

# jcd

vol. 28 issue 3

Journal of Cosmetic Dentistry

## Occlusion Philosophies—

More Alike than Different

Insights from Pioneers, Educators, and Mentors

The Significance of Occlusal Influences on Function

FALL 2012

**AAO** American Academy  
of Cosmetic Dentistry®

# Introducing the Future of Composite Technology



The first high-performance posterior composite with **Ivocerin™**

Ivocerin is a patented photo-initiator that is more reactive to curing than conventional initiators resulting in a deeper, more efficient cure. Tetric EvoCeram Bulk Fill now features:

- **Single-layer placement** up to 4mm for faster procedures
- **Low shrinkage** and low shrinkage stress for superior margins
- **Nano-filler technology** for improved strength, high-gloss polish and low wear



To receive your **FREE sample** or to learn more about Tetric EvoCeram Bulk Fill and Ivocerin log onto [www.ivoclarvivadent.us/tetric](http://www.ivoclarvivadent.us/tetric)

100% CUSTOMER SATISFACTION  
GUARANTEED!

[ivoclarvivadent.com](http://ivoclarvivadent.com)

Call us toll free at 1-800-533-6825 in the U.S., 1-800-263-8182 in Canada. © 2012 Ivoclar Vivadent, Inc. Ivocerin is a trademark of Ivoclar Vivadent. Ivoclar Vivadent and Tetric EvoCeram are registered trademarks of Ivoclar Vivadent, Inc.

**Tetric EvoCeram® Bulk Fill**  
Nano-Hybrid Composite with Ivocerin™

**ivoclar**  
**vivadent**  
passion vision innovation

# jcd

vol. 28 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, allison@cremedellacreme.org

#### 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. Peyton, DDS, FAACD, Bakersfield, CA  
J.A. Reynolds, DDS, AAACD, Franklin, TN  
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 P. Allen, DDS, PhD, Dallas, TX  
Elizabeth M. Bakeman, DDS, FAACD, Grand Rapids, MI  
Oliver Brix, MDT, Kelkheim, Germany  
Christian Coachman, DDS, CDT, São 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, FAACD, FICD, Atlanta, GA  
Steve D. Hoofard, CDT, AAACD, Hermiston, OR  
Nelson Y. Howard, DDS, AAACD, San Marcos, CA  
Ronald D. Jackson, DDS, FAACD, Middleburg, VA  
Sang K. Jun, CDT, Monterey, CA  
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 A. 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 III, DDS, AAACD, Nashville, TN  
W. Peter Nordland, DMD, MS, La Jolla, CA  
Paul S. Petrunaro, 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

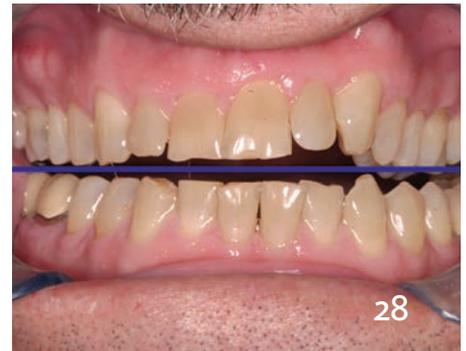
## Reprints

High-quality reprints with possible customization are available for authors and advertisers. Please contact Hope.robinson@sheridan.com, Content Sales Specialist who will work with you to get the exact reprint you would like for your presentations, lectures, or patient literature.

Features

- 28 Visually Speaking  
Are We Asking Function to Follow Form? ♦  
*Christopher J. Stevens, DDS*
- 36 Clinical Cover Story  
Careful Planning to Replace Congenitally Missing Teeth ♦  
*Thomas E. Oppenheim, DMD, FAACD*
- 46 Myths vs. Realities  
LVI Neuromuscular Dentistry Philosophy ♦  
*William G. Dickerson, DDS, LVIM*
- 56 10 Steps  
The Myth of Anterior Guidance ♦  
*Elizabeth M. Bakeman, DDS, FAACD*  
*John Kois, DMD, MSD*
- 64 Timeless Principles in Esthetic Dentistry ♦  
*John C. Cranham, DDS*  
*Scott W. Finlay, DDS, FAGD, FAACD*
- 74 Freedom to Believe ♦  
*Peter E. Dawson, DDS*
- 82 Functional and Esthetic Challenges ♦  
*Amanda N. Seay, DDS*  
*Brad Patrick, BSc*
- 94 Force and Failure ♦  
*Lee Ann Brady, DMD*  
*Gary M. DeWood, DDS, MS*
- 104 Minimally Invasive & Comprehensive Rehabilitation of Severe Tooth Wear & Extensive Decay ♦  
*Didier Dietschi, DMD, PhD*
- 118 Critical Factors of Occlusion ♦  
*DeWitt C. Wilkerson, DMD*
- 126 Are Occlusion and Comprehensive Dentistry Really that Important? (CE Article) ♦  
*Gary Alex, DMD, AAACD*

- 144 AACD Self-Instruction Continuing Education ♦
- 146 Product Review  
Material Selection for Accurate Bite Registrations ♦  
*Sabiha S. Bunek, DDS*
- 150 Advertising Index



Columns

- 8 Editor's Message  
Occlusal Harmony—  
Many Approaches...Similar Goal  
*Edward Lowe, DMD, AAACD*
- 10 Up Front  
Occlusion: The Current State  
of the Art ♦  
*John N. Nasedkin, DDS, FRCD(C), FADM*

educate | inspire | connect

# AACD 2013

Seattle

**Featuring:** Betsy Bakeman, DDS,  
Newton Fahl, Jr., DDS, David Garber, DMD, John  
Kois, DMD, Jacinthe Paquette, DDS,  
Maurice Salama, DMD, Cherilyn Sheets, DDS, Frank  
Spear, DDS, and more!

\*Educators subject to change



[www.AACDconference.com](http://www.AACDconference.com)

April 24 - 27, 2013

29<sup>th</sup> Annual AACD Scientific Session



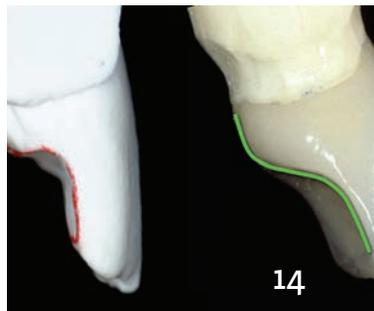
**AACD** American Academy  
of Cosmetic Dentistry

## Departments

- 12** Behind the Smile  
**When Aspiration Meets Passion**  
*Thomas E. Oppenheim, DMD, FAACD*
- 14** Speaker Spotlight  
**Candid Advice Regarding the Complexities of Occlusion** ♦  
*Frank Spear, DDS, MSD*
- 24** Accreditation Essentials  
**Charting Your Course** ♦  
*Tiffany Stronghart*



12



14



24



## 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.



### 2012 Statement of Ownership, Management and Circulation

Statement of Ownership, Management and Circulation, required by Title 39, United States Code 3685. Title of publication: *The Journal of Cosmetic Dentistry*. Date of filing: September 18, 2012. 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): 7153.50; mailed outside-county paid subscriptions stated on PS Form 3541: 5790.75 paid distribution by other classes of mail through the USPS: 20.75; Total paid distribution: 5811.50; Free or nominal rate copies mailed at other classes through the USPS: 31.25; Free or nominal rate distribution: 26.75; Total free or nominal rate distribution: 58; Total distribution: 5869.50; copies not distributed: 1284; Percent paid: 99. Number of copies of single issue published nearest to filing date: Total number of copies (net press run): 6801; mailed outside-county paid subscriptions stated on PS Form 3541: 5457; paid distribution by other classes of mail through the USPS: 19; Total paid distribution: 5476. Free or nominal rate copies mailed at other classes through the USPS: 23; Free or nominal rate distribution outside the mail: 0; Total free or nominal rate distribution: 23; Total distribution: 5499; copies not distributed: 1302; Percent paid: 99.5. I certify that all information furnished is correct and complete. Signed Tracy Skenandore, Managing Editor.

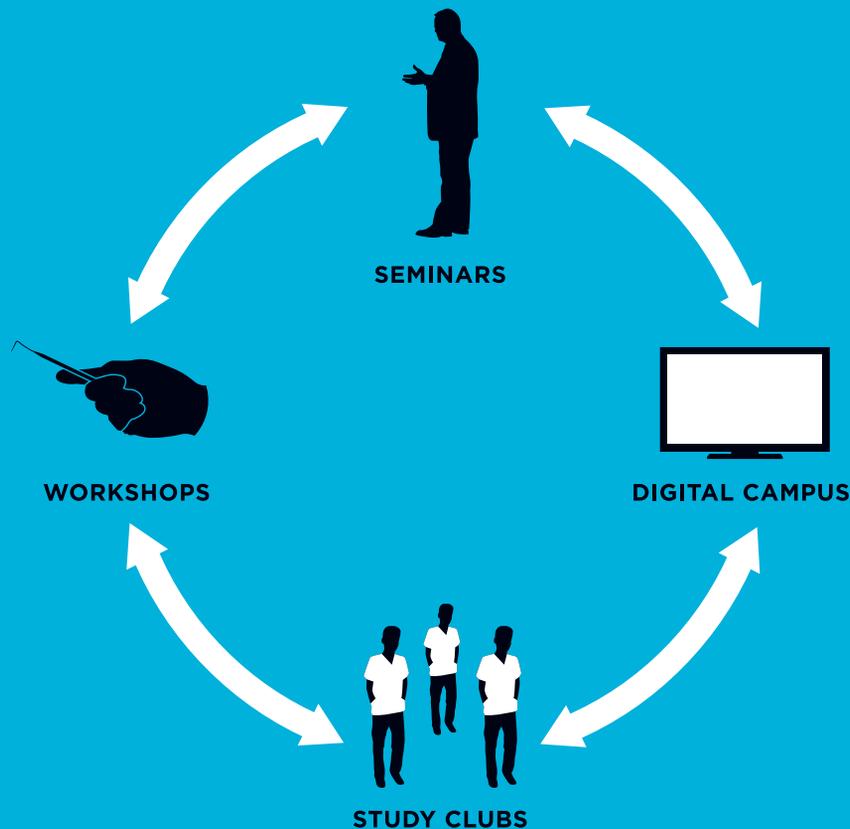
POSTMASTER: send address changes to:  
Journal of Cosmetic Dentistry  
American Academy of Cosmetic Dentistry  
402 West Wilson Street  
Madison, WI 53703

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® 2012 American Academy of Cosmetic Dentistry®

The *Journal of Cosmetic Dentistry* maintains signed patient release forms for all articles featuring clinical or other patient photography.

You'll thrive in our ecosystem  
of clinical education.



Our ecosystem of clinical education creates a rich learning environment that you can absorb at your own pace and comfort level. Make your practice more successful by choosing the educational elements that suit you best, and using them however you choose, whenever you like.

We offer a variety of ways for you to learn about new techniques, effective tools, and cutting-edge products. From seminars and study clubs to customized digital delivery of courses, Spear's education is designed to help you excel. Learn differently. Learn faster. Learn your way.

[speareducation.com](http://speareducation.com) 866.781.0072

# Occlusal Harmony— Many Approaches...Similar Goal



**This issue of *jCD* celebrates the diversity of methods we share when it comes to occlusion and the function of the masticatory system.**

There was no doubt from the beginning that this topic would be a challenge to coordinate, as the very mention of the word *occlusion* divides dentists into their own corner of the occlusion philosophy "ring." Never has there been a topic where supporters assert the superiority of their own approach more fervently.

At the end of the day we must focus on treating each patient to the best of our abilities. There is no room to be dogmatic about any one approach. Rather, clinicians can combine the best of several occlusion viewpoints to create their own personal treatment modality.

I found occlusion to be uninteresting when I was in dental school. I wanted to drill and fill teeth, grind them down to make crowns and bridges, straighten them with perfect midlines, file and obturate their root canals. Occlusion? Why would I care about how teeth work together in relation to the jaw and muscles?

**There is no room to be dogmatic about any one approach.**

But times have changed. Today, I would have to say that occlusion is the foundation of everything I do

in dentistry. Learning about the various ways to restore the teeth and masticatory system is a commitment we must make to ourselves and to our patients.

Comprehensive cosmetic dentistry without a solid knowledge of occlusion is unwise and risky. It invites failure and consequently, ill feelings between clinicians and patients. It gives cosmetic dentists a reputation as unscrupulous hawkers of esthetics without consideration for form or function. The days of cosmetic dentistry being about dentofacial appearance at any cost are gone.

It is easy to say you are a cosmetic dentist. Most dentists do. However, in order to be an exceptional one, you must have a solid understanding of the various occlusion philosophies and their role in the function of the masticatory system. The way the teeth come together and their function is critical in the overall care of the patient. So what do you want to be...mediocre, or exceptional?

My profound thanks to all the educators who have contributed insightful articles to this issue of *jCD*. I appreciate your professionalism and candor in writing on a subject that engenders so much passion in us all.

Cheers,

A handwritten signature in black ink that reads "Edward Lowe".

Edward Lowe, DMD, Editor-In-Chief  
AACD Accredited Member



# WE DON'T HAVE A B TEAM.

OUR TEAM IS YOUR TEAM. The members on the LK Dental Studio team of technicians are some of the best in the world, each with between 12 and 40 years of dental laboratory experience in occlusion, implants and cosmetic dentistry. We work intimately with you and for you, providing quality restorations reflective of your desires and individualized technical preferences. But we're not just a high-end boutique laboratory. As a full-service, price-competitive dental laboratory, LK Dental Studio can provide you with a full range of products, from traditional PFM crowns and bridges, to implants, to partials and dentures. Let us help you deliver the best. We look forward to beginning a partnership with you that we intend to earn... case after case!

*Laura Kelly* A.A.C.D.

2007-2008 PRESIDENT  
American Academy  
of Cosmetic Dentistry  
ACCREDITED MEMBER

## YOU NEED IMPLANTS WE KNOW IMPLANTS

*The LK Dental Studio implant team is your I-Team, here to provide you with:*

- expert case implant planning, scanning and fabrication
- dedicated I-Team member, fellowship in ICOI
- continuing education partnerships with key implant companies

## YOU NEED ESTHETICS WE KNOW ESTHETICS

*LK Dental Studio provides you with some of the most skilled and experienced technicians in the dental laboratory world:*

- technical expertise with occlusion and esthetics
- masters with eMAX™ Empress Esthetic™ Lava™ and feldspathic technique
- work directly with your own technician

## YOU NEED SERVICE WE KNOW SERVICE

*We are here to do everything we can to make your life easier and, ultimately, your patients' dreams come true, including:*

- concierge service, without a concierge price
- complimentary custom shades
- 24/7 access whenever you need us

*"LK Dental Studio provides amazing esthetic results and finely crafted restorations for my implant prosthetics. I rely on their expertise in the planning and successful execution of my cases..."*

SAM STRONG D.D.S.

*"I recently needed two of my own ceramic crowns replaced and chose LK Dental Studio for the case....The shade matches and fit were right on the money and the occlusion was dialed in just the way I wanted..."*

JEFF MORLEY D.D.S., F.A.A.C.D.  
CO-FOUNDER, AMERICAN ACADEMY  
OF COSMETIC DENTISTRY  
JEFFMORLEY.COM

DENTAL **LK** STUDIO



John N. Nasedkin  
DDS, FRCD(C), FADM

## Occlusion: The Current State of the Art

*Up Front* provides a forum for influential leaders to share their opinions. In this issue, we welcome Vancouver prosthodontist Dr. John Nasedkin, whose primary experience is in esthetic dentistry, prosthetic dentistry, and bite and jaw problems. The views expressed in *Up Front* reflect the opinions of the author. They do not imply an opinion on the part of *JCD* or the AACD.

Thirty-six years ago, *Occlusion: The State of the Art*<sup>1</sup> attempted to break down barriers between different groups and their approaches to occlusion.

Three major points were agreed:

- The optimum condylar position at maximum intercuspation involves the condyle on the disk in an anterior-superior position in the fossae.
- The intercuspal position is bilateral simultaneous tooth contacts, either cusp-fossa or cusp-marginal ridge. Forces are best directed down long axes of teeth. Anterior teeth should be just out of contact. Some freedom in centric (slight anterior movement) is acceptable.
- In terms of eccentric relationships, a canine or mutually protected occlusion without balancing contacts is most desirable.

In 2012 these tenets continue to be widely accepted as what Guichet termed "the criteria of an optimum occlusion."<sup>2</sup>

What accounts for the continuing controversy?

Occlusion is more than the contact of teeth and involves the entire stomatognathic (chewing) system. The neuromusculature and all aspects of pain, the structural components, and the temporomandibular joints must be considered.

As dentistry has become more evidence-based we have built up considerable documentation in regard to neuromotor activity. Bite refinement has moved from routine to controversial. Dr. Charles Greene's assertions do not help to clarify matters.<sup>3</sup>

Dental school graduates today are

poorly educated in occlusion, due to reductions in teaching time. The continuing education programs offered by the presenting authors and others do, however, provide training both in diagnosis and in the development of needed clinical skillsets.

Most mature mouths in the developed world today suffer from micro-malocclusion. Teeth are retained longer and numerous fillings and other dental procedures have altered the way most people's teeth mesh. Additional macro-trauma and excessive orofacial muscle tension can place undue force on the remaining dental units, resulting in bony exostoses, fractured teeth, broken fillings, periodontal reactions, and worn restorations. All-ceramic and composite restorations can leak and fracture and are subject to degradations related to material or to the hostile oral environment. Correction of micro-malocclusions secures patient comfort; it is why equilibration is still critical to general and specialist dentistry.

Computerized occlusal analysis is essential for dealing with implants that move mere micrometers and teeth with periodontal membranes that allow movement of 50 to 100 microns. Such devices can be used to time load so that natural teeth contact first and implants are loaded last.

New technology with CAD/CAM-fabricated restorations made from industrially processed composites make for long-term overlays and temporary restorations. As we interface more frequently with CT scans, three-dimensional diagnostics, and

orthodontic and surgical treatment planning, the quality of our patient services is markedly enhanced. Many intraoral scanners are now available that use common computer interfaces without system bias to communicate with diagnostic and laboratory centers.

A virtual articulator is on the way. It is possible to predict the advent of cast- or model-free dentistry. Articulating ribbon will be replaced with new bite-sensing wafers to be scanned in the office for occlusal contact interpretation.

The contents of this issue of *JCD* define the current state of the art and science of occlusion. Leaders in this field whose work may be relied upon by clinical practitioners offer thought-provoking articles and valuable insights. We are confident that evidence is being discovered to confirm the clinically important relationships that we apply in daily practice. Occlusion and its effective management for patient comfort and health is vitally important for the cosmetic and general dentist of today.

### References

1. Celenza FV, Nasedkin JN. *Occlusion: the state of the art*. Chicago: Quintessence Pub.; 1978.
2. Guichet NF. *Occlusion: a teaching manual*. Anaheim (CA): Denar Corp.; 1977. 51 p.
3. Greene CS. Managing the care of patients with temporomandibular disorders: a new guideline for care. *J Am Dent Assoc*. 2010;141:1086-8.

# When No-Interest payments aren't affordable for patients,

## Do you have an attractive alternative?

**Springstone Has No-Interest\* Plans PLUS the Best Rates for Extended Plans**

<b>Case Size</b>	<b>12 Month No-Interest Payment</b>	<b>Our Extended Plan LOWEST Payment</b>
\$5,000	\$417	\$102 60 mo. @ 7.99% APR*
\$10,000	\$834	\$181 72 mo. @ 8.99% APR
\$20,000	\$1,667	\$334 84 mo. @ 9.99% APR
\$40,000	N/A	\$667 84 mo. @ 9.99% APR

- Lowest monthly payment available
- Fixed rates as low as **3.99% APR\***
- Plans to **\$40,000**

\* For plan details, please visit [springstoneplan.com](http://springstoneplan.com).

**Call 800-630-1663**  
**Visit [meetspringstone.com](http://meetspringstone.com)**



# *When Aspiration*



Sarah, a rather shy college student and aspiring model, had recently completed orthodontic therapy when her orthodontist referred her to me. The referral was primarily for a fixed replacement of the congenitally missing lateral incisors, but during the consultation, it became apparent that Sarah had other specific concerns that were equally important to her. In addition to being embarrassed about the overall dingy, mottled discoloration of her teeth, she felt that one of her front teeth was noticeably “tilted and uneven” and that her eye teeth seemed somewhat “short and stubby.” Sarah wanted a perfectly straight, bright, white smile, and she wanted it “yesterday.”

