACD is a recognized credit provider for the Academy of General Dentistry, American Dental Association, and National Association of Dental Laboratories. For any questions regarding this self-instruction exam, call the AACD at 800.543.9220 or 608.222.9540.

1. In comparing ceramic and composite restorations, the author believes that

a. ceramics remain the preferred esthetic option for many clinicians due to their ability to conserve tooth structure.
b. direct bonded composite restorations remain the preferred esthetic option for many clinicians due to their ability to conserve tooth structure.
c. direct bonding techniques are still considered intricate, sensitive and, to a certain degree, unpredictable.
d. laboratory-fabricated composite veneers are outdated and have been replaced by full-coverage porcelain restorations.

2. The concept of "bio-esthetics" refers to the

a. utilization of concepts learned through the study of biology to restore teeth with the most natural materials available.
b. idea of giving priority to additive, minimally invasive procedures to preserve tooth biology and biomechanics.
c. beauty of the underlying biology and necessitates the use of materials such as porcelain to achieve an optimal result.
d. processing of a restoration such that it duplicates a natural tooth in ways including hardness and the scattering of light.

3. Current direct bonded composite systems

a. have optical properties that have simplified their application techniques.
b. show that freehanded anterior bonding has limited usefulness compared to porcelain.
c. are currently unacceptable for the functional rehabilitation of patients with severe wear.
d. are less technique-sensitive than bonded porcelain systems.

4. Prefabricated composite veneers are

a. made indirectly by a technician, and therefore are less expensive.
b. more technique-sensitive and time-consuming.
c. prone to imperfections such as bubbles, and insufficient curing and polishing.
d. molded under heat and pressure to create a high-quality restoration.

5. Indirect composite restorations are best indicated for

a. the treatment of Class III, IV, and V lesions.
b. correcting lateral incisor aplasia.
c. severe tooth discoloration not treatable by bleaching.
d. congenital deficiencies such as hypoplasia.

To see and take the complete exam, log onto www.aacd.com.

"PEARLS" FOR PLACING POSTERIOR COMPOSITES

Amanda N. Seay, DDS, Mount Pleasant, SC

Placing posterior composites is a skill that every dentist needs to know how to do no matter what type of practice they may have. While the amount of time spent and the fee may vary greatly from one practice to another, there are a few "pearls" that we can all use to place beautiful posterior composites.

I have learned some amazing techniques from educators like Dr. Newton Fahl, but then we all take bits and pieces of what we learn and apply it to our everyday dentistry. Here is my quick system for all posterior composites.

1. Mark the centric and eccentric contact to get an understanding of the proper contours and anatomy before you begin. This takes just five seconds (Fig 1).
2. After rubber dam is placed, tooth is prepared, and bonding protocol completed....place flowable first—always!
3. A two-shade composite system can work as fast as a one-shade system. Use either a dentin A3.5 or dentin A3. It works every time as long as it is placed where dentin should be anatomically. Then use the enamel shade of what you want the restoration to be. A milky-white translucent shade almost always works (Fig 2)!
4. Sculpt the anatomy...make dots in the composite where the pits should be and connect the dots by "drawing" in the sulci. Use a fine-tipped instrument to do this. You instantly have natural-looking anatomy that gives a beautiful result (Fig 3).
5. Smooth with a dry sable brush and cure (Fig 4).

This is simple and anyone can do it. If you wanted to do more artistry then you can add some higher value bleach shades to the triangular ridges, create some tertiary anatomy with an extra-fine tipped instrument (explorer or endo file), and add some stain to the grooves. **jCD**

Figure 1: Existing preventive composite restoration that was failing, along with pit fissure decay on #18 and #19.

Figure 2: Composite shade A3 dentin placed to rebuild anatomy of the dentin.

Figure 3: Milky white enamel shade composite placed to rebuild anatomy of the enamel.

Figure 4: Final restorations that deliver excellent esthetics in very little time.

Advertiser Index

Immediate high strength bonds you can rely on.

Easy Clean-Up Formula!

Developed to maximize the performance of indirect restorations, Multilink® Automix creates a strong immediate bond between dentin & enamel, and all types of restorative materials providing security you and your patients can rely on.