Because of her school schedule, active lifestyle, and travel distance to our office, as well as her desire to immediately pursue a modeling career, Sarah wanted her treatment completed in as expeditious a manner as possible. After a detailed discussion of the treatment options with Sarah and her parents, implants were not considered an option for various reasons. Choosing bridges over implants was simply a preference for Sarah and her family due to their time constraints.

It was then mutually decided that two three-unit fixed bridges would be utilized, not only to replace the lateral incisors, but also to create a more pleasing proportion and arrangement to the entire anterior sextant. Four veneers on the bicuspids would be key to completing the enhancement of the entire esthetic landscape through expansion of the buccal corridors and by creating an ideal anterior/posterior gradation of Sarah’s teeth from a lateral perspective. Among the important fringe benefits to Sarah’s treatment were the optimized occlusion and improved functional dynamics that were incorporated within the final outcome. Previously nonexistent anterior stops were solidified, while balanced excursive and bilateral protrusive contacts were created for the sake of healthy longevity.

# *Meets Passion*

*“It has been said that the fortunate among us are those who have found our passion.”*

Clichés such as “Change your Smile, Change your Life!” are often overused in dental marketing circles. However, during Sarah’s initial checkup after completion of her treatment, it was readily evident that there was a dramatic change in her personality. No longer shy, she was overflowing with self-confidence. Sarah stated how her new smile has affected every single area of her life, including her relationships and modeling career. In Sarah’s words, “No one will ever know how this has truly changed my life!”

I consider myself lucky to have participated in what was a meaningful milestone in Sarah’s life. It is very rewarding to have the opportunity to directly impact someone’s appearance and self-esteem in such a positive way. These types of situations always remind me of how extremely grateful I am to have chosen dentistry as my profession. Properly planned and well-executed esthetic restorative dentistry can profoundly influence our patients’ lives in amazing ways, both tangible and intangible. It has been said that the fortunate among us are those who have found our passion. I count myself blessed to be one of the fortunate.

For more information on the clinical aspects of this case, please turn to page 36.

*Restorative dentistry and clinical images: Thomas E. Oppenheim, DMD, FAACD (Thomasville, GA). Laboratory technician: Sandra Cook, CDT, AAACD (Idaho Falls, ID). Cover photography: Todd Stone (Leesburg, GA). Cover photograph shot with a Nikon D700 camera (Nikon Inc.; Melville, NY).*



**Preoperative**



**Postoperative**

# Candid Advice Regarding the Complexities of Occlusion

## An Interview with Dr. Frank Spear—Occlusion Master

Frank Spear, DDS, MSD

Renowned educator Frank Spear, DDS, MSD, will be speaking at the 29th Annual AACD Scientific Session in Seattle, Washington, on April 25, 2013. His topic will be "A Systematic Approach to Achieving Esthetic Excellence in Patients with Anterior Esthetic Challenges." In this interview, Dr. Spear answers thought-provoking questions from the *Journal of Cosmetic Dentistry* Editorial Review Board.

**Q:** What do you believe is your single most important contribution to dentistry?

**A:** I believe taking complex topics—particularly complex treatment-planning topics, such as the worn dentition—and making them understandable and manageable through a systematic approach to treatment planning and treatment, then communicating that in a very clear and understandable way, has probably been my biggest contribution to dentistry.

**Q:** How have your teaching approaches evolved through the years regarding helping dentists incorporate occlusal considerations in their diagnoses and treatment plans?

**A:** I think the biggest change for me has been to move away from teaching occlusion simply as a procedural-based entity. Traditionally, you learn occlusion as a series of procedures. You are taught to examine a patient, and if their occlusion doesn't look like the occlusion you were taught, you are supposed to make it look like the occlusion you learned. Today, I focus heavily on looking at occlusion from a diagnostic point of view, scrutinizing the temporomandibular joints, muscles, and teeth. If these entities have no signs or symptoms, then regardless of what the occlusion looks like, I would consider treatment unnecessary unless I were going to be intervening in some way, such as with orthodontics or restorative dentistry. The movement away from occlusion as a rigid dogma, treated with a series of procedures, and toward how to diagnose correctly has been the biggest single shift regarding occlusion that I have observed (Figs 1-5).



**Figure 1:** A 63-year-old female unhappy with the esthetics of her smile.



**Figure 2:** Evaluation of the anterior teeth shows minimal wear for a 63-year-old.

**Q:** A number of traditional gnathological teachings proclaim that the anterior teeth never touch in function, citing selected studies by Gibbs and Lundeen.<sup>1</sup> Is this belief still valid, or can we acknowledge that teeth do contact, and potentially wear, during masticatory movements?

**A:** My training in the 1970s and early 1980s emphasized that teeth did not contact during mastication. Today, there is ample research showing it is possible for teeth to touch during function, depending on the patient's chewing pattern. Some patients have more of a "chopping" chewing pattern, in which they open straight, then move to the side they chew on, and finally initiate a path of closure into their intercuspal position without running into the inclines of the teeth. In these patients, we tend not to see any mobility or wear from normal function. There are studies, however, that show that patients who have more of a broad grinding pattern of chewing can end up with occlusal contacts during function and potential mobility and/or wear.<sup>2,3</sup> The difficulty comes when we see wear on any tooth that looks like attrition—in other words, when there is presence of wear. The challenge is to understand why the mandible moved in such a way that produced that wear. It is difficult (and, I think, dangerous) to look at a facet and say, "That was caused during function or parafunction," or "This is the patient who bruxes." We may not know for sure why the mandible is moving in such a way that the teeth are rubbing against each other. But yes, I think we are in an era where a functional etiology is certainly a valid etiology, as are the concepts of parafunction or bruxism, for some patients.

**Q:** Most dental schools prepare their students and teach them how to build the morphology of the dentition, whether as a laboratory equilibration or building restorations, relying on articulator movements in the laboratory utilizing the incisal pin, or even custom incisal guide tables to guide working and balancing excursive movements. How well do these techniques translate to providing a functional occlusion for the patient in the operatory?

**A:** I was gnathologically trained in the 1970s using hinge axis locators, pantographic tracings, and Stuart fully adjustable articulators. I was trained to grind in the condylar guidance and Bennett movements to match the pantographic tracing very precisely for each patient. However, that does not mean it is necessary or translates into what patients need. There is no question that we have to evaluate all the restorations we make once they are in the mouth, because moving the articulator left, right, and forward on the laboratory bench does not represent how the mandible moves for that patient during functional and nonfunctional movements.



**Figure 3:** The patient had a 100% overbite; the deep overbite would normally tend to show symptoms such as anterior tooth wear, mobility, fremitus, lateral pterygoid pain, or joint symptoms, but she had none of the above.



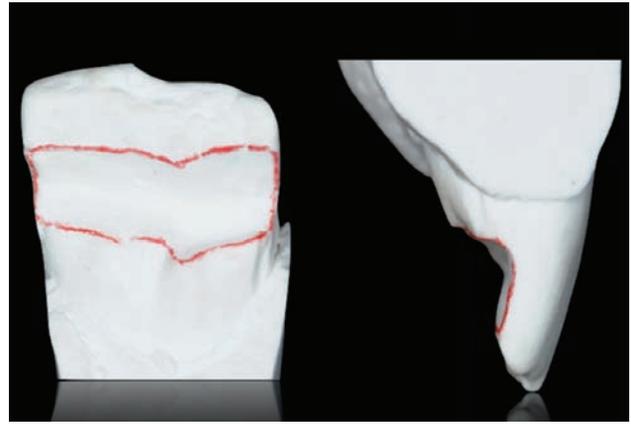
**Figure 4:** She had an exaggerated Curve of Spee from mandibular anterior over-eruption. The molars showed an Angle Class II skeletal relationship. Correction would require mandibular advancement or removing upper premolars and anterior retraction.



**Figure 5:** There were no occlusal symptoms of any kind, despite the overbite. She was treated with 2.5 mm of facial crown lengthening, and veneers that shortened the anteriors a corresponding amount; no occlusal changes were made.



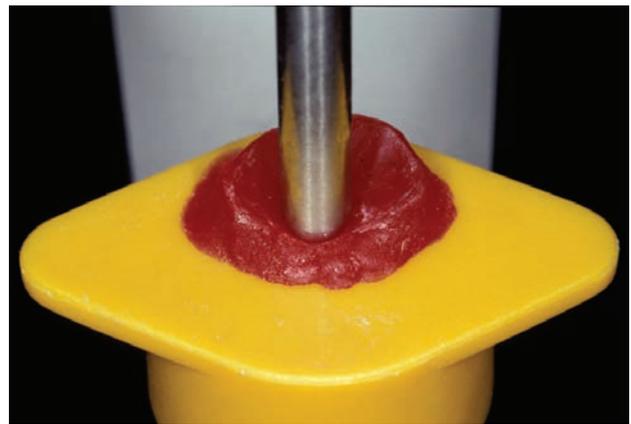
**Figure 6:** A patient with severe lingual wear on his incisors but minimal incisal edge wear.



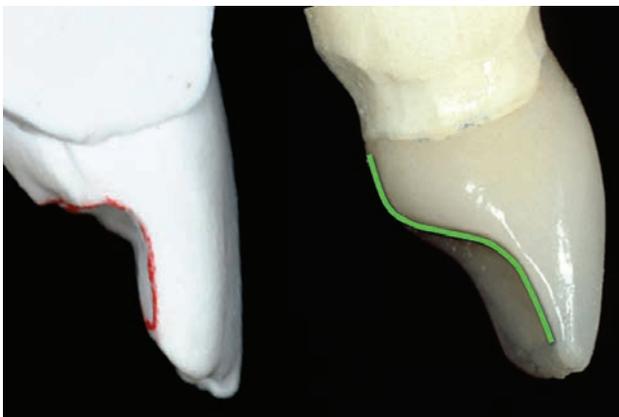
**Figure 7:** A section of a stone model of the central shows the severity of the pathway-type wear, suggesting this patient needs more freedom of movement.



**Figure 8:** The severity of the lingual wear resulted in the fracture of the lateral incisor. Note the lack of room for restoration, indicating eruption of the maxillary or mandibular incisors, or a loss of vertical dimension.



**Figure 9:** A custom guide table is fabricated from the patient's existing wear pattern. The goal is to restore him with more freedom of movement than he has with the existing occlusion.



**Figure 10:** A comparison of the pathway of movement between the existing worn central and the final restoration shows a significant increase in freedom, which proved successful in the provisional restorations.



**Figure 11:** The space needed to restore the teeth and increase the freedom of movement came from treating the maxillary arch and opening the vertical. This case is now eight years post treatment.

This is not to minimize the importance of using an articulator and an accurate mounting. In addition, things like custom incisal guide tables can be very helpful in setting up a new guidance pattern that is more similar to what the patient is used to, versus a more traditional approach where we try to tell the patient what type of guidance we are going to give them. So it's a combination of diagnosing and looking carefully at where the patient is, then developing the occlusion on the articulator that seems most appropriate for each patient (Figs 6-11). By contrast, 30 years ago we tried to provide every patient with the same occlusion instead of customizing it based on the patient's needs. Ultimately, for most patients, what really matters concerning occlusion is what they do with their muscles. If their muscles are quiet, virtually every occlusal scheme will work. Hence, what we do on the articulator transfers quite well the vast majority of the time. But I believe it is always necessary to evaluate and refine the occlusion.

**Q:** What are your guidelines and parameters when searching for the right occlusal vertical dimension for any given patient?

**A:** I think the idea that there is one correct vertical dimension is probably one of the biggest misconceptions in dentistry. It is fairly clear that patients tolerate a range of vertical dimensions and do very well regarding comfort and functionality. If I am changing the vertical dimension from what the patient has currently, three things typically are evaluated to determine the vertical dimension that is chosen. First is the incisal edge position of the maxillary anterior teeth. This is determined by evaluating tooth display at rest, lip mobility, the occlusal plane, and phonetics. Second is the mandibular anterior incisal edge position. Finally, the functional relationships of the anterior teeth and the desired amount of overbite, overjet, and phonetics have to be evaluated to arrive at the final vertical dimension chosen. If the esthetics of the anterior teeth are correct, the vertical dimension, in my experience, is perfectly tolerated by the patient. The mistake I often see students make is to look at worn teeth and think that the vertical dimension needs to be increased. It is possible to have anterior wear and no posterior wear, in which case there will have been no loss of vertical dimension. But commonly, the anterior teeth will secondarily erupt to maintain occlusal contacts. In these patients, opening the vertical dimension to restore the anterior teeth often produces teeth that are too far down in the patient's smile. The correct treatment is to either orthodontically intrude the over-erupted teeth or lengthen their crowns prior to restoration (Figs 12-17). The converse is true when looking at worn posterior teeth



**Figure 12:** A 36-year-old female who appears to have severe attrition and a loss of vertical dimension.



**Figure 13:** An examination of her teeth shows severe lingual wear from bulimia and almost no posterior wear, meaning it would be very difficult for her to lose vertical dimension.



**Figure 14:** This lip-at-rest image shows a normal amount of tooth display for the patient's age, but the centrals are only 6 mm long. This makes it highly unlikely one would want to lengthen them incisally 4.5 mm and open her bite.

with unworn anterior teeth. Students often think the bite needs to be opened to gain space for severely worn and, most likely, over-erupted posterior teeth. They may not realize that, for every 1 mm that is opened in the posterior, the anterior actually is opened 2 or 3 mm and it is now necessary to compensate by making oversized anterior teeth. If the vertical dimension is going to be altered, it is always established by the anterior teeth. If the posterior teeth are too short, they either need crown lengthening or intrusion to put them back where they belong.

**Q:** How important is condylar guidance for the average restorative dentist, and what should dentists incorporate into their protocol to best compensate for variations in patients?

**A:** The concept of condylar guidance is really an issue of how much downward movement the condyle exhibits any time the mandible starts translating. That downward and forward movement obviously has the ability to disclude posterior teeth, which, for most occlusal schemes, is a desirable trait. Typically, what we have done for 25 to 30 years is reduce the condylar guidance on our articulators to an average number somewhere around 20 degrees. This intentionally incorporates less condylar guidance in the laboratory than most patients have. Hence, when we develop the occlusion on the articulator and take it back to the patient, we will actually have greater condylar guidance, as well as greater posterior disclusion and more rapid posterior disclusion than what we had on the articulator. The exceptions to simply using an average number, such as 20 degrees, are if we are dealing with severely worn posterior teeth, those that lack anterior guidance due to an anterior open bite or end-to-end anterior relationship, or those that require a scheme such as a group function for one reason or another. In these cases, it may be beneficial to take protrusive records and make a more accurate setting of the condylar guidance on the articulator. To achieve the latter, a pantographic tracing can be used, although I admit I have not done one in approximately 25 years. Semi-adjustable articulators work fine for me, but I know it means I am going to have to check everything in the mouth and may need to make greater adjustments than if I had used a tracing and fully adjustable articulator.



**Figure 15:** The full smile confirms the likelihood of anterior over-eruption, not a loss of vertical dimension. The treatment choices would be anterior intrusion or crown lengthening followed by restoration.



**Figure 16:** Appearance after 4.5 mm of circumferential crown lengthening, which was possible because of very long roots. The incisal edge position and vertical dimension will remain unchanged.



**Figure 17:** Appearance after the restoration of the maxillary arch. The crown lengthening was carried back to the second premolars.



**Figure 18:** A 50-year-old female seeking a cosmetic improvement to her smile.



**Figure 19:** An examination of the anterior teeth showed minimal wear for her age.



**Figure 20:** The molars had significant wear while the premolars had almost none; in fact, the maxillary right first and second molars were just restored due to fractures.

**Q:** Is it imperative that full-mouth rehabilitation be built with access to a condylar position of centric relation (CR)?

**A:** This goes back to an era where many occlusal philosophies believed that if we didn't restore patients in CR, the cases would fail. There is ample research indicating that the vast majority of humans do not have their intercuspal positions coincident with CR. Depending on the study examined, the range of humans whose intercuspal position is coincident with CR varies from 1 to 20 percent. The bottom line is that not having occlusion built in CR certainly does not mean there is going to be failure or symptoms. What is necessary, however, when we do a full-mouth reconstruction is a repeatable position of closure. Without that, anything we do on the articulator cannot be predictably taken back to the mouth. We can't know that, when the patient closes his or her mouth, we are going to get the same occlusion we saw on the articulator. Consequently, I use CR, assuming that the joints can comfortably be seated, because it provides the most repeatable position of closure. I also think some cases need to be built in CR to be successful. There are patients who, in fact, go into a seated condylar position and grind there. In these patients, we see significantly higher wear on the second molars—possibly the first molar—with occasional slight wear on the anterior teeth or the premolars. If our goal is to protect the posterior teeth, it is necessary that the condyle be seated with the anterior teeth in contact, so that any mandibular movement actually discludes the posterior teeth and takes advantage of the anterior guidance (Figs 18-23). If we treat a particular patient who parafunctions in a retruded position and build them in an anterior position, the anterior teeth will not touch when the condyle does seat. Then, they have the ability to put much greater bite force on the posterior teeth. So the answer is no, it's not imperative, but it certainly makes sense for most patients if the joint can comfortably be seated.

**Q:** Are the lateral excursive contacts we check for and establish in the laboratory on our articulators synonymous with movements by the patients when they are in masticatory function?

**A:** No; there are several differences. First, during normal function, such as incising or mastication, the patient opens first, moves into position, and then closes into their intercuspal position. Typically, when we move an articulator, it is done with the teeth in occlusion as we go into excursions, from the intercuspal position out as opposed to the other way around. Secondly, we typically move articulators left, right, and protrusive to evaluate the occlusion. We know patients have a broad range of positions that they move into that are in between pure left,

right, or protrusive. What we can say, however, is that we have a long history of evaluating occlusions the way we have been taught. For the most part, these methods work very successfully. The ultimate test, as I noted earlier, is that we still have to evaluate the restorations in the patient's mouth, having them move in all directions, and giving feedback. Ask the patient: Does something feel like it's in the way? Is there something uncomfortable? Do you feel restricted? If any of the answers is "yes," then, regardless of what we observed in the left and right movements, we need to alter the restorations so that the patient has a sense of comfort in terms of the guidance we are providing.

**Q:** With market trends in dentistry showing a decline in demand for bigger, high-end esthetic and restorative cases, what do you see regarding opportunities for growth in these practices in the years to come?

**A:** If we look at a typical general practice, there usually are four types of patients. First, there are "reactive" patients, who tend to come in only because they have to (i.e., they are in pain). When we offer them anything specific (e.g., "Your tooth is cracked, and if we don't do anything it is going to break"), they are likely to say, "I'll wait for it to break." Second, there are "proactive" patients, who make up the bulk of the general practice. These patients will come in twice a year. If we tell them they have decay, they want it fixed, as they don't want the consequences of letting it go untreated. They tend to be more sensitive to fees and insurance issues. The third group, "discretionary" patients, is driven by their appearance. They will agree to veneers, bleaching, orthodontics, and whatever it takes to look better. The fourth group, "regenerative" patients, will undergo interdisciplinary dentistry, including implants and full-mouth reconstruction; in short, whatever it takes to make their oral condition and esthetics ideal.

Based on my decades of experience, the biggest growth potential for almost any dental practice is represented by the "proactive" patient. We may think they want only what their insurance companies will pay for and that they don't want to do anything else. But my experience is that, when we do an examination and share with the patient what we've found as well as what most likely will happen to each tooth if nothing is treated, we give them an idea of what is possible. Then, we can ask them, "How would you like to proceed? Is this something you would like to move forward with?" Many of these patients actually desire more dental treatment. That is certainly what we hear from students at Spear Education. We work very hard at helping students learn how to talk to patients, rather than just present treatment plans. The feedback we typically get from dentists is how surprised they are that many patients want to do more



**Figure 21:** The mandibular arch had a similar pattern, heavy second molar wear, new first molar restorations due to fractures, and minimal premolar wear. This pattern indicated a patient who parafunctioned in a retruded condylar position.



**Figure 22:** The maxillary arch and mandibular posteriors were restored in CR with anterior coupling to provide protection for the posterior teeth by utilizing anterior guidance.



**Figure 23:** The completed restoration and smile nine years post treatment.

dentistry. We just have to give them the opportunity to see what is possible (and, often, phase it over several years).

In short, I think the biggest area of growth is what it has always been—sharing possibilities with “proactive” patients, instead of trying to specifically target only “discretionary” patients.

**Q:** With your background in both periodontics and prosthodontics, what is your assessment of the oral-systemic connection and how a restorative occlusion-based practice can take advantage of this emerging trend?

**A:** I believe that our role is basically to evaluate the patient comprehensively in terms of head and neck issues, including joints, muscles, dental issues, and periodontal problems. There is no question that there is a potential link between certain periodontal diseases and particular systemic conditions, such as valve replacements and cardiovascular relationships. A restorative occlusion-based practice can make patients aware of several connections between restorative dentistry, occlusion, and periodontal diseases. This can be done by performing a periodontal evaluation, informing the patient of existing conditions, and educating them about how dental disease can be linked to other issues that are systemic in nature. I believe that patients who are susceptible to periodontitis may have an increased risk that uncontrolled occlusal issues may accelerate the rate at which the periodontitis could progress. This, therefore, increases the risk of systemic issues. Debates in the literature about this issue will continue as they have for decades between those who believe there is a relationship and those who don't.<sup>4,5</sup>

## References

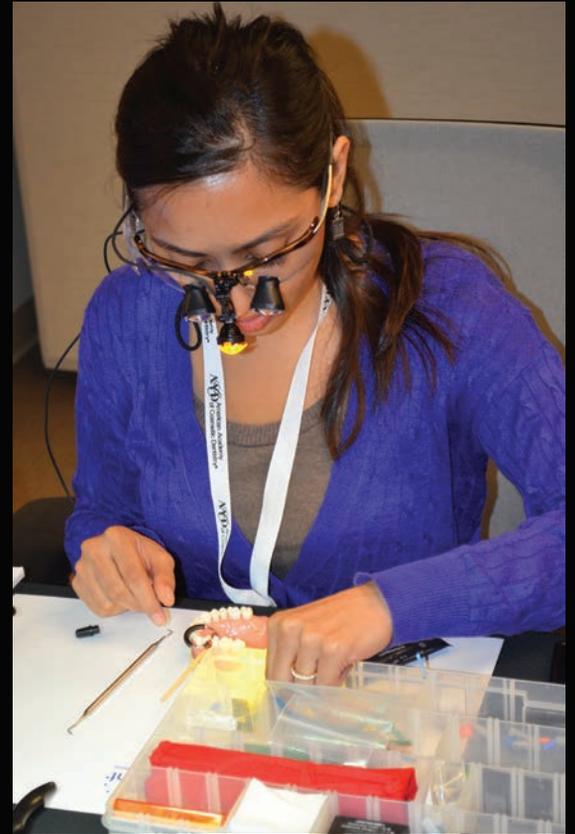
1. Gibbs CH, Mahan PE, Lundeen HC, Brehnan K, Walsh EK, Holbrook WB. Occlusal forces during chewing and swallowing as measured by sound transmission. *J Prosthet Dent.* 1981 Oct;46(4):443-9.
2. Ishigaki S, Kurozumi T, Morishige E, Yatani H. Occlusal interference during mastication can cause pathological tooth mobility. *J Periodontal Res.* 2006 Jun;41(3):189-92.
3. Kim SK, Kim KN, Chang IT, Heo SJ. A study of the effects of chewing patterns on occlusal wear. *J Oral Rehabil.* 2001 Nov;28(11):1048-55.
4. Branschovsky M, Beikler T, Schäfer R, Flemming TE, Lang H. Secondary trauma from occlusion and periodontitis. *Quintessence Int.* 2011 Jun;42(6):515-22.
5. Jin LJ, Cao CF. Clinical diagnosis of trauma from occlusion and its relation with severity of periodontitis. *J Clin Periodontol.* 1992 Feb;19(2):92-7. **jCD**

## I focus heavily on looking at occlusion from a diagnostic point of view, scrutinizing the temporomandibular joints, muscles, and teeth.



Dr. Spear is an affiliate professor of the graduate prosthodontics program at the University of Washington. His dental degree and MSD were earned at the University of Washington School of Dentistry. He is the founder of Spear Education, in Scottsdale, Arizona.

Disclosure: Dr. Spear is a stock shareholder in Spear Education, in Seattle, Washington.



“This course was amazingly helpful. Facilities were excellent and staff was very accommodating. I will be attending future events.”

- AACD Unplugged attendee



EARN  
**16 CE**  
CREDITS  
PER EVENT

# AACD Unplugged

Madison, WI | 2013



Jan. 25-26, 2013  
Charting the Course for  
Implementing and Restoring Implants  
David Little, DDS  
Sponsored by Heraeus and Dentsply



### WHAT'S UP NEXT?

March 15-16, 2013  
Educator Training  
Karen Cortell Reisman, MS

July 19-20, 2013  
Smile Design and Photography  
Ed Lowe, DMD

Sept. 20-21, 2013  
Veneers  
Betsy Bakeman, DDS

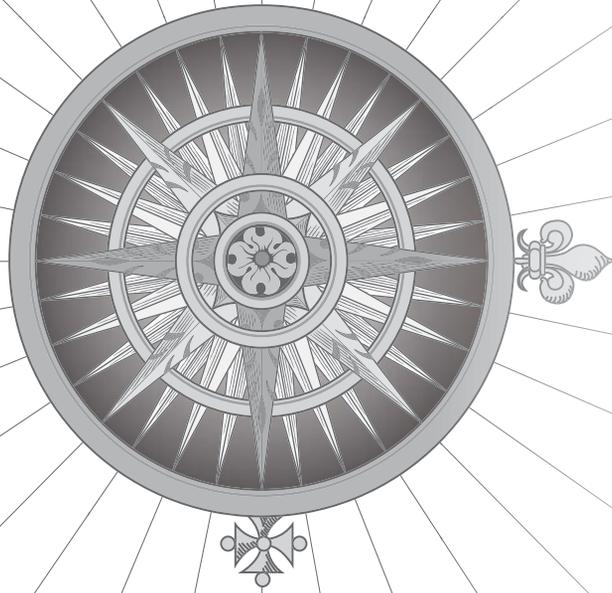
Learn more at [www.aacd.com/unplugged](http://www.aacd.com/unplugged)

\*Earn 8 credits per day

# Charting Your Course

## AACD Releases Accreditation Module

Tiffany Stronghart



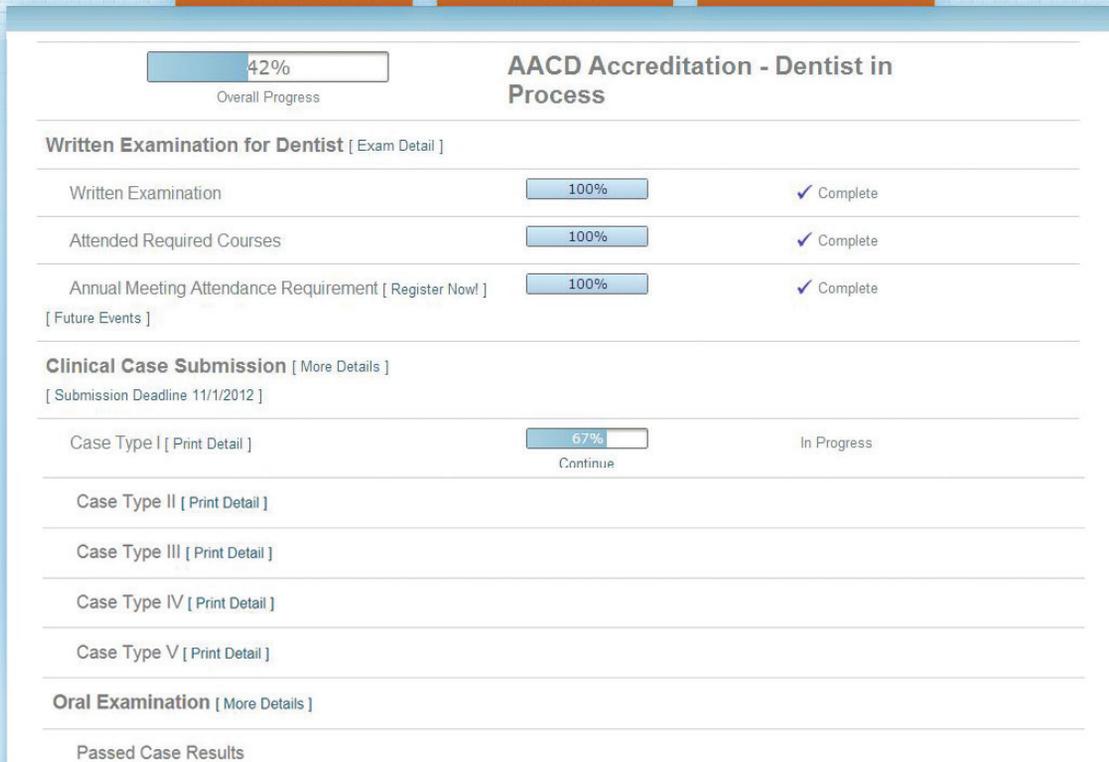
**A**chieving Accreditation in the American Academy of Cosmetic Dentistry (AACD) is a pivotal moment in a cosmetic dentist's or laboratory technician's career. It is a badge of honor, a sign of high skill level and commitment to the field.

But the journey along the way is rigorous and not to be taken lightly. That is why the AACD has developed a new online "dashboard"—the Accreditation module—to help members in the process (MIPs) by giving them a streamlined way to chart their progress (Fig 1).

The module makes MIPs' administrative part of the Accreditation process smoother so that they can focus on doing great dentistry, instead of paperwork. With the more technical aspects of the Accreditation process made easier through the module's tracking functions, the AACD hopes that more members will be encouraged to begin and complete their journey toward Accreditation (Fig 2).

The Accreditation process starts when an individual passes the Accreditation Written Examination. After passing the written exam, he or she has five years to complete the process. Dentists are required to submit and pass five case types; laboratory technicians are required to submit and pass three case types. After the cases are completed, the Accreditation candidate must pass an oral exam at the AACD's Executive Office in Madison, Wisconsin.

**// It is a badge of honor, a sign of high skill level and commitment to the field. //**

[DENTAL PROFESSIONALS](#)
[DENTAL PATIENTS](#)
[GIVE BACK A SMILE](#)


**Figure 1:** Dashboard of module upon login for a dentist in the process of Accreditation.



**Figure 2:** Example of a Case Type I progress check, indicating completed steps and those yet to be completed .

The module is available to AACD member dentists and laboratory technicians who are in the process of Accreditation, and it is also available to non-AACD members. AACD members log into the module through My AACD, the AACD’s online member community.

With the module, users can easily determine where they are in the Accreditation process. They can see when they took and passed the written exam, when their five years comes to a conclusion, which cases they have submitted, and any remaining requirements left to fulfill. If they have not yet passed the written exam, they can register and pay for it through the module.

Upon logging into the module, the user will see three categories: Written Examination, Clinical Case Submissions, and Oral Examination (Fig 1). An overall progress bar is located at the top of the screen to let members know how far they have come and what steps remain in each category.

**“ One of the module’s biggest benefits is that it allows MIPs to submit their cases and other materials online. ”**



**Figure 3:** Example of case images uploaded to the module, with file names and descriptions.

When a user hovers over the Written Examination, Clinical Case Submission, or Oral Examination categories with the mouse, they will see an explanation of each requirement and how the requirement must be fulfilled. For instance, the case submission category provides detailed information about how a user must submit case materials and what photo formats are required. When users click on the case types, they are provided with a printable guide explaining how the case will be judged by Accreditation Examiners.

One of the module's biggest benefits is that it allows MIPs to submit their cases and other materials online, significantly decreasing the amount of time normally needed to physically mail materials to the AACD Executive Office (Fig 3). It is a huge benefit for international members, who may normally have to schedule several days or weeks for their case submission materials to arrive at the AACD Executive Office on time. Instead

of dropping case submission materials in the mail, a user can simply upload files to the module. When a user has successfully uploaded images or other materials, they can see a progress bar showing that the task is 100% complete, and will receive an immediate confirmation.

Another helpful feature of the module is the deadline reminders. The module displays upcoming case submission deadlines, and any future events or reminders relevant to the Accreditation process. The reminders aim to keep MIPs on track to achieving their Accreditation goals.

While the clinical steps in actually achieving Accreditation have not become easier, the administrative work for MIPs is now greatly simplified thanks to the module. Members in the Accreditation process can rest easy, knowing that some of their tasks are just a "click" away.

**// It is a huge benefit for international members, who may normally have to schedule several days or weeks for their case submission materials to arrive at the AACD Executive Office on time. //**



Ms. Stronghart earned a Master's degree in journalism from the University of Wisconsin—Madison. She is a communication specialist at the AACD Executive Office in Madison.

**Disclosure:** The author did not report any disclosures.

Yeah, it's kinda like that.  
But totally **worth** it.

Our members say that AACD Accreditation is a challenge, but it's also a life-changer.

Take the **first step** toward earning your credential and sign up for the written examination today.



[www.aacd.com/firststep](http://www.aacd.com/firststep)

**AACD** American Academy  
of Cosmetic Dentistry®

# Are We Asking Function to Follow Form?

# The Importance of Occlusal Design

Christopher J. Stevens, DDS

## Introduction

Cosmetic cases are treated in nearly every dental office. The most successful practitioners compile a list of records in advance of care. These records include photographs, as well as information on tooth shape, tooth color, and midline position. To be complete, records also should include incisal edge length, tissue modification requirements, stickbite registration, and an evaluation of temporomandibular joint (TMJ) stability. These items help to ensure that the patient will receive successful care. Fortunately, most patients do.

Unfortunately, some patients may not. When a case is initially unsuccessful, many dentists tend to ask themselves, "What should I do to fix it?" Perhaps, however, the first question actually should be, "Why did it fail?" Then, an appropriate response to the failure can be determined.

In the author's experience, failures usually can be traced back to a lack of respect for function. Unfortunately, when we plan a cosmetic case, design for esthetics too often outweighs design for function. Although it is hoped that the patient's function can adapt and/or tolerate the planned esthetic form, sometimes the patient cannot tolerate the changes. In these cases, restorations can break or symptoms such as jaw or muscle pain or dental sensitivities can occur.

In the author's opinion, most cases have a functional plan developed according to the doctor's or laboratory's preference of articulators. This type of plan generally considers lateral and protrusive excursions, often critical to the success of a case. However, this design frequently is based only upon average settings of the articulator being used and not the actual functional requirements of a particular patient.

One means of understanding the potential impact that function will have on esthetic changes is to design provisionals that can be tested functionally. Mastication analysis is considered the truest method of functional evaluation.<sup>1,2</sup> As such, measuring the ability to function under masticatory demands with the provisionals should give the clinician insight into the patient's ability to function with the final restorations.

**“Unfortunately, when we plan a cosmetic case, design for esthetics too often outweighs design for function.”**

## Case Study

A 62-year-old man wished to esthetically enhance his smile. His periodontal health was within normal limits. After gathering complete records, it was clear that he presented several challenges regarding enhanced esthetic design. These challenges included unilateral crossbite on the left side, significant maxillary cant, reverse anterior Curve of Spee, deep posterior Curve of Spee, midline discrepancy, and moderate tooth wear (Figs 1-2b).

## Findings

TMJ stability was evaluated by using joint vibration analysis (BioJVA, BioResearch Associates; Milwaukee, WI). Minimal vibrations were evident, and, because this analysis has a specificity of 98%, his TMJs were considered normal.<sup>3</sup> Because the treatment plan intended to enhance the left buccal corridor by reversing the crossbite, mastication traces were also obtained (Fig 3). These traces are obtained through utilization of a jaw-tracking device recording movement of a magnet affixed to the patient's mandible (Fig 4). The movements recorded include vertical, anteroposterior, and lateral jaw motions. Once the jaw tracker and magnet are placed, a recording is generated by asking the patient to place pre-softened gum on their tongue (Fig 5). The recording is started and the patient is asked to chew either on the left or the right side. Analysis of the recording can then be completed. Mastication patterns can be used to analyze TMJ function as well as chewing function. In this case, mastication patterns also supported the initial impression of normal TMJs.<sup>4,5</sup>

As anticipated from physical examination, the chewing pattern on the left was reversed in a crossbite situation. The patient opened laterally and closed medially (Fig 6). His turning point was on the appropriate side. It was not clear, however, if he would be able to function with a new occlusal scheme if his crossbite relationship was altered. In other words, after so many years in a reversed chewing pattern, it needed to be determined whether the patient would be able to adapt to and function with a normal occlusal relationship. The chewing pattern of the right side was normal, other than an increase in the maximum lateral width. As expected, the patient opened medially, had a turning point on the right side, and closed laterally to chew on the right side (Fig 7).

## Treatment Options

After the records were obtained and evaluated, treatment options were discussed. It was explained to the patient that the cant and the midline discrepancy could not be corrected without orthodontic interven-



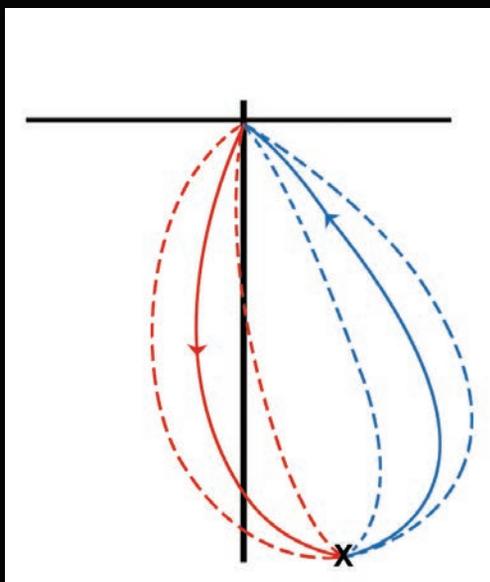
**Figure 1:** Unretracted preoperative view. The midline discrepancy and the anterior reverse curve are both evident.



**Figure 2a:** Retracted preoperative view. The cant, wear, and crossbite present further challenges.



**Figure 2b:** Retracted preoperative view. The blue line is a reference determined from the stickbite. The stickbite reference is perpendicular to an imaginary line drawn vertically from the patient's nasion to gnathion. The cant and reverse anterior curve are evident.



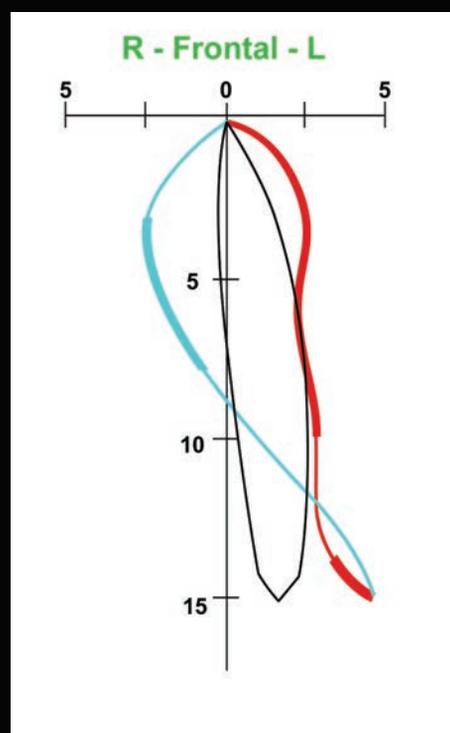
**Figure 3:** Example of normal left-sided chewing function. This is an average chewing pattern of 10 to 15 cycles. While no two cycles of chewing are the same, averaging a sequence can reveal the underlying pattern of movement as normal, altered by TMJ dysfunction or altered by malocclusion. The red line is opening; the blue line is closing.



**Figure 4:** A patient with jaw tracker in place. Note the magnet is affixed to the gingival tissue of the mandibular anterior teeth. Movement of the magnet is tracked within the sensors on the jaw tracker.



**Figure 5:** After placement of the magnet, a recording is generated by placing pre-softened gum on the patient's tongue. The recording is started, the gum is moved to the side being tested, and the patient chews the gum for 15 seconds.



**Figure 6:** Preoperatively, the left side has a reversed sequence of opening and closing patterns. Note that the opening trace is lateral (red) and the closing trace is medial (light blue), due to the crossbite.

tion. The patient rejected this option due to the length of treatment. Furthermore, he understood that orthodontics would not change the shape and color of his teeth. A second option of fewer veneers (primarily ##7-10), whitening, and orthodontics was also not an option due to the treatment time of the orthodontics. The patient did accept, however, the option of care on 21 teeth.