- High-immediate bond strengths to all types of restorative materials
- Fast, easy clean-up
- Self-etching primer for reduced sensitivity

Recommended for IPS e.max®

Multilink® Automix
UNIVERSAL ADHESIVE CEMENT

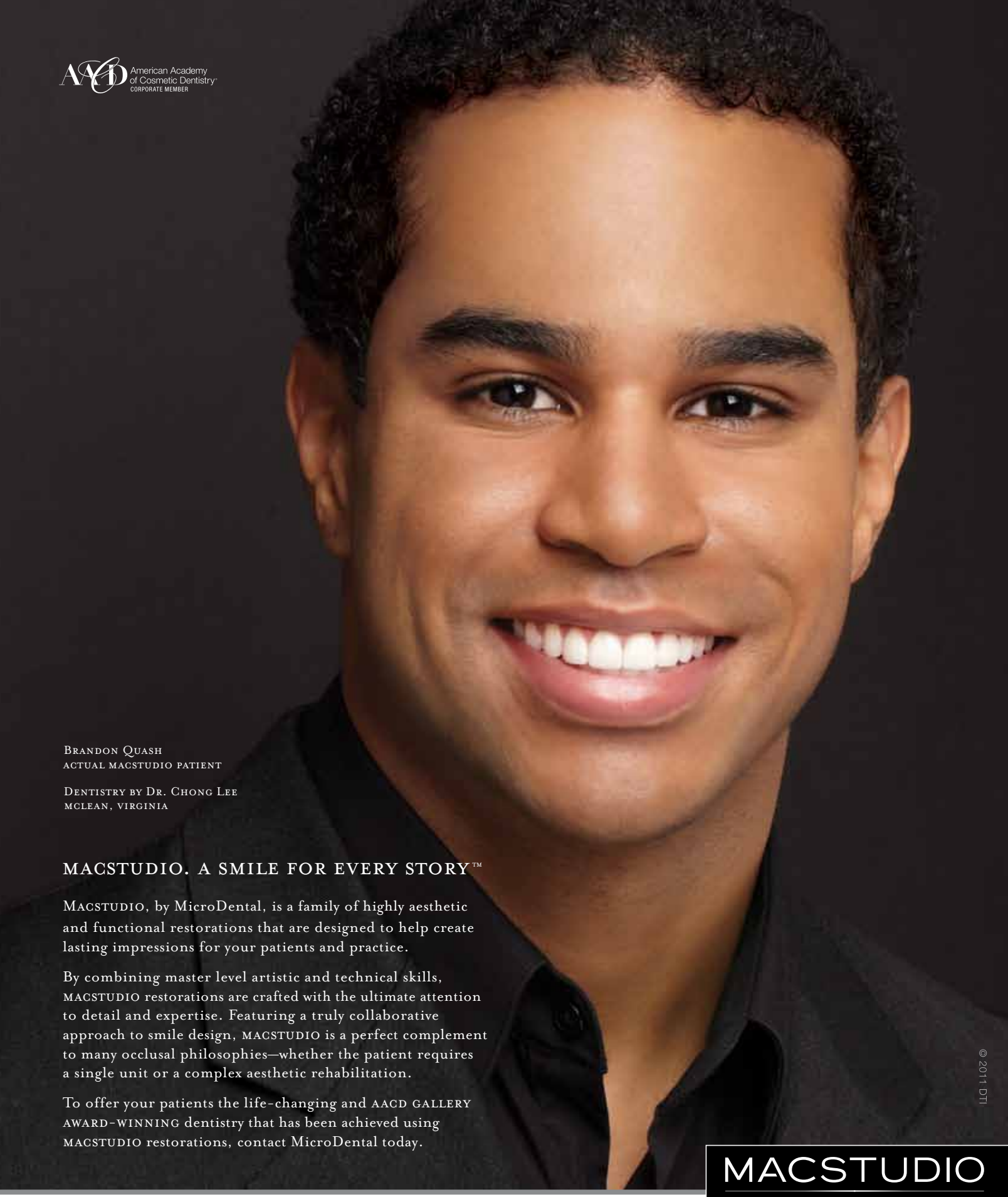
100% CUSTOMER SATISFACTION GUARANTEED!

ivoclarvivadent.com/multilink

Call us toll free at 1-800-533-6825 in the U.S., 1-800-263-8182 in Canada.

©2011 Ivoclar Vivadent, Inc. Multilink is a registered trademark of Ivoclar Vivadent, Inc.

ivoclar vivadent®
passion vision innovation



American Academy of Cosmetic Dentistry
CORPORATE MEMBER

Brandon Quash
actual macstudio patient

Dentistry by Dr. Chong Lee
mclean, virginia

MACSTUDIO. A SMILE FOR EVERY STORY™

Macstudio, by MicroDental, is a family of highly aesthetic and functional restorations that are designed to help create lasting impressions for your patients and practice.

By combining master level artistic and technical skills, macstudio restorations are crafted with the ultimate attention to detail and expertise. Featuring a truly collaborative approach to smile design, macstudio is a perfect complement to many occlusal philosophies—whether the patient requires a single unit or a complex aesthetic rehabilitation.

To offer your patients the life-changing and aacd gallery award-winning dentistry that has been achieved using macstudio restorations, contact MicroDental today.

© 2011 DTI

MACSTUDIO
BY MICRODENTAL LABORATORIES

DUBLIN, CALIFORNIA 800.229.0936
LAS VEGAS, NEVADA 800.933.6838
VANCOUVER, BC 800.561.0926