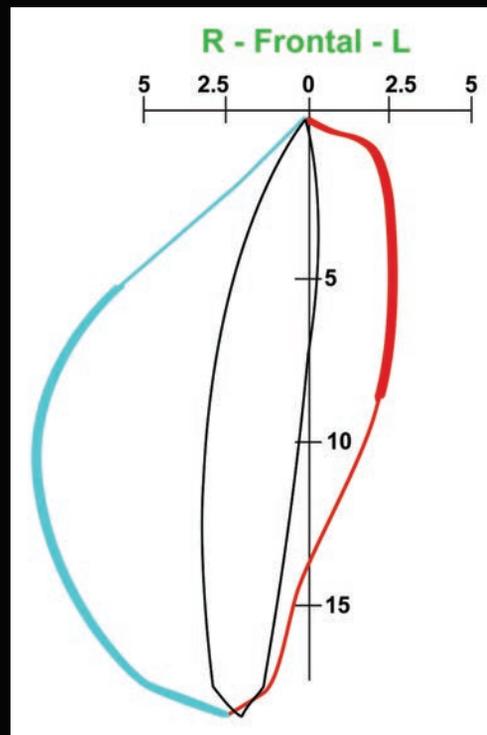
The patient was told that functional mastication testing of the crossbite would be evaluated prior to designing the final restorations. The wax-up and thus the provisionals would reverse the crossbite. The patient's mastication patterns while in provisionals would be recorded, evaluated, and compared to the pretreatment traces. If the mastication traces demonstrated no difficulty with function then the final restorations could be designed to reverse the crossbite and enhance the buccal corridor. The patient understood he would need to return to a left-sided crossbite if function dictated it.

**Treatment**

A white wax-up was completed on 21 teeth, including ##4-14 on the maxillary arch and ##20-29 on the mandibular arch. Tooth #14 would be brought into an edge-to-edge position and, from there, a normal relationship was designed. Phonetic and esthetic testing for incisal edge position determination demonstrated the current position of the distal-incisal edge of #8 was an appropriate length and the wax-up was made accordingly.

Preparations were performed in the normal manner, with all 21 teeth prepared in a single visit. After the proper depth of the preparations was ensured using a reduction guide, core shades of the preparations were obtained with a Stumpf shade guide (Ivoclar Vivadent; Amherst, NY). Provisionals were fabricated using a polyvinyl siloxane-lined Sil-Tech matrix (Ivoclar Vivadent) filled with Luxatemp (Zenith/DMG; Englewood, NJ). The occlusion of the provisionals was adjusted, the provisionals were polished, and the patient was dismissed (Fig 8).

After five days in the provisionals, the patient returned to the office for follow-up mastication testing. The crossbite was "corrected" esthetically and functionally. The occlusal design allowed the patient to continue his habitual reverse sequence, as the patterns were consistent with those observed in the pretreatment traces (Fig 9). Had the left-sided crossbite been blindly corrected, there would have been concern about functional adaptation. However, because the provisionals were tested and it was demonstrated that the patient could function with them, they could serve



**Figure 7:** Preoperatively, when chewing on the right side, the patient opens (red) medially and closes (light blue) laterally, indicating normal sequencing. There is an increase in the maximum width of the open and closing traces.



**Figure 8:** Provisional restorations for ##4-14 and ##20-29. The correction of the left crossbite starts at #14. Note that the cant and the midline discrepancy still exist and are accepted by the patient.

as a “road map” for the final restorations. The author expected that, as this patient was older, it might be more difficult for him to change his function from a reverse sequence to a normal movement pattern. More studies are needed to analyze the ability to change from reverse to normal sequencing.

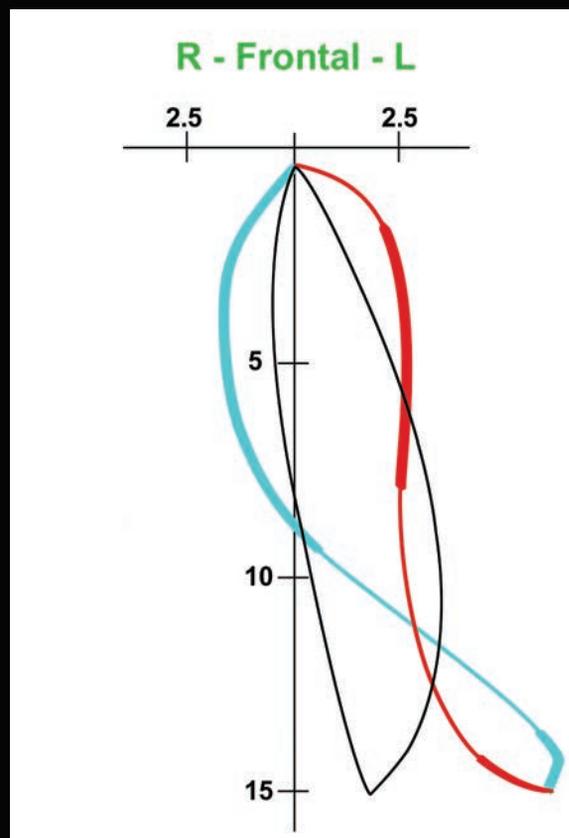
It should be noted that mastication is not used to design the occlusal scheme of the wax-up and thus the provisionals; rather, it is a method used to test the occlusal design. In other words, it is a method to assess how well the design is working within that particular patient’s physiology. As it is a measure of the actual function of the patient, it is more reliable than static entities like articulating paper or shimstock.

The final restorations were fabricated using IPS Empress (Ivoclar Vivadent). The provisionals were removed, the preparations were scrubbed, and the final restorations were tried in place for fit, contacts, shape, and color. After approval by the patient, a rubber dam was placed for isolation. Using proper adhesive techniques, the restorations were seated using RelyX Veneer (3M ESPE; St. Paul, MN). Cleanup of excess bonding resin was completed, preliminary occlusal adjustments were made, and the patient was rescheduled for final adjustments (Figs 10 & 11).

The patient was scheduled for mastication analysis one month post-insertion. Chewing traces again were obtained using both gum and licorice as a bolus. The patterns were consistent with those observed in the pretreatment traces (Fig 12). Furthermore, the patient reported no concerns with the final outcome and tolerated the change in his occlusal scheme without incident. At the one-year follow-up appointment, all restorations were intact and the patient was functioning without difficulty.

## Conclusion

Much of today’s dentistry can be performed with incredible predictability. However, some cases may be less predictable, especially when the intent is to change the occlusal environment to enhance esthetics. Nearly all of these cases affect physiology—at times positively and at times negatively. When physiology is negatively affected, clinicians may see fractured restorations and patients may report TMJ-type symptoms. In these cases, function needs to be considered as a source of the problem. Fortunately, through the use of advanced measurement protocols, dentists can now test and monitor function before designing the final restorations.



**Figure 9:** Mastication trace chewing on the left with the provisionals in place. Note that the pattern is similar to the preoperative trace, indicating that the patient will accept the crossbite correction.



**Figure 10:** Retracted view of the final restorations.

Acknowledgment

The author thanks Arrowhead Dental Laboratory (Sandy, UT) for fabrication of the restorations in this case.

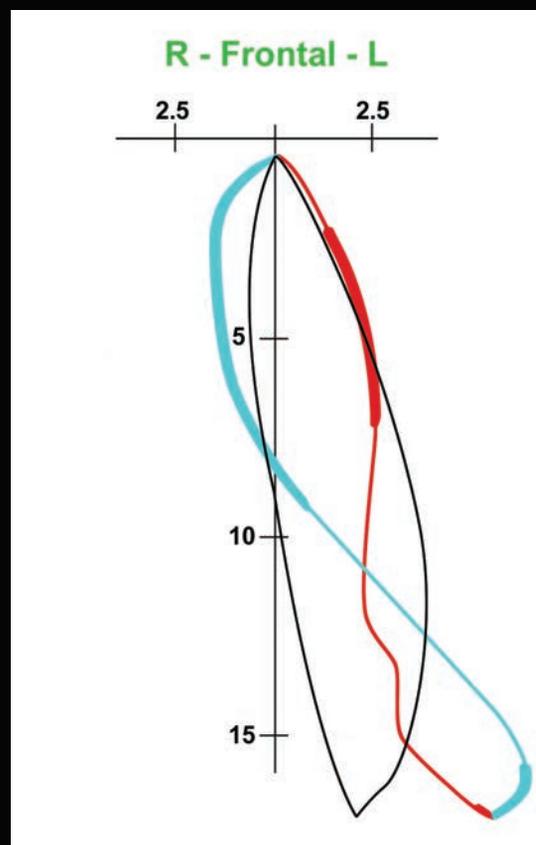
References

1. Murakami T, Harada T, Abe K, Tanaka T. Masticatory movement in two cases with unusual alignment of the maxillary canine. *J Oral Rehabil.* 2000;27(4):317-31.
2. Wilding RJ, Adams LP, Lewin A. Absence of association between a preferred chewing side and its area of functional occlusal contact in the human dentition. *Arch Oral Biol.* 1992;37(5):423-8.
3. Ishigaki I, Bessette RW, Maruyama T. Vibration of the temporomandibular joints with normal radiographic imagings: comparison between asymptomatic volunteers and symptomatic patients. *J Craniomandib Prac.* 1993;11(2):88-94.
4. Kuwahara T, Bessette RW, Maruyama T. Chewing pattern analysis in TMD patients with and without internal derangement. part II. *Cranio.* 1995;13(2):93-8.
5. Kuwahara T, Bessette RW, Maruyama T. Characteristic chewing parameters for specific types of temporomandibular joint internal derangements. *Cranio.* 1996;14(1):12-22. **jCD**



**Figure 11:** Unretracted view of the final restorations. The patient was very pleased with the final esthetics.

“Much of today’s dentistry can be performed with incredible predictability. However, some cases may be less predictable, especially when the intent is to change the occlusal environment to enhance esthetics.”



**Figure 12:** Mastication trace chewing on the left with the final restorations in place. Note that the pattern is again similar to the preoperative trace.



Dr. Stevens owns a private practice in Sun Prairie, Wisconsin.

Disclosure: The author has an affiliation with BioResearch Associates but did not receive any financial remuneration for writing this article.



# Imagine the esthetics of a layered restoration from all-zirconia.

The unique formula of Lava™ Plus High Translucency Zirconia provides significantly higher translucency<sup>1</sup> and unprecedented beauty—without compromising strength.

- **The patented shading system** enables highly esthetic all-zirconia or traditionally layered restorations.
- **Excellent color match** to the VITA® Classical Shade Guide and VITA SYSTEM 3D-MASTER® Shades.
- **High strength** allows tooth-preserving  $\leq 0.5$  mm minimum wall thickness—requiring 3X less occlusal preparation than lithium disilicate glass ceramic because of its 3X greater strength.<sup>2</sup>

Lava Plus zirconia is the beautifully durable material of choice.

[www.3MESPE.com/LavaPlus](http://www.3MESPE.com/LavaPlus)

Lava™ Plus  
High Translucency Zirconia

**3M** ESPE

# Careful Planning to Replace Congenitally Missing Teeth

## Using Hybrid Restorations to Complete a Smile Makeover

Thomas E. Oppenheim, DMD, FAACD

### Abstract

Our responsibility as dentists is to identify the appropriate solutions to meet our patients' needs and goals while giving them the best possible level of care. Sometimes, what is deemed the standard of care is incompatible with a patient's most significant needs and desires. For example, the standard of care for replacing congenitally missing incisors surrounded by healthy teeth is placing an implant-supported restoration. However, for any number of reasons—including time constraints, economic issues, and biological factors—some patients may adamantly refuse this treatment in favor of a three-unit fixed restoration. Regardless, properly planned and well-executed esthetic restorative dentistry incorporating three-unit bridges in the anterior sextant can profoundly influence our patients' lives in both tangible and intangible ways. This article details the treatment planning and restorative decisions undertaken to restore the smile of a patient with congenitally missing anterior teeth.

**Key Words:** Smile design, gingival recontouring, occlusion, authentic leucite-reinforced pressed ceramic technology, hybrid restorations, three-unit fixed restorations, esthetic functional restorations



## CLINICAL COVER STORY



**Figure 1:** Preoperative full-facial image revealing missing lateral incisors and gummy appearance.

### Introduction

As dentists, we are often placed in the difficult position of providing our patients with the most advantageous outcomes based upon their individual needs while simultaneously incorporating principles of minimally invasive dentistry. Patients desire solutions that are fast, reliable, and long-lasting regardless of the complexities that their condition may present. Our responsibility is to identify the appropriate solutions to meet our patients' needs and goals while giving them the best possible level of care.

In addition to minimally invasive treatments, smile design principles also dictate the techniques and procedures required. While research shows esthetics are generally a matter of personal opinion, patients demand restorative work that appears natural and is esthetically pleasing.<sup>1</sup> Smile design principles and esthetics have evolved as dentistry transitions from aggressive tooth preparation to preserving and building upon natural tooth structure. Therefore, reducing natural tooth structure is minimized in favor of augmenting the natural teeth through smile design principles that emphasize augmentation and tensional integrity when designing crown and bridge restorations.<sup>2</sup>

“Smile design principles and esthetics have evolved as dentistry transitions from aggressive tooth preparation to preserving and building upon natural tooth structure.”

Multidisciplinary procedures, such as reconstruction of the maxillary anterior segment, generally necessitate a combination of treatment options to achieve optimal esthetics, function, and comfort.<sup>3</sup> After tooth extraction, the interproximal papillae recede and the buccal bone collapses. This presents the challenge of restoring an edentulous space in the esthetic zone. A viable nonsurgical option is placing a temporary bridge with an ovate pontic at the time of extraction to support the proximal papillae, facial soft tissue, and healing gingival tissue.<sup>4</sup> Another option is resin-bonded bridges.<sup>5</sup> Research shows that resin-bonded bridgework has an 84 percent success rate.<sup>6</sup>

Porcelain materials used in combination with improved bonding materials and techniques enable the realization of conservative esthetic restorations fabricated without the need for metal substructures, facilitating smile design principles involving optical properties, light reflection, and gingival health.<sup>7</sup> When replacing missing maxillary anterior teeth, a difficulty that arises is concurrently providing an improved tooth-to-soft tissue relationship, regardless of whether the restorative modalities are implants, naturally supported fixed bridges, or removable partial dentures. To achieve esthetically harmonious soft tissue architecture when a high gingival smile line is present, reestablishing the interdental papillae is essential. Careful planning and proper communication with the patient regarding these issues is necessary for thorough understanding and educated consent to treatment, as well as clinical and esthetic success.<sup>8</sup>

Typically, the standard-of-care treatment for missing teeth—especially when the teeth on either side of the space are intact and restoration-free—has transitioned to implant-supported crowns. However, there are circumstances that may require dentists to treatment plan an esthetic fixed three-unit restoration. These include the need to restore the adjacent teeth, limited bone in which to place an implant, and/or a patient's desire for quick and predictable treatment without procedures that require ongoing healing and repeat visits.

In the case discussed here, the patient first presented at our office nearly five years ago. She had recently completed orthodontic therapy and was seeking a solution for her congenitally missing lateral incisors, mottled tooth discoloration, overjet, and occlusal issues.<sup>9</sup> After the initial consultation, the patient and her parents discussed all of the issues with her smile and the need to complete treatment within a limited time frame. It was mutually decided that two fixed three-unit Authentic-pressed-to-metal “hybrid” bridges (Jensen Dental; North Haven, CT) would be used to replace the lateral incisors and create a more pleasing proportion for

esthetics.<sup>10</sup> Authentic veneers were also selected to complete the required 10-unit restoration.

## Case Presentation

An 18-year-old female presented with a chief complaint about congenitally missing lateral incisors (**Fig 1**). Shy and quiet, she attributed her reserve to her unesthetic smile. Having recently completed orthodontic therapy, she wanted to close the spaces between her teeth. Because she would be leaving for college at the end of the summer and wanted an immediate solution, the time frame for completing her restorations could not exceed three consecutive months. As implant restorations can take up to six months (factoring in healing time), they were deemed inappropriate for this patient based upon her personal needs.<sup>11</sup>

## Diagnosis

After a standard clinical examination, it was apparent that the patient exhibited occlusal defects, including a lack of stable centric stops on the cuspids and central incisors (**Fig 2**). Aside from esthetically obvious congenitally missing lateral incisors, there was generalized discoloration of her teeth and a distinct morphological difference between the uneven, mottled central incisors. The patient also displayed mild decalcification and enamel dysplasia. The patient's cuspids and bicuspid were relatively short, causing a somewhat "gummy" appearance that was especially evident during a broad smile; this would require some gingival reduction (**Fig 3**). Lastly noted, the ridge thickness was inadequate for placing implants in the correct three-dimensional positions unless soft tissue and/or bone augmentation was implemented. Unfortunately, these requisites would result in overall treatment and healing time surpassing the three-month time limit the patient had established.

## Treatment Planning

Several treatment options were discussed with the patient regarding replacing the congenitally missing lateral incisors. These included single-tooth implants, removable prostheses, conventional fixed or cantilever prostheses, Maryland bridges, and orthodontic repositioning of the canines to close the edentulous areas. The advantages and shortcomings of each treatment alternative, both from an esthetic and practical standpoint, were discussed. This discussion addressed the tooth reduction usually associated with conventional fixed prostheses. In this particular case, the necessary osseous grafting and ridge augmentation required to render each edentulous site "implant-ready" also were discussed.

During the co-discovery and co-diagnostic process, it became apparent that the patient displayed at least 10 maxillary teeth when smiling broadly. Among those 10 teeth were the four discolored anterior teeth, two of which were uneven and had caries beneath a bonded wire retainer, and all four of which were out of occlusion, having no stable centric stops at all.



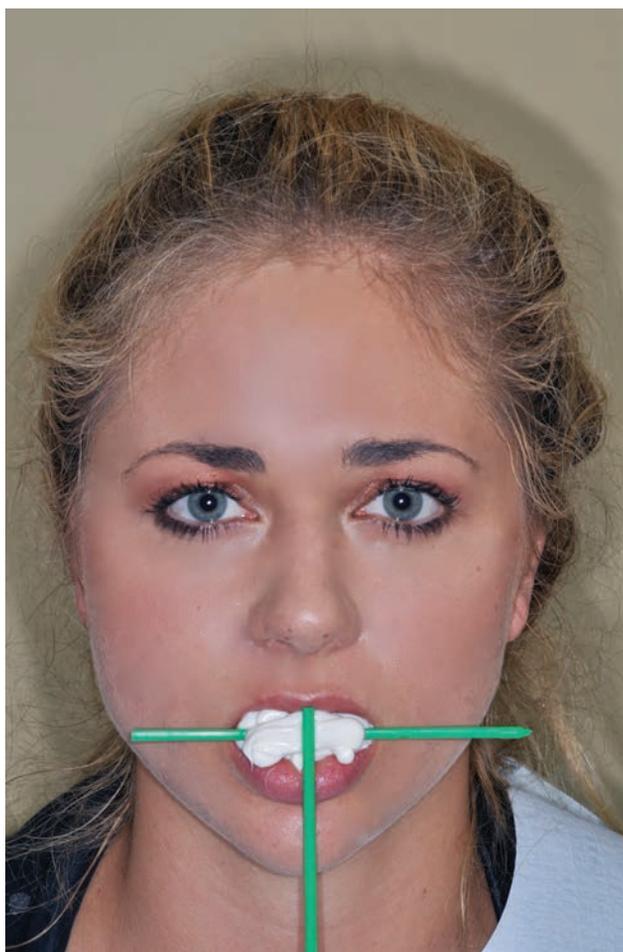
**Figure 2:** Close-up retracted preoperative image showing uneven central incisors and gingival prominence.



**Figure 3:** Preoperative image of the patient in natural smile, revealing the gummy appearance of the excess gingival tissue.

“The patient understood and acknowledged the distinct necessity for functional as well as esthetic restoration of all four anterior abutment teeth, as well as removing caries during the restorative process.”

## CLINICAL COVER STORY



**Figure 4:** A stickbite was taken to facilitate identification of the patient's midline and smile line.



**Figure 5:** Retracted view of the patient's gingival tissues following gingival recontouring procedures.

The patient understood and acknowledged the distinct necessity for functional and esthetic restoration of all four anterior abutment teeth, as well as removing caries during the restorative process. She also understood the added benefit of maintaining a healthy long-term orthodontic retention. Therefore, the patient opted to replace the lateral incisors in conjunction with the esthetic/functional restoration of the anterior sextant utilizing two conventional three-unit fixed bridges.

Ovate pontic designs were chosen for teeth #7 and #10, not only for hygienic purposes, but also to create the illusion of natural teeth with normal emergence profiles. A gradual sloping transition of the porcelain from beneath the tissue, accompanied by mild compression toward and into the interproximal areas, would facilitate the formation of "pseudo" papillae, which further increased the esthetic qualities of each bridge.

The Authentic Pressable Ceramic System would be utilized to optimize function and strength without sacrificing esthetics. The bicuspid would receive Authentic veneers to complete the 10-unit smile transformation.

### Procedures and Protocol

An initial wax-up on a diagnostic model was created from a vinyl polysiloxane (VPS) impression (Imprint II, 3M ESPE; St. Paul, MN), using a preoperative stickbite and stickbite photographs as a guide for the patient's midline and smile line (Fig 4). Pontic sites were scored on the model and excavated approximately 1.5 mm to 2 mm to help in determining how much of the pontics could be compressed down onto the tissue. The pontic sites were waxed to ideal contour with properly positioned gingival zeniths. A Sil-Tech (Ivoclar Vivadent; Amherst, NY) putty matrix was then formed and fabricated from the initial wax-up.

Gingival recontouring was accomplished around teeth ##4-13 to lengthen the cuspids and bicuspid, and to achieve harmonious symmetry of the surrounding gum tissue above each tooth. The patient was anesthetized with Citanest Plain (Dentsply Pharm.; York, PA) and Septocaine (Septodont; Lancaster, PA). Type I esthetic crown lengthening/gingival recontouring was accomplished via radiosurgery to create ideal gingival margin locations while simultaneously avoiding the violation of biologic widths (Fig 5).

The pontic socket depression was established with radiosurgery and surgical diamond burs. To evaluate the feasibility of ovate/semi-ovate pontic sites, additional bone sounding was accomplished in the edentulous areas of #7 and #10 while the patient was anesthetized to determine the thickness of the respective soft tissue layers and proximity of the underlying alveolar bone beneath each pontic. Each wound was treated with tincture of benzoin and myrrh.

The teeth were prepared by strictly adhering to requirements that would allow for adequate pressed material thickness, maximum potential strength, and esthetics of the bridges and veneers. It was imperative that adequate room for strength be considered. Caution was



**Figure 6:** A photograph of the preparations was taken with the shade guide.

taken to avoid sharp internal line angles and undercuts, while maintaining shoulder preparations with butt joint margins for abutments and deep chamfers for the veneers.

Incisally, the preparations approximated a 2-mm reduction from the planned final crown length. The two-plane facial surface reduction was .8 mm to 1 mm in the cervical one-third, and approximately 1.2 mm to 1.5 mm in the incisal two-thirds of the crown. A minimal taper of an estimated 10 degrees was targeted. Because all four of the anterior teeth were previously 1.5 mm to 2 mm out of occlusion, sufficient room for the planned hybrid framework and a lingual clearance of 1.5 mm was easily preserved in centric contact areas.

A base shade of Chromoscope 030 (Ivoclar Vivadent) was chosen as the final shade for the pressed ceramic restorations. The BOO+ ingot was selected for this particular case because it contains a small amount of opacity yet retains its depth of color and fluorescence. A photograph of the preparations with a preparation shade guide (ND2) was taken and sent to the laboratory (Fig 6).

A final bite registration was made with a super-rigid VPS bite registration material (Mega Bite, DenMat; Santa Maria, CA), as well as a final stickbite registration using a medium-viscosity VPS bite registration material (Vanilla Bite, DenMat) and a Benda Brush handle (Centrix; Shelton, CT). A stickbite photograph was also obtained.

A final impression was made using heavy and light body materials (Imprint). Tissue retraction was accomplished using a combination of a temporary gingival retraction system (Expasyl, Kerr; Orange, CA)

and tiny, isolated segments of a very thin, braided retraction cord (Gingi-BRAID+ 0a, DUX Dental; Oxnard, CA).

The provisional restorations were created using a composite resin in shade Bleach White (Integrity, Dentsply Int.; Milford, DE) and were patterned after the wax-up by using the Sil-Tech putty matrix. Renamel flowable microfill composite (Cosmedent; Chicago, IL) was used to refine the pontics and the margins of the temporaries. The composite was added incrementally to create the compression into the tissue. The provisional bridges were tried in to confirm a slight amount of positive pressure in the pontic areas. The provisionals were glazed (BisCover LV provisional glaze, Bisco; Schaumburg, IL) and cemented with a provisional cement (TempBond NE, Kerr).

The occlusion and contours of the temporaries and pontics were refined, and the patient's speech patterns and phonetics with the temporaries were assessed and confirmed. Smile design and color schematics were revisited to ensure the esthetics would satisfy the patient's requirements. Photographs, a bite registration, and a stickbite were taken of the temporaries to be sent to the laboratory along with a detailed prescription and checklist. This included preoperative and provisional photographs, along with preparation shade photographs, stickbite and stickbite photographs, preoperative and provisional models, original wax blueprint, provisional bite registration, trimmed wafer-thin master bite registration, master impression, and opposing master impression.

#### Laboratory Fabrication

The Authentic Pressable Ceramic System was selected to optimize function and strength without sacrificing esthetics. There was a two-fold advantage of using this leucite-reinforced pressed ceramic technology. First, it is kind to the opposing natural dentition; and, second, it demonstrates a uniform optical refractive index in the mouth, even with mixed media cases. An additional attribute of Authentic is its superior biocompatibility. This case translated into a strikingly natural, vital smile that exhibited the "pop" all dentists seek and discriminating patients desire.

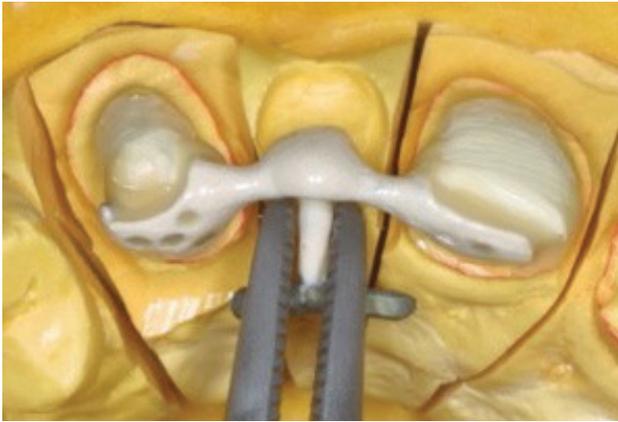
Additional steps were taken at the laboratory when fabricating the bridge restorations to ensure strength and to optimize the natural beauty, subtle nuances, and translucence in the anterior sextant. As opposed to a solid metal framework with typical abutment copings, a "hybrid framework" was fabricated for each "not-so-conventional" bridge (Fig 7).

This unique hybrid framework was perforated and embedded into the wax-up from the lingual aspect to ultimately incorporate strength and stability within the pressed ceramic material without compromising the beauty of the underlying tooth structure (Fig 8). Not only would natural light be able to pass through the framework, but light curing and complete polymerization of the adhesive luting cement would also be assured (Fig 9). The final result was a beautifully crafted, metal-reinforced pressed ceramic bridge that would facilitate light transmission.

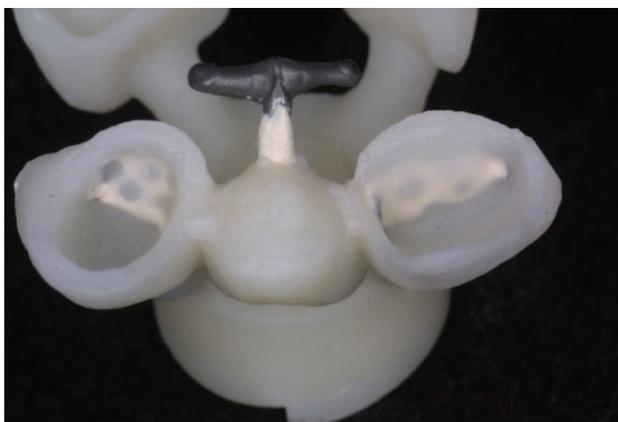
## CLINICAL COVER STORY



**Figure 7:** Hybrid framework prior to opaquing, with “tail” attached to facilitate handling of the framework and bridge during fabrication in the laboratory.



**Figure 8:** Adapting the opaqued framework to the preparations on the working model with hemostats.



**Figure 9:** Photograph of the bridge restoration after divesting with sprues still in place.

### Try-in Appointment

When the patient returned for the cementation appointment, the temporaries were removed with hemostats and a large spoon excavator. The preparations were cleaned using a combination of a scaler, explorer, sandblaster, and an antimicrobial scrub (Consepsis, Ultradent; South Jordan, UT) with a slurry of pumice and hydrogen peroxide. Hemostasis was achieved with ViscoStat (Ultradent).

All restorations were tried in with RelyX try-in paste shade BO5 (3M ESPE). Each bridge was tried in and held with sustained, progressive pressure until both were completely seated with pontics fully compressed into intimate contact with the tissue in the ridge areas with no blanching (Fig 10). Any areas of blanching were marked with pressure-indicating paste, and the pontic was meticulously adjusted and polished until there was only passive contact with the tissue.

After all units were in place, the patient was seated upright in the chair to assess all requested esthetic parameters. Once these were confirmed, the patient was given a mirror for the preliminary reveal and encouraged to walk around the office and view the restorations privately and under various lighting conditions, including outside. After she approved the restorations, they were removed, cleaned, and readied for bonding.

### Cementation

The restorations were washed thoroughly, re-etched with 9.6 percent hydrofluoric acid, and silanated. They were coated internally with a thin film of Adper Single Bond Plus adhesive (3M ESPE) and loaded with RelyX veneer cement shade BO5, then set aside sequentially on an ambient light-protected tray. ViscoStat was reapplied within and around the sulcular areas, and each preparation was thoroughly cleaned with Consepsis, after which all preparations were washed with copious amounts of water.

The enamel was selectively etched with 38 percent phosphoric acid and washed thoroughly. All preparations were then completely isolated from moisture contamination and coated with G-Bond one-component, self-etching, light-cured adhesive (GC America; Alsip, IL) and thinned with an air syringe and an HVE suction tip (Medicom; Tonawanda, NY).

The veneers were gently seated in pairs onto the preparations; and while stabilizing the veneers with the end of a Benda Brush handle, they were tacked into place with an Optilux 501 curing light (Demetron/Kerr; Orange, CA). Each bridge was seated and held down by the doctor while the assistant tacked each abutment with the curing light tacking tip.

All remaining cement was then semi-cured using a wave technique with a slow, sweeping back-and-forth motion once on the lingual aspect of the bridges, and then back and forth once all across the labial surfaces. Gross cement removal was accomplished with a sickle scaler. Each labial and lingual surface was then light cured individually for 30 seconds, after which De-Ox glycerin (Ultradent) was applied to the marginal areas and light cured for an additional 10 seconds.



**Figure 10:** Intraoral lingual view of bridge during try in.



**Figure 11:** Postoperative retracted view of definitive restorations one week after placement.



**Figure 12:** Full-face postoperative image of the definitive restorations.

The restorations were then thoroughly washed and dried. Final cement removal was achieved using a Hu-Friedy (Chicago, IL) H6/H7 sickle scaler and Miltex (York, PA) #12 and #15 stainless steel disposable scalpels. Marginal flash was assessed using a sharp explorer and Butler unwaxed floss (Sunstar Americas; Chicago, IL). Using a Hu-Friedy Kincheloe gingival retraction instrument, the tissue was gently retracted while slight marginal irregularities and flash were removed with fine and ultra-fine diamonds (Brasseler USA; Savannah, GA).

Centric contacts and excursive movements were evaluated using AccuFilm (Parkell; Edgewood, NY). With copious amounts of water, Brasseler finishing diamonds were used to progressively refine the occlusion. Final polishing of adjusted areas was accomplished using Brasseler's Dialite Intra-Oral Porcelain Adjustment and Polishing Kit to create a wet, glazed look to the finished restorations (Figs 11 & 12).

## Conclusion

Properly planned and well-executed esthetic restorative dentistry can profoundly influence our patients' lives in both tangible and intangible ways.<sup>12</sup> This case demonstrates first-hand how clichés such as “change your smile, change your life” are accurate. During the patient's initial visit, she had a shy and quiet demeanor due to her lackluster and displeasing smile. After completing her restorative treatment, she was radiant and overflowing with self-confidence (Figs 13 & 14). She stated that her new smile was having a positive impact on all aspects of her life, including relationships and her newfound modeling career. This case, although almost five years old, is still an unqualified success. Sarah's smile looks as healthy and as strikingly natural today as when it was originally completed.

Making a positive difference in a patient's life—as in the case presented here—is extremely rewarding. Commitment to excellence, adherence to proven principles, and meticulous attention to detail can not only yield outstanding esthetic results for our patients, but can also provide them with a sound investment in the healthy longevity of their entire dentition.

## CLINICAL COVER STORY



**Figure 13:** Final view of the patient demonstrating her natural smile.



**Figure 14:** A very happy patient.

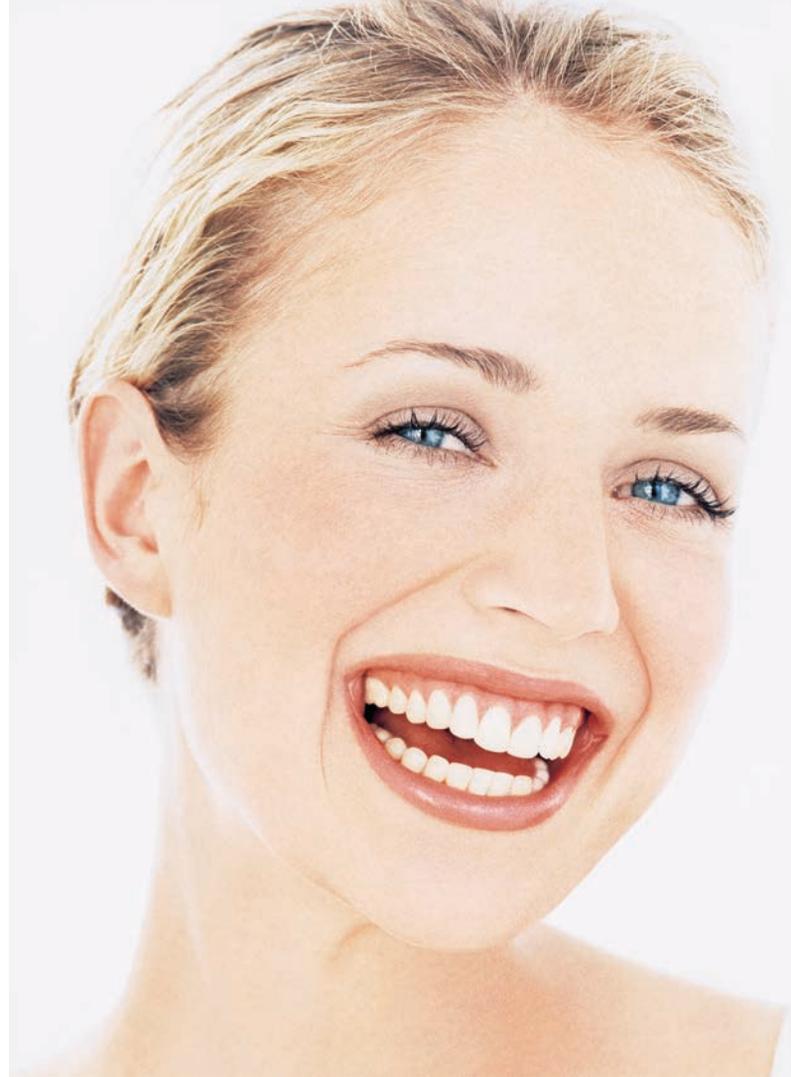
### References

1. Armbruster PC, Gardiner DM, Whitley JB JR, Ferra J. The congenitally missing maxillary lateral incisor. Part 1: esthetic judgment of treatment options. *World J Orthod.* 2005 Winter;6(4):369-75.
2. Carlson RS. Dental artistry. *Gen Dent.* 2003 Jul-Aug;51(4):326-30.
3. Miller MB. Aesthetic anterior reconstruction using a combined periodontal/restorative approach. *Pract Periodontics Aesthet Dent.* 1993 Oct;5(8):33-40; quiz 42.
4. Taleghani M, Roshan S, Baker FL, Denson PS, Herrman AB. Nonsurgical management of interdental papillae loss following extraction of anterior teeth. *Gen Dent.* 2008 May-Jun;56(4):326-31.
5. Durey KA, Nixon PJ, Robinson S, Chan MF. Resin bonded bridges: techniques for success. *Br Dent J.* 2011 Aug 12;211(3):113-8. doi:10.1038/sj.bdj.2011.619.
6. Howard-Bowles E, McKenna G, Allen F. An evidence based approach for the provision of resin-bonded bridgework. *Eur J Prosthodont Restor Dent.* 2011 Sep;19(3):99-104.
7. Denissen HW, Gardner FB, Wijnhoff GE, Veldhuis HA, Kalk W. All porcelain anterior veneer bridges. *J Esthet Dent.* 1990 Jan-Feb;2(1):22-7.
8. Joffe E. Esthetic re-creation of soft tissue architecture in replacing missing maxillary anterior teeth. *Gen Dent.* 2003 Jul-Aug;51(4):316-9.
9. Galler D, Quiong C, Galler J. A multi-disciplinary approach to congenitally missing anterior teeth. *NY State Dent J.* 2009 Jan;75(1):51-3.
10. Narcisi EM. Three-unit bridge construction in anterior single-pontic areas using a metal-free restorative. *Compend Contin Educ Dent.* 1999 Feb;20(2):109-12, 114, 116-9; quiz 120.
11. Cardaropoli G, Lekholm U, Wennström JL. Tissue alterations at implant-supported single-tooth replacements: a 1-year prospective clinical study. *Clin Oral Implants Res.* 2006 Apr;17(2):165-71.
12. Patel RR, Richards PS, Inglehart MR. Periodontal health, quality of life, and smiling patterns—an exploration. *J Periodontol.* 2008 Feb;79(2):224-31. **JCD**



Dr. Oppenheim is an AACD Accredited Fellow. He owns a private practice in Thomasville, Georgia.

Disclosure: The author did not report any disclosures.



# Renamel® Microfill™

Can You Get This Kind of Long-Term Color Stability with Your Composite?



An Incredible 22-1/2 Years Post-Op!

Picture taken before composite repair.  
Dentistry and photography by: Bud Mopper, D.D.S., M.S.



## Are Your Patients Coffee, Tea or Cola Drinkers?

A recent clinical study showed that Renamel® Microfill has a statistically significant resistance to staining and discoloration from common drink and food ingredients as compared with Filtek Supreme Ultra.\*

## Try Renamel, Your Patients Will Be the Beneficiaries!

*"The shade match was perfect! After all these years, the old veneers had not discolored one bit. The patient said she drinks tea and wine quite often. The polishability of microfill is amazing... and it apparently maintains its luster for years. My patient was really impressed also. Very happy that I have used Cosmedent products for years."*

— Dr. Mark Johnson

\*Study available on request.

# COSMEDENT®

*Spreading Smiles*



TRY OUR 30 DAY RISK-FREE GUARANTEE.

to order Renamel Microfill  
**800-621-6729**  
WWW.COSMEDENT.COM

# Myths vs. REALITIES

## LVI Neuromuscular Dentistry Philosophy

William G. Dickerson, DDS, LVIM

**Key Words:** Neuromuscular dentistry, muscular physiologic bite, neuromuscular orthotic, physiologic occlusion, parafunction

### Introduction

As dental professionals, we do what we believe is right for our patients. In line with its educational mission to provide a forum for various viewpoints and thoughts, the *JCD* invited Dr. Bill Dickerson to participate in a “Myths vs. Realities” article on neuromuscular dentistry (ND). Dr. Dickerson is the founder and CEO of LVI Global in Las Vegas, Nevada. LVI teaches ND, which treats to a muscular physiologic bite. Although it is not a new concept, it is still not widely understood by many dentists. The “myths” were submitted by members of *JCD*’s Editorial Review Board. It is hoped readers will find this article informative as it addresses possible misconceptions about ND.





## Opening Comments from Dr. Dickerson

I was asked to talk about some of the “myths” that still may exist about ND. Actually I was surprised that there are still such questions or concerns regarding ND after the more than 13 years that LVI and others have been trying to educate our profession. Many dentists have realized the power of the physiological approach to occlusion and have been exposed to the scientific evidence relating to neuromuscular dentistry.<sup>1-27</sup> I agree that it is important to address any misinformation and clarify what ND is about. I appreciate the *jCD* giving me an opportunity to discuss these myths.

“If a patient can adapt and does not have symptoms, the NM dentist is trained to not do anything.”

## Myth

A neuromuscular (NM) orthotic does not address or solve the underlying problems of parafunctional bruxing and the final NM restorations only move cusps and cuspal inclines from the destructive horizontal bruxing path.

## Reality

If that were the case, then any “splint” would work. But they don’t. Many cases of temporomandibular disease (TMD) where patients were given appliances in the past with no results have been successfully treated with an NM orthotic. We have literally had patients come in with a box full of “splints” that had been made for them. Yet putting them in their NM position with an appliance immediately resolved the problem. It is not the piece of plastic, but how it was determined where to place that piece of plastic that makes all the difference.

But how to eliminate all inclines? Don’t they have to “hit” something? Even if they only hit the cuspid, they would destroy that as well, and we have seen thousands of cases where the cuspid has been worn down due to bruxing. But by relaxing the muscles through neuromuscular principles we can eliminate bruxing.<sup>27</sup> I personally have never been able *not* to stop someone from bruxing with NM treatment. The bite will try and equilibrate itself through bruxing to find a comfortable muscular position. Finding that position before restoring the teeth prevents bruxing and is the reason why NM dentists don’t have to give their patients nightguards to protect their esthetic restorations (Figs 1 & 2).

## Myth

NM dentistry always results in a full-mouth restoration.

## Reality

That is not true. LVI teaches treatment for complex cases ranging from coronoplasty (minor tooth recontouring) to orthodontics. Restoratively it can range from a few teeth to a full mouth, depending on the individual situation of each case. The LVI dentist sees the complete picture of the health of the system, including the teeth, bones, muscles, and joints. Some of these patients will benefit from full-mouth rehabilitation and some will not, but all should have a comprehensive evaluation.

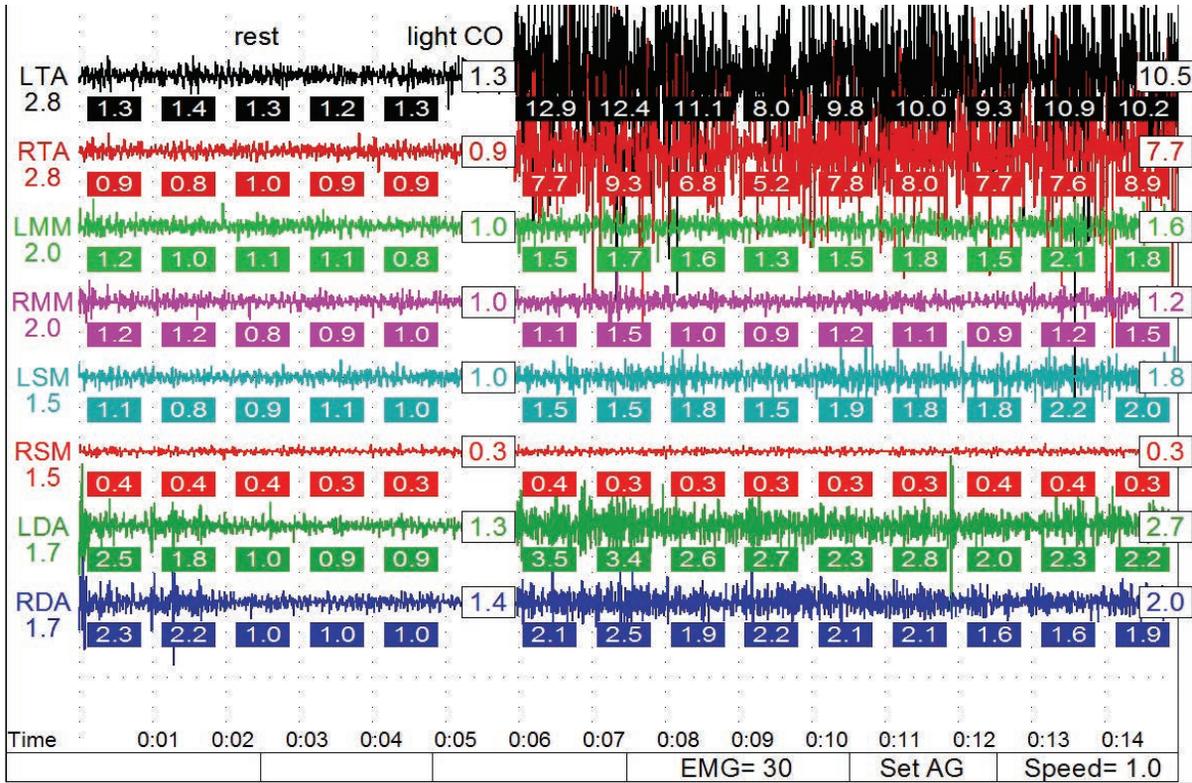


Figure 1: Electromyography (EMG) at rest, and existing bite showing hypertonicity.

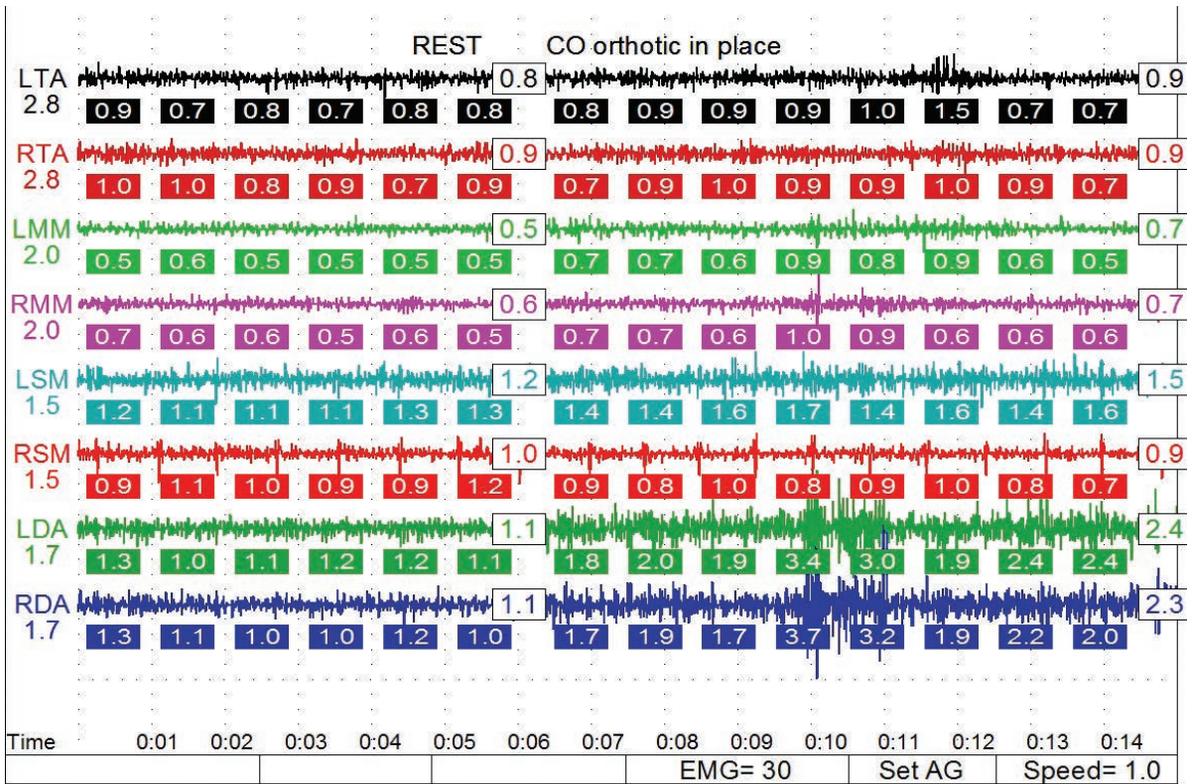


Figure 2: EMG at rest, and NM bite showing no hypertonicity.

In addition, just because someone is not in their NM position, does not mean they need treatment. If a patient can adapt and does not have symptoms, LVI students are trained to not do anything. But the patient still needs to be diagnosed as they may be predisposed to problems. It is the ethical responsibility of the clinician to inform their patients. It is no different from an ethical physician informing his or her patients of increased serum cholesterol level rather than waiting for a heart attack. By letting them know that, they can immediately seek proper treatment if issues arise (Figs 3-5).

### Myth

NM dentistry goes from using a transcutaneous neural stimulator (TENS) unit to finished restorations without testing the new vertical dimension of occlusion (VDO).

### Reality

Courses at LVI stress the importance of achieving comfort with an NM orthotic before doing any irreversible dentistry. In this respect, the LVI protocol is in conformance with the ADA's TMD dental practice parameters. I show failed cases in a lecture at LVI; failure to achieve healing and stabilization by transitioning through the orthotic stage is the leading cause of why things go wrong. Sometimes it may take up to a year of orthotic therapy to achieve desired results. Sometimes, Phase 2 (permanent case stabilization) can begin after a month of orthotic therapy, but it is dependent upon the individual case and the existing pathology.

The beauty of NM dentistry is that we know before we ever touch the teeth whether we can help the patient. And we stress not to start irreversible treatment until the dentist knows they have them in a comfortable and balanced position and can back that up subjectively through symptom resolution or objectively with EMG data. Now, without proper knowledge, the bite transfer can lose the bite as well as during case finishing. NM dentistry is not difficult, but it cannot be performed without proper training and knowledge (Figs 6-9).

### Myth

Muscle-guided vertical position obtained with NM concepts can often lead to long anterior teeth when compared to average length of natural teeth. It seems unlikely to achieve normal teeth lengths using the neuromuscular discipline.

### Reality

The average width-to-height ratio is based upon esthetics and does not create long teeth. It is possible that some dentists and/or patients select longer or whiter teeth for some reason known only to them, but the teachings of LVI are based upon the "golden proportion" found in nature.



Figure 3: Bite before coronoplasty.



Figure 4: Bite after coronoplasty in NM position.



Figure 5: NM interferences marked for adjustment.

Many dentists are used to seeing worn-down, stubby teeth and some assume that is normal. There are scientific principles around determining tooth size. The good news is that in the six dimensions of occlusion (vertical, lateral, AP, pitch, roll, and yaw), vertical is the most “forgiving” and the treating dentist has the freedom to adjust the length of the teeth pretty much as much as he or she wants (Fig 10).

## Myth

Neuromuscular dentistry is necessary and/or considered as part of an evaluation, even if a patient comes in for a cosmetic improvement to their smile and has no biologic abnormalities with their temporomandibular joints, and has no muscular symptomatology with function. For example, the patient does not desire lengthy orthodontic treatment to correct maxillary and mandibular anterior crowding.

## Reality

Dentists can diagnose only what they can see. Prior to going to dental school, a dentist couldn't diagnose much past dentures and decay that was visible to the naked eye. If you introduce x-rays, then all of a sudden the dentists who use them can diagnose interproximal decay much earlier and those who don't use x-rays may claim the others are “over-diagnosing.” Dentists who use lasers or digital photography to assist in gathering data will have the same allegations made against them. In exactly the same way, dentists who evaluate the comfort of the musculature using scientific data may be met with the same criticisms.

When a dentist does a thorough and complete examination of the patient, muscular harmony and pathology should be evaluated. As stated above, if someone is not in their muscularly harmonious position, that does not necessarily mean they need treatment. For example, I am not in my NM position but have no symptoms. However I am one of the rare members of the population that rest their jaw away from its working position. Most people hold their jaw close to the “activity.” If I diagnose anyone like myself, or anyone that has no pain even though they are not in their NM position, I will not suggest treatment. But I do inform them of the condition of their bite. This is analogous to a medical doctor informing someone with high blood sugar that they might develop diabetes in the future or that a high cholesterol level predisposes them to plaque buildup in their arteries and to be cognizant of it. I am not sure how this is any different from a dentist informing a patient of an “incipient” lesion and that he or she will watch it to see if it develops into something worse.

Now, if someone has no symptoms but shows “signs” of NM disharmony, like anterior wear, then doing esthetic treatment on that case may be ill advised without first eliminating the cause of the parafunction. The longevity of the restorations may be sacrificed for the expediency of a short-term financial gain. Nothing



Figure 6: Removable NM orthotic.



Figure 7: LVI (fixed) orthotic on mandibular arch.



Figure 8: Overclosed bite before orthotic.

“ The beauty of NM dentistry is that we know before we ever touch the teeth whether we can help the patient. ”



Figure 9: Dual-arch LVI orthotics placing patient in NM position.

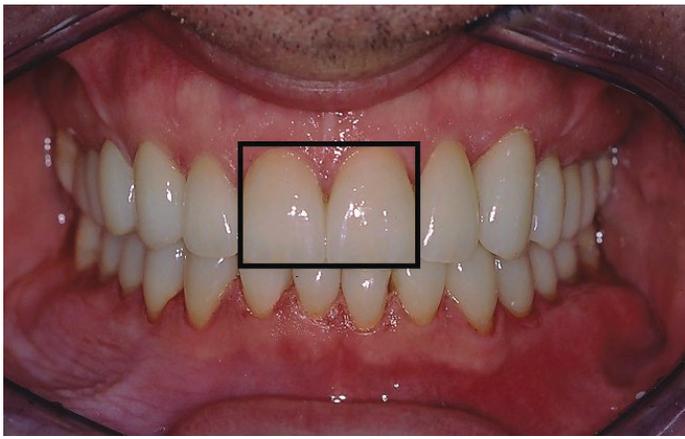


Figure 10: Normal height restoration case showing golden rectangle.

is being done to change what is causing the parafunction and it will continue. The burden of responsibility lies with the patient after informing them of the diagnosis. If they choose to continue with esthetic treatment, I will...but I won't guarantee the longevity of their restorations.

### Myth

According to neuromuscular principles, the anterior positioning of the temporomandibular joint in the glenoid fossa when the teeth are in maximum intercuspation is not a concern.

### Reality

This is hard to explain to someone who has not taken the opportunity to hear the evidence and science behind NM dentistry that during normal function, the mandible does not purely rotate, not even in the first few millimeters of motion.<sup>28</sup> That function is never in a seated position.

What is absent in conventional education about the TMJ is the remodeling of the bone that occurs due to the forces acting upon it. Start looking at joint x-rays and notice the bending of the neck of the condyle. Where would the head of the condyle be if the neck had not remodeled and bent over the years? How does someone chew like you and I do after having a condylectomy? In one of our programs, we show a video of someone eating an apple with no condyle. How? The TMJ is the only joint in the body with a hard tissue stop, and that's the teeth. That is why what we do is so important—because we can iatrogenically cause joint problems with our dentistry by compressing or distalizing the joint. Losing that posterior stop during posterior restorations is far more common than many realize.

But why is it that our profession is the only medical specialty that wants to “compress” the joint? Every other specialty wants to “decompress” the joint (Figs 11 & 12).

### Myth

The repeatability and long-term stability of the NM position is a concern.

### Reality

NM dentistry has never been more popular. Would that be the case if it weren't working? Before LVI, NM dentistry had been around for 35 years. In a past *Visions* magazine we show a 40-year-old case of Bob Jankelson's where the bite is in the exact same position it was when originally constructed.<sup>29</sup>

I have been monitoring my “old” NM patients over the past 13 years and the amazing thing is the stability of the cases. The bite has not changed in all those years in almost all cases. Some of my early cases I've had to adjust because of advances made and new knowledge gained. But the stability of NM dentistry is profound because of the harmony reached with the muscles. It's the muscles that force the changes one sees in bites over the years.

## Final Comments from Dr. Dickerson

As Dr. Omer Reed said, "You can't be down on something you're not up on!" As a scientific profession it is incumbent upon us to learn and understand concepts before we pronounce them as wrong or of no value. An example of this occurred when Professor Fusayama first wrote articles on etching dentin with phosphoric acid and he was criticized and dismissed. The automatic bias against this concept that we didn't understand took 10 years to accept in American dentistry. Of course, we now etch dentin every day in our practices. In the same manner, instead of relying on hearsay when forming an opinion on neuromuscular dentistry, the astute dentist will take a course and will arrive at an educated conclusion.

### References

1. Areso MP, Giralte MT, Sainz B, Prieto M, García-Vallejo P, Gómez FM. Occlusal disharmonies modulate central catecholaminergic activity in the rat. *J Dent Res*. 1999 Jun;78(6):1204-13.
2. Kobayashi T, Yamazaki K, Ookubo T, Furuya J, Nomura T, Kondo T, Suzuki T. HPA axis activity on occlusal interference in rat: IADR General session; June 2006 Iwate Medical University, Morioka-shi, Iwate, Japan.
3. Budtz-Jørgensen E. Occlusal dysfunction and stress: An experimental study in macaque monkeys. *Oral Rehabil*. 1981 Jan;8(1):1-9.
4. Kato K, Ono Y, Kubo K-Y, Sasaguri K, Watanabe K, Onozuka M, Sato S. Occlusal disharmony suppresses long-term potentiation in the rat hippocampal CA1 region. *Int J Stomatology & Occlusion Medicine*. 3(2):71-75. DOI: 10.1007/s12548-010-0047-3.
5. Marthol H, Reich S, Jacke J, Lechner KH, Wichmann M, Hilz MJ. Enhanced sympathetic cardiac modulation in bruxism patients. *Clin Auton Res*. 2006 Aug;16(4):276-80.
6. Ueda HM, Miyamoto K, Saifuddin M, Ishizuka Y, Tanne K. Masticatory muscle activity in children and adults with different facial types. *Am J Orthod Dentofacial Orthop*. 2000 Jul;118(1):63-8.
7. Farella M, Bakke M, Michelotti A, Rapuano A, Martina R. Masseter thickness, endurance and exercise-induced pain in subjects with different vertical craniofacial morphology. *Eur J Oral Sci*. 2003 Jun;111(3):183-8.
8. Garcia-Morales P, Buschang PH, Throckmorton GS, English JD. Maximum bite force, muscle efficiency and mechanical advantage in children with vertical growth patterns. *Eur J Orthod*. 2003 Jun;25(3):265-72.
9. Ciochon RL, Nisbett RA, Corruccini RS. Dietary consistency and craniofacial development related to masticatory function in minipigs. *J Craniofac Gen Dev Biol*. 1997 Apr-Jun;17(2):96-102.

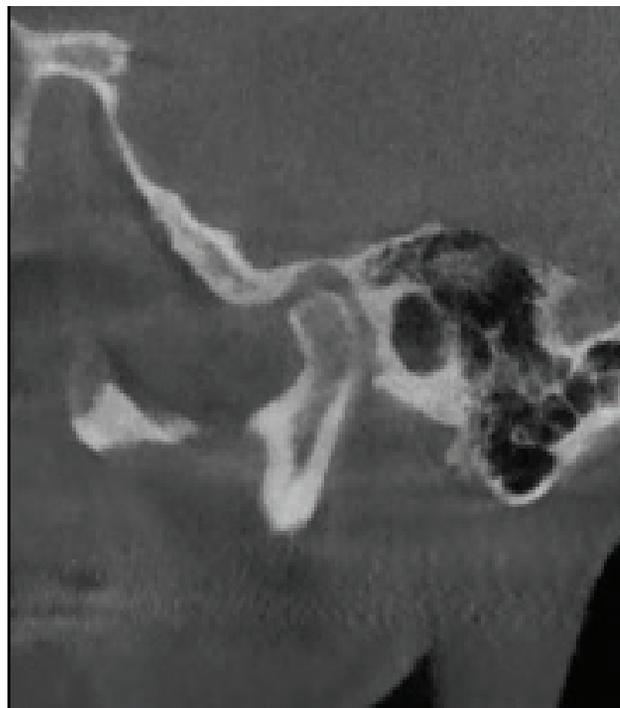


Figure 11: Joint in compressed position.

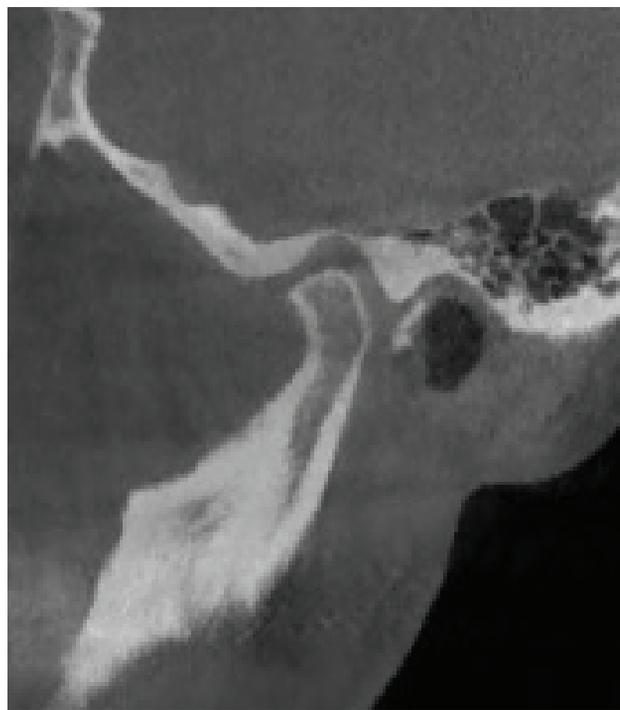


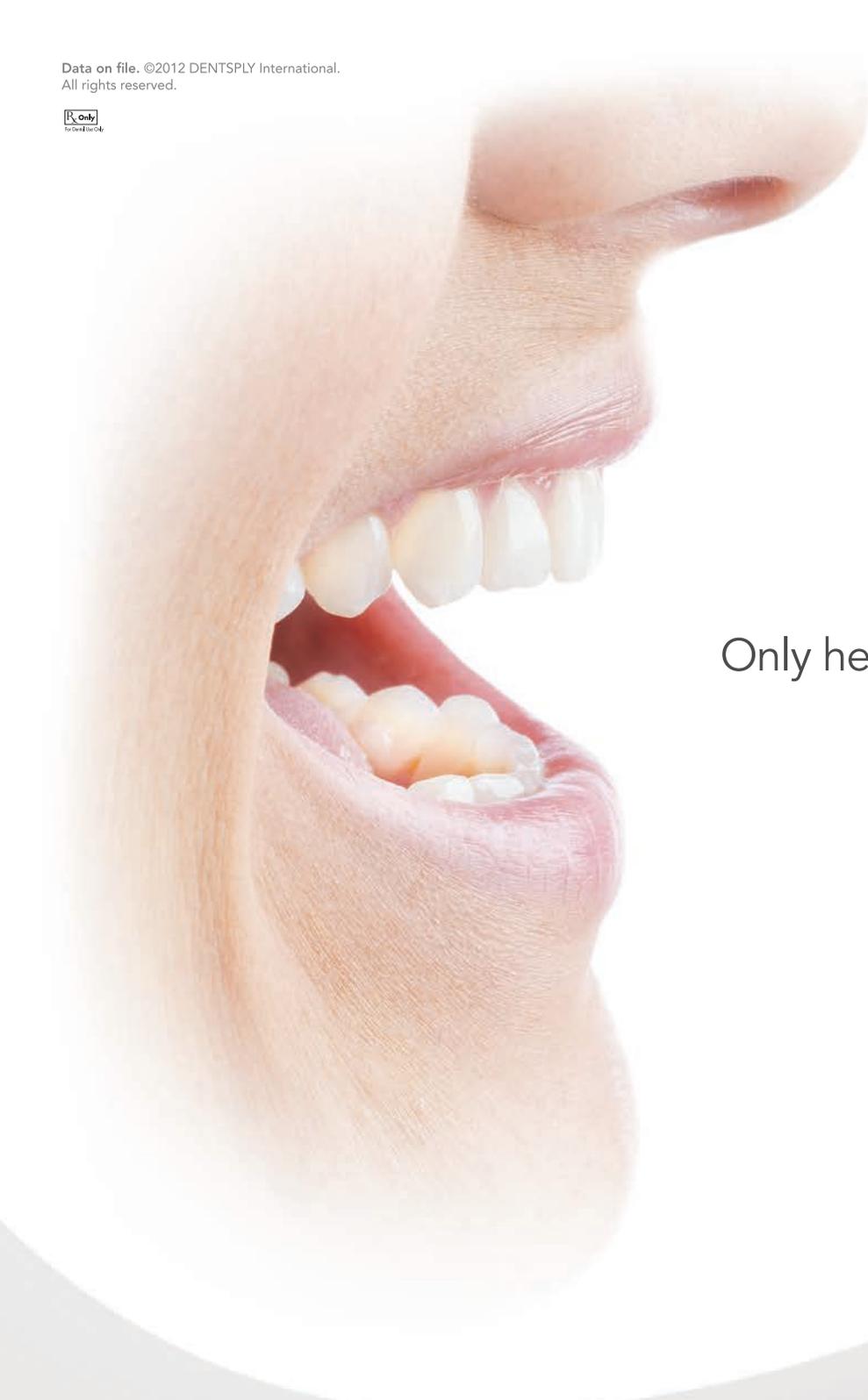
Figure 12: Joint in NM decompressed position.

10. Langenbach GE, Zhang F, Herring SW, Hannam AG. Modeling the masticatory biomechanics of a pig. *J Anat.* 2002 Nov;20(5):383-93.
11. Chamay A, Tschantz P. Mechanical influences in bone remodeling. Experimental research on Wolff's law. *J Biomech.* 1972 Mar;5(2):173-80.
12. Ciochon RL, Nisbett RA, Corruccini RS. Dietary consistency and craniofacial development related to masticatory function in minipigs. *J Craniofac Genet Dev Biol.* 1997 Apr-Jun;17(2):96-102.
13. Bresin A, Bagge U, Kiliaridis S. Adaptation of normal and hypofunctional masseter muscle after bite-raising in growing rats. *Eur J Oral Sci.* 2000 Dec;108(6):493-503.
14. Bresin A, Kiliaridis S. Dento-skeletal adaptation after bite-raising in growing rats with different masticatory muscle capacities. *Eur J Orthod.* 2002 Jun;24(3):223-37.
15. Hart RT, Davy DT, Heiple KG. A computational method for stress analysis of adaptive elastic materials with a view toward applications in strain-induced bone remodeling. *J Biomech Eng.* 1984 Nov;106(4):342-50.
16. Kiliaridis S, Engstrom C, Thilander B. Histochemical analysis of masticatory muscle in the growing rat after prolonged alteration in the consistency of the diet. *Arch Oral Biol.* 1988; 33(3):187-93.
17. Kiliaridis S, Shyu BC. Isometric muscle tension generated by masseter stimulation after prolonged alteration of the consistency of the diet fed to growing rats. *Arch Oral Biol.* 1988;33(7):467-72.
18. Yoshikawa S, Nodai E, Habu M, Furuta N, Fukuda J, Yamaguchi K. Influence of altered occlusal plane on rabbit TMJ cartilage. *J Oral Pathol Med.* 2008 Jan; 37(1):30-7.
19. Chaves K, Munerato MC, Ligocki A, Lauxen I, de Quadros O. Microscopic analysis of the temporomandibular joint in rabbits using an occlusal interference. *Cranio.* 2002 Apr;20(2):116-24.
20. Koike H, Yamashita S, Hashii K, Kirihara T. Influence of condylar guidance Inclination to condylar displacement during clenching. IADR General Session; (June 28 - July 1, 2006) Matsumoto Dental University, Graduate School of Oral Medicine, Nagano, Japan.
21. Cholasueksa P, Warita H, Soma K. Alterations of the rat temporomandibular joint in functional posterior displacement of the mandible. *Angle Orthod.* 2004 Oct;74(5):677-83.
22. Yabushita T, Zeredo JL, Toda K, Soma A. Role of Occlusal Vertical dimension in spindle Function. *J Dent Res.* 2005 Mar;84(3):245-9.
23. Fujita K. Response properties of the jaw—closing muscle spindle during decreased occlusal vertical dimension in rats. *Kokubyo Gakkai Zasshi.* 2008 Mar;75(1):1-5.
24. Woda A, Piochon P, Palla S. Regulation of mandibular postures: mechanisms and clinical implications. *Crit Rev Oral Biol Med.* 2001;12(2):166-78.
25. Keshvad A, Winstanley RB. Comparison of the replicability of routinely used centric relation registration techniques. *J Prosthodont.* 2003 June;12(2):90-101.
26. Mckee Jr. Comparing condylar position repeatability for standardized versus nonstandardized methods of achieving centric relation. *J Prosthet Dent.* 1997 Mar;77(3): 280-84.
27. Simmons WC. Neuromuscular orthotics in the treatment of bruxing and clenching in subjects with and without cervical pathology. *Anthology Int. Coll. Cranio-Mandibular Orthopedics.* 2005;VII.
28. Ferrario VF, Sforza C, Miani A Jr, Serrao G, Tartaglia G. Open-close movements in the human temporomandibular joint: does a pure rotation around the intercondylar hinge axis exist? *J Oral Rehabil.* 1996 June;23(6):401-8.
29. Jankelson R. 40 year neuromuscular/orthodontic restorative case study. *LVI Visions.* 2006 Apr-June:76-84. **jCD**



Dr. William Dickerson is a faculty member at the Las Vegas Institute for Advanced Dental Studies (LVI Global) in Las Vegas, Nevada.

Disclosure: Dr. Dickerson is the founder and CEO of LVI Global.



Only her dentist knows.

Now with  
Optimized  
Handling!



**ESTHET-X<sup>®</sup> HD**  
HIGH DEFINITION MICRO MATRIX RESTORATIVE

Restorations as real as the real thing.

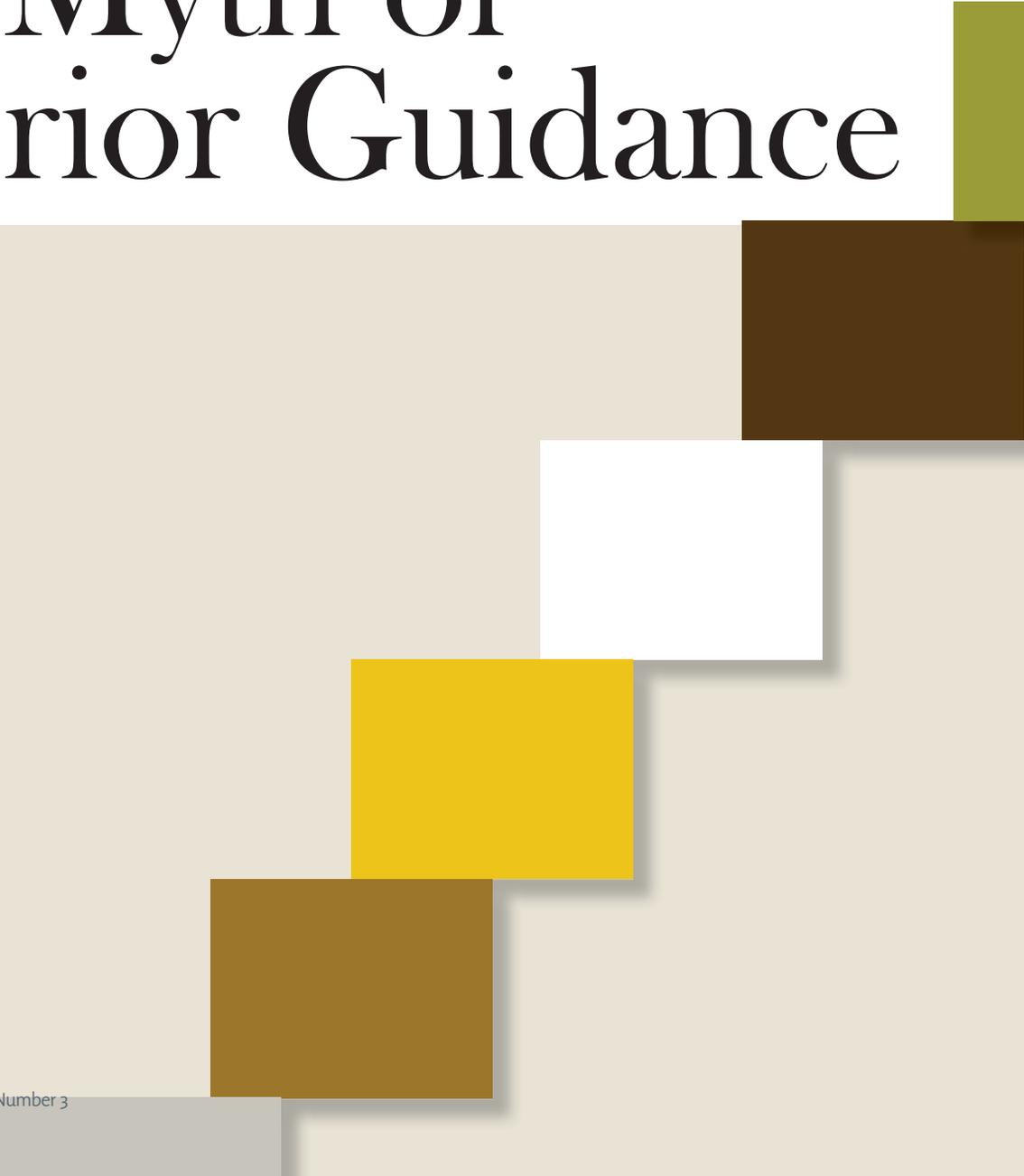
Esthet-X<sup>®</sup> HD Restorative gives you the power to mimic nature. Our TruMatch<sup>®</sup> Shade Guide offers unmatched ability to predict and control the esthetic outcome of every restoration. And optimized handling and excellent polishability deliver life-like results for a beautiful smile that's as real as the real thing.

Visit [www.esthetxhd.com](http://www.esthetxhd.com) for your FREE sample today!

GET REAL.



# The Myth of Anterior Guidance



# 10 Steps in Designing Proper Clearance for Functional Pathways

Elizabeth M. Bakeman, DDS, FAACD  
John Kois, DMD, MSD

**Key Words: Functional pathways, anterior guidance, lingual contours, anterior teeth, occlusion**

## Introduction

When restoring anterior teeth, the establishment of the incisal edge position and the development of the facial contours are dependent upon dentofacial (esthetic) parameters.<sup>1-3</sup> Establishment of the teeth's lingual contours is dependent upon functional considerations such as the dynamic relationship of the maxillary and mandibular anterior teeth when chewing, speaking, swallowing, and breathing. If the lingual contours are not appropriately developed, unfavorable consequences can occur, including chipped restorations, sore muscles and joints, tooth mobility, cement fatigue, and attrition.<sup>4</sup>

“Evaluating this dynamic relationship in the clinical setting requires an approach that more closely mimics the outside/in functional pathways.”

### Unique Pathways

We have traditionally been taught to examine the intra-arch relationship of anterior teeth by evaluating lateral and protrusive guidance. This is done by placing the patient in a supine position, placing articulating paper between the teeth, and asking the patient to occlude their teeth. The patient brings the posterior teeth into occlusion and then moves the mandible in lateral and protrusive directions. These movements represent the teeth rubbing together, starting from a position of maximum intercuspation. This examination of anterior guidance can be summarized as an evaluation of inside/out mandibular movements.

The problem with this approach is that these inside/out mandibular movements do little to represent the dynamic movements and relationships of the teeth that occur during function. During function, the teeth are apart and the mandible moves via a range of pathways to a position of maximum intercuspation. Functional movements occur from an outside/in direction and fluctuate with different degrees of muscular load.<sup>5</sup> These pathways are unique to each patient and can vary within an individual based on such factors as the type, consistency, and size of the food bolus, patient position (supine vs. upright), and skeletal influences on speech patterns.

Evaluating this dynamic relationship in the clinical setting requires an approach that more closely mimics the outside/in functional pathways. This distinction is important because outside/in movements (functional movements) require muscle activation and increased load to the teeth. Conversely, inside/out movements (excursive movements used to evaluate anterior guidance) require muscle deactivation and decreased load to the teeth. They are not the same.

### 10-Step Approach for Clinical Management

**1.** Make sure the patient is in an upright position. Functional pathways vary with postural changes. A patient will have a slightly larger envelope of function in the upright position, and this must be taken into account.



**2.** Insert articulating paper between the teeth. The paper should be 200- $\mu$  thick, which is the clearance required to prevent premature loading of the teeth as well as the distance needed to comfortably and appropriately form sibilant sounds when speaking.



**3.** Ask the patient to “chew”—to open and close and bring their back teeth together to maximum intercuspation, as if they were chewing food.

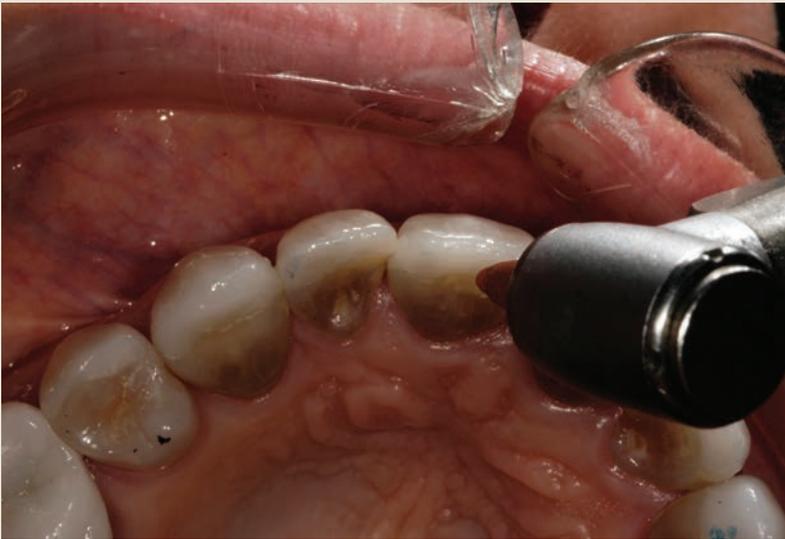


**4.** Ink streaks made by the articulating paper on the lingual aspect of maxillary incisors (provisional or definitive) represent premature loading of the teeth. The lingual contours of the maxillary incisors are adjusted until the marking ink is no longer expressed as surface streaks during chewing.





**5.** There will still be a light mark on the lingual aspect of the incisors at the most terminal aspect of the chewing stroke.



**6.** Polish tooth contours to create smooth transitions and remove any sharp angles that may have been created during the adjustment.



**7.** In the upright position, all posterior teeth and the cuspids should hold shimstock (8 μ) in maximum intercuspation.

**8.** In the upright position, the incisors should allow shimstock to slide through when the teeth are in maximum intercuspation. This does not mean the incisors are out of contact, but that the intensity of the contact is less on the incisors than it is on the posterior teeth.



**9.** There should be no fremitus on the maxillary anterior teeth.



**10.** The patient should feel as though the posterior teeth can be brought together without bumping or being constrained by their anterior teeth.



Precise records and transfer of information regarding provisional restorations, adequately designed to account for functional pathways, will minimize the need for adjustment of the definitive restorations. Even so, it is important to evaluate functional pathways in the same manner when delivering provisional or definitive restorations to avoid prematurely loading the anterior teeth.

Proper lingual contours can be predictably designed by simulating functional postures and movements. Limiting our thinking to confirmation of anterior guidance does not guarantee functional success. Inside/out movements are not representative of movements patients engage in on a daily basis when chewing, speaking, swallowing, and breathing. Designing proper clearance for functional pathways can be achieved with proper knowledge and training and will help to ensure predictable, long-term restorative outcomes.

## References

1. Gillen RJ, Schwartz RS, Hilton TJ. An analysis of selected normative tooth proportions. *Int J Prosthodont.* 1994;7(5):410-7.
2. Misch CE. Guidelines for maxillary incisal edge position—a pilot study: the key is the canine. *J Prosthodont.* 2008 Feb;17(2):130-4.
3. Vig RG, Brundo GC. The kinetics of anterior tooth display. *J Prosthet Dent.* 1978 May;39(5):502-4.
4. Dawson PE. Evaluation, diagnosis and treatment of occlusal problems. 2nd ed. St. Louis: Mosby; 1989. p. 321-52.
5. Gibbs C, Lundeen H. Jaw movements and forces during chewing and swallowing and their clinical significance. *Advances in occlusion.* Los Angeles: John Wright; 1982. p. 2-32.
6. Hiiemae K, Heath MR, Heath G, Kazazoglu E, Murray J, Sapper D, Hamblett K. Natural bites, food consistency and feeding behavior in man. *Arch Oral Biol.* 1996 Feb;41(2):175-89. **JCD**

“ Proper lingual contours can be predictably designed by simulating functional postures and movements. ”



Dr. Bakeman is an Accreditation and Fellowship Examiner for the AACD. She has served as chair of Accreditation for the AACD and chair of the American Board of Cosmetic Dentistry®.

Dr. Bakeman, an AACD Accredited Fellow, is a clinical instructor at the Kois Center in Seattle, Washington. She practices in Grand Rapids, Michigan.



Dr. Kois is the director of the Kois Center, in Seattle, Washington. He also is in private practice in Seattle.

Disclosure: The authors did not report any disclosures.

# Heraeus

## Venus® Family of Composites The New Standard of Care.

With its unique monomer chemistry, the **Venus** line of composites offers an unprecedented combination of low shrinkage stress, high durability, and superior handling for esthetic brilliance without compromise.



**PURCHASE** 6 Refills of Venus branded composites,\*  
**RECEIVE** 2 of the same –  
**AND** a syringe of Venus Bulk Fill **FREE!**

1000804071

\*Includes Venus® Diamond, Venus® Diamond Flow, Venus® Pearl, Venus® Composite, and Venus® Flow.

TO REDEEM FREE PRODUCTS: Purchase products from an authorized Heraeus dealer on one invoice between 10/1/12 and 12/31/12. Write campaign code on your invoice and fax it to (877) 271-5211. Offers can also be mailed to Heraeus, Attn: Free Goods Fulfillment, 300 Heraeus Way, South Bend, IN 46614. Invoice must be received by 1/31/13. All offers subject to change. Not to be combined with any other offers. Please allow 6–8 weeks from receipt of invoice for delivery. OFFER EXPIRES 12/31/12. \*Refill equivalent is syringe or 20-pack PLT. Venus,® and Venus Diamond® are trademarks of Heraeus Kulzer GmbH.

© 2012 Heraeus Kulzer, LLC [www.heraeusdentalusa.com](http://www.heraeusdentalusa.com)

Venus®  
The New Esthetics

# Timeless Principles in Esthetic Dentistry



Media and the economy have influenced the mindset of consumers, resulting in more educated purchasers who put great value on having their dental work done right the first time.

## A Four-Stage Protocol

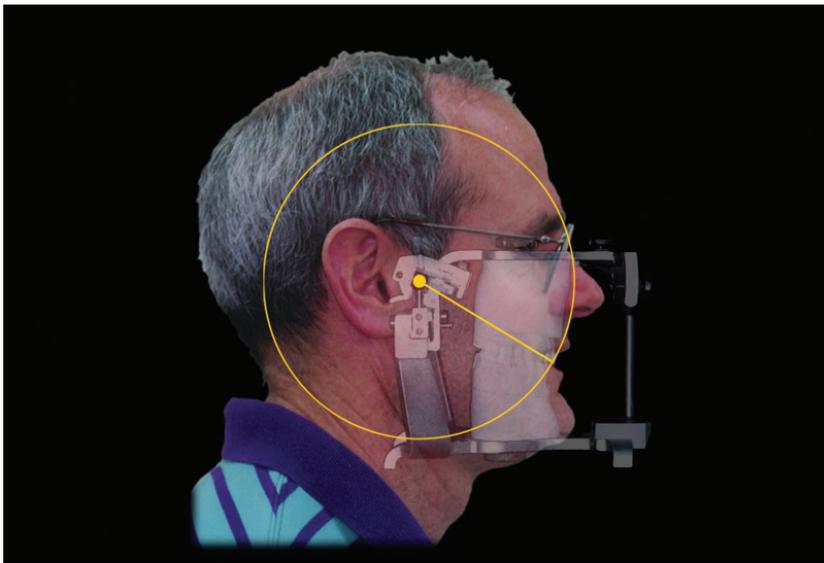
John C. Cranham, DDS  
Scott W. Finlay, DDS, FAGD, FAACD

### Abstract

The demand for dental esthetics continues to expand, driven by the media and manufacturers of dental materials. The key factors in providing predictable, durable, and esthetic restorative results for patients lie in the understanding that true dental esthetics is a mirror of the relative health of the system. It is our understanding of this masticatory system, as we begin to manipulate the components of smile design, that will ensure our success.

This article highlights the Dawson Academy's timeless protocol in achieving restorative predictability relative to dental esthetics. The protocol, referred to as the functional matrix, involves four stages: functional-esthetic analysis, three-dimensional treatment planning, prototype restorations, and definitive restorations.

**Key Words:** Occlusion, esthetics, function, smile design, provisionals



**Figure 1:** Successful, predictable treatment requires an understanding of the engineering of the masticatory system.

## Introduction

“Baby Boomers” are experiencing the signs and symptoms of dental deterioration. They represent a significant demographic with very special dental needs and present at our offices asking us to improve their oral health and their smiles.<sup>1</sup> Many have done their online research and are requesting veneers, whitening, and clear orthodontic braces. The restorative dentist’s challenge becomes the reconstruction of these smiles with plastic and glass, with predictability and durability. Adding pressure, media and the economy have influenced the mindset of consumers, resulting in more educated purchasers who put great value on having their dental work done right the first time.<sup>2</sup> For these reasons, although this is the best time in history to be involved in the dental profession, it also is the most challenging time. The core value that is the essential ingredient to success in dental esthetics is the commitment to the best interests of the patient relative to their oral health and the engineering of the masticatory system.

Although tooth-colored restorative materials and techniques have been available for the past century (in the earliest form as silicate cements), the predictability and esthetic results were disappointing.<sup>3</sup> Great progress was

made in dental materials over the ensuing decades, but the missing link was the relationship of esthetic goals and the proper management of the engineering of the system within which these teeth functioned. These wonderful advances in materials have allowed us to be even more conservative and effective in the dental treatment we provide.<sup>4</sup> However, relying on technology alone can be a double-edge sword as it can also lead to getting into trouble faster. Ninety percent of failures are attributed, not to the materials or techniques, but to our failure to plan.<sup>5</sup> As restorative dentists, we need to be comprehensive in evaluating our successes and failures. Our vision of “failure” often takes in only the fracture of the restoration, when in truth we must also recognize failure to include all of the signs and symptoms of occlusal disease, including tooth mobility or migration, gingival recession, sensitivity, muscle symptoms, and the potential for breakdown of the temporomandibular joints (TMJs).<sup>6</sup> It is our responsibility to adhere to a protocol and philosophy that help to ensure predictability and health for our patients. The goal of this article is to provide an outline of this protocol that the authors refer to as the *functional matrix*.

## Functional Matrix

As our understanding of the design of the masticatory system has evolved, we began to identify and address the two primary etiologies of dental deterioration: bacteria and force. By creating restorations that mimic natural tooth contours and with proper positioning, we can provide an environment that is cleanable and maintainable for our patients, and promote the best opportunity to obtain optimal biological health.<sup>5</sup> With the application of the functional matrix we can begin to manage the risk factors related to force.<sup>5</sup> The functional matrix is a sophisticated system that relates the optimal contours of the anterior teeth to the TMJs and the muscles of mastication. It teaches us how the importance of every specific contour of the anterior teeth is designed for a specific function. A compromise in any of these contours will inescapably influence the muscles and TMJs. The masticatory system, when properly designed, allows the muscles to respond in a non-antagonistic way, providing comfort and efficiency. The design of this system allows the TMJs, when they are in their hinge axis position, to facilitate balanced simultaneous contacts on all teeth, with an anterior guidance that is in harmony with the envelope of function and a peaceful neuromusculature (Fig 1). This helps to ensure an orthopedically stable position. The starting point of this functional matrix begins with a balanced distribution of forces with muscles that are comfortable and coordinated due to the non-conflicting proprioceptive feedback from the sequentially loaded teeth. We begin with the assessment of the joints, because we are focused on predictability. Predictability that provides a reproducible, specific reference point is referred to as *centric relation*. This is based upon our scientific understanding of the physiology in this orthopedically stable relationship.<sup>7</sup>

The goal is to provide predictable solutions for our patients, with the best esthetics possible. We are responsible for



**Figure 2:** The key to effective analysis in two dimensions through the use of photographs requires the discipline to capture images that are consistent in angulation, magnification, and exposure with a diagnostic composition in mind.

being the patient's advocate in accomplishing this endeavor as conservatively as possible through the application of a timeless protocol. This protocol is a marriage of our understanding of how this system functions and our vision of universally accepted parameters of dental esthetics, otherwise known as *smile* design. This protocol is comprehensive in nature and is evidence-based. The application of this advanced level of treatment planning is not about elitism or dentistry for the rich and famous. Whether the solutions involve plastic or ceramic, implants or partials, the

decision process remains the same. We must not be focused on selling products like veneers, bonding, or implants; but rather, on finding a treatment solution that endorses and promotes health, providing balance in a maintainable environment. This consistency in treatment planning presents a unique value in challenging economic times, when treatment may involve transitional stages that allows for "upgrades" in the future when a patient's resources permit.<sup>8</sup>

### Four-Stage Protocol

The process begins with a complete examination and an understanding of the patient's desires. Our responsibility is to study these data and make recommendations for treatment based upon the existing signs and symptoms of dental disease (Fig 2). Educating the patient about their dental needs and relating them to their desires provides a basis upon which to make decisions that are well supported and in the patient's best interest. The protocol involves four stages:

## THE FUNCTIONAL-ESTHETIC ANALYSIS

Are the TM Joints stable and healthy? Can they comfortably accept maximal load testing?	If 'Yes' proceed with checklist.	
	If 'No' treat joint first.	
<b>5 Requirements of Occlusal Stability</b>	<b>Yes/No</b>	<b>Treatment Options</b>
Are there stable stops on <b>all teeth</b> or a substitute?		
Is the anterior guidance in harmony with the envelope of function? (CR contact to incisal edges)		
Do all the posterior teeth disclude in protrusion?		
Do all the posterior teeth on the balancing side disclude during excursion toward the midline?		
Do any teeth on the working side interfere with the anterior guidance?		
<b>6 Macro Esthetic Goals</b>	<b>Yes/No</b>	<b>Treatment Options</b>
Does the patient have an acceptable maxillo-mandibular relationship in centric relation (Face, Airway, Bite)?		
Is the labial embrasure between the centrals parallel with the midline and perpendicular to the occlusal plane?		
Does the vertical and horizontal edge position of the maxillary central incisors relate to the <b>inner</b> vermillion border of the lower lip?		
Are the posterior occlusal planes in harmony with the incisal planes?		
Is the buccal corridor (transverse relationship) within normal limits?		
Is the display of gingiva acceptable when smiling?		
<b>6 Micro Esthetic Goals</b>	<b>Yes/No</b>	<b>Treatment Options</b>
Does the gingival contour have proper position & balance?		
Are 6-11 in golden proportion?		
Is the width-to-length ratio of the central incisors 75-85%?		
Is the papillary position acceptable, without black triangles present?		
Are the axial inclinations of the anterior teeth acceptable esthetically?		
Is the depth of the incisal embrasures appropriate for the patient?		
▶ <b>Treatment options:</b> Reshape, Reposition, Restore, Reposition a bony segment		

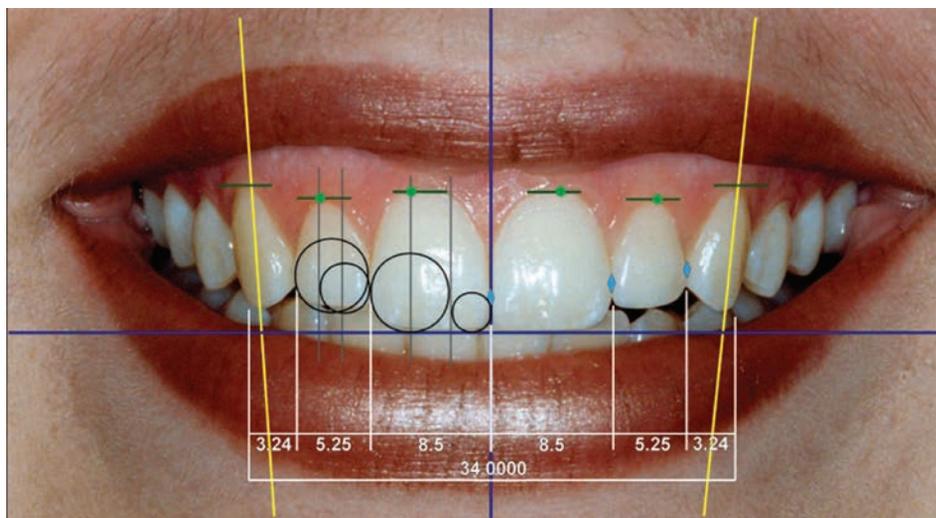
**Figure 3:** The use of checklists is essential in ensuring predictable, durable, and maintainable results.

1. Functional-esthetic analysis: The creation of a problem list that encompasses the biological, structural, functional, and esthetic components of the smile, creating a vision with the end in mind.
2. Three-dimensional treatment planning: The in vitro creation of a dental "blueprint" through the use of diagnostic mounted models with the anticipated surface changes to the teeth modeled in wax.
3. Prototype restorations: The in vivo testing of the restoration's designed contours and positions in the patient's mouth.
4. Definitive restorations: The delivery of the final restorations.

### Functional-Esthetic Analysis

Functional-esthetic analysis is the first of the checklists to help ensure the result (Fig 3). This assessment is initiated by evaluating the health of the joints and the five requirements of occlusal

stability.<sup>5</sup> This allows us to clearly identify the problems in the TMJ and the occlusion. In this process we are developing a vision of potential solutions for the patient's esthetic and functional needs. Smile design encompasses those parameters of dental esthetics that have been recognized and vetted over the past several decades (Fig 4). Our analysis of smile design is divided into three sections to conceptually assist our evaluation. We begin with the broadest strokes of smile design and progressively narrow our focus to critique the individual characteristics in our attempt to emulate nature. The concept of global esthetics focuses on those criteria that are observed in unretracted smiles and how the smile orients to the face and the lips. Continuing to narrow the field of study, we look at the elements of macro esthetics, which identifies the shapes and contours of teeth and their relationship to each other. Our final frame of reference converges on micro esthetics, which are those criteria related to the subtle intricacies of shade, textures, translucencies, and surface effects that make teeth look like teeth. These are the criteria that aid us in fooling the eye and allowing restorations to blend invisibly with natural teeth. Although esthetics in the purest sense is subjective and open to artistic interpretation, it is important to first establish a universal set of objective, systematic criteria to measure and guide the evaluation process. It is important to keep in mind, however, that every smile is unique. The true art in creating a beautiful smile is tempered by the specific idiosyncrasies of the individual patient and their underlying functional requirements. The core principle is that if we do not first share a common set of parameters for dental esthetics and smile design, then deviations from these criteria will be met with inconsistent success and uncertain value. Effective artistic interpretation can come only after mastering the proper founding principles of smile design.<sup>9</sup>



**Figure 4:** Mastering the concepts of smile design allow the clinician the ability to modulate the contours of the teeth to harmonize with the functional needs of the patient.

### Three-Dimensional Treatment Planning

Three-dimensional treatment planning offers the opportunity to envision the smile. This is accomplished with the use of accurately mounted diagnostic models in duplicate (Fig 5a). While one set of models provides our original reference point, the second set is manipulated with the use of reductive recontouring or additive waxing to begin to simulate the anticipated results (Fig 5b). This anticipated design can then be virtually tested on the articulator to see if it meets the functional parameters for stability and predictability. Once the contours of the teeth have been defined by this modulation process this becomes the dental “blueprint.” A specific set of matrices can then be fabricated from this blueprint, to be utilized chairside to allow our preparations to be efficient and conservative (Fig 6). These matrices will also aid in the fabrication of prototype provisional restorations.<sup>10</sup> It is important to remember, no matter how good a diagnostic wax-up looks, it is at best an educated guess. These contours must be tested in the provisional prototypes.

### Prototype Restorations

The prototype restorations play a far more important role than simply a transitional phase as the laboratory fabricates the definitive restorations.

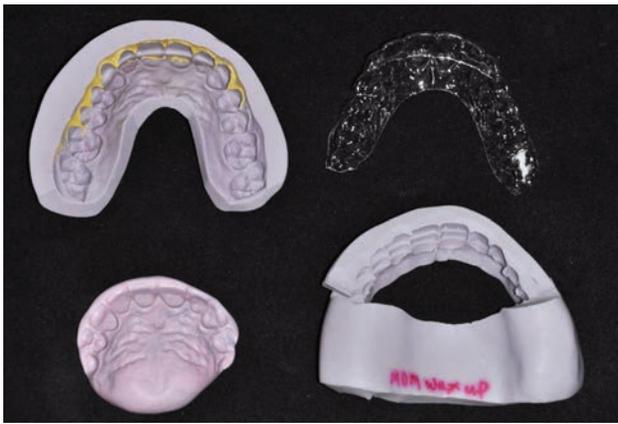
These prototypes are a reflection of the anticipated shapes and contours of the final restorations and allow us to verify two important criteria related to function and esthetics. The evaluation of the prototype restorations is completed 48 hours postoperative. Functionally, we want to customize the anterior guidance and harmonize it with the envelope of function. Phonetically, we need to test the length and position of the incisors to the patient’s tolerance in speaking. In two-dimensional treatment planning, the goal was to maximize the display of the anterior teeth. This is accomplished by observation of the display of the anterior teeth relative to the lip drape. Four key views are utilized in this assessment to determine the vertical and horizontal position of the incisal edges. The first determination is the horizontal position of the incisors. This can be observed in a profile view of the smile and a view from the anterior at an angulation 45 degrees superior to the occlusal plane. The critical factor is to ensure that the incisal edges are inside the wet dry line on the lower lip, which will facilitate the lip closure path and the neutral zone.<sup>5</sup> The second determination is the vertical component of the position of the incisal edges. With the lips at rest, a youthful smile will display 2 to 4 mm of tooth structure. A more mature smile may display only 1 to 3 mm of tooth

structure.<sup>11</sup> Observation of the centrals, when the patient says “E” and smiles, should position the incisal edges 50 to 70% between the upper and lower lip.<sup>12</sup> Comparing the position relative to the mobility of the lips will help to define the best estimate of what is appropriate for the patient. The more lip mobility, the less tooth structure will be displayed at rest. Through a series of phonetic exercises with the prototype restorations, we can confirm the need for any further adjustment. The “F” sounds, when softly spoken, will help to determine whether the teeth are too long. It should be noted however, that forcefully pronounced “F” sounds would allow the muscles to accommodate and not necessarily give a proper indication of proper tooth length. These phonetic exercises will provide clues only to teeth that are too long, not too short. The second component that is evaluated with the prototypes is the criteria related to global and macro esthetics. The orientation and alignment of the teeth to the face is a critical communication reference for the laboratory. Once the final adjustments to the prototypes are completed, and approved by the patient and the doctor, a copy of these approved provisionals is sent to the lab.<sup>13,14</sup>

The key point to remember is that initiating restorative treatment is indicated only after we have effectively evaluated the TMJs and if we have carefully satisfied each of the requirements of occlusal stability as identified in the functional-esthetic analysis checklist. The checklist establishes a protocol that will aid in predictability. The first question asks: “Are the TMJs stable and healthy? Can they comfortably accept maximal load testing?” This question appears in red (Fig 3) because if the answer is “no,” the restorative dentist cannot move forward and must treat the joint before proceeding with restorative treatment. Skipping ahead to a restorative solution without a complete assessment can only end in unpredictable results.



**Figures 5a & 5b:** The use of accurately mounted diagnostic models creates virtual simulation of the anticipated changes to the system in the development of a dental blueprint.



**Figure 6:** The fabrication of a specific series of matrices from the dental blueprint allows for efficient, effective, and conservative preparation of tooth structure and the creation of diagnostic-quality prototype restorations.

### Definitive Restorations

In the creation of the definitive restorations, the laboratory now has the information to produce predictable, beautiful restorations. The laboratory technician will utilize the approved provisional model to create two key indices that will assist in this predictability (Fig 7a). The first is an incisal edge matrix. With a mounted approved provisional restoration, a putty matrix can capture the exact horizontal and vertical position of the incisal edges of the anterior teeth. This will facilitate the reproduction of this incisal edge position in space with the final restorations

model is then moved through all excursive movements defined by the guidance that has been carefully refined and captured on the lingual guiding surfaces of the provisionals. The movement of the incisal pin through the resin material on the incisal table will record these contours, enabling the technician to reproduce these surfaces in the definitive restorations (Figs 7d & 7e).<sup>16</sup> When the restorative dentist receives the restorations from the laboratory, he or she should also receive back the two key indices (described above) for verification. The restorations can then be presented to the patient with a level of confidence

This protocol must honor the functional and esthetic parameters that are found in nature.

(Figs 7b & 7c).<sup>15</sup> The second index that the technician will create is a custom incisal guide table. With the mounted approved provisional model in place, the incisal pin is raised off the incisal table of the articulator. A dollop of resin or composite is placed on the incisal table with a lubricated surface. The approved provisional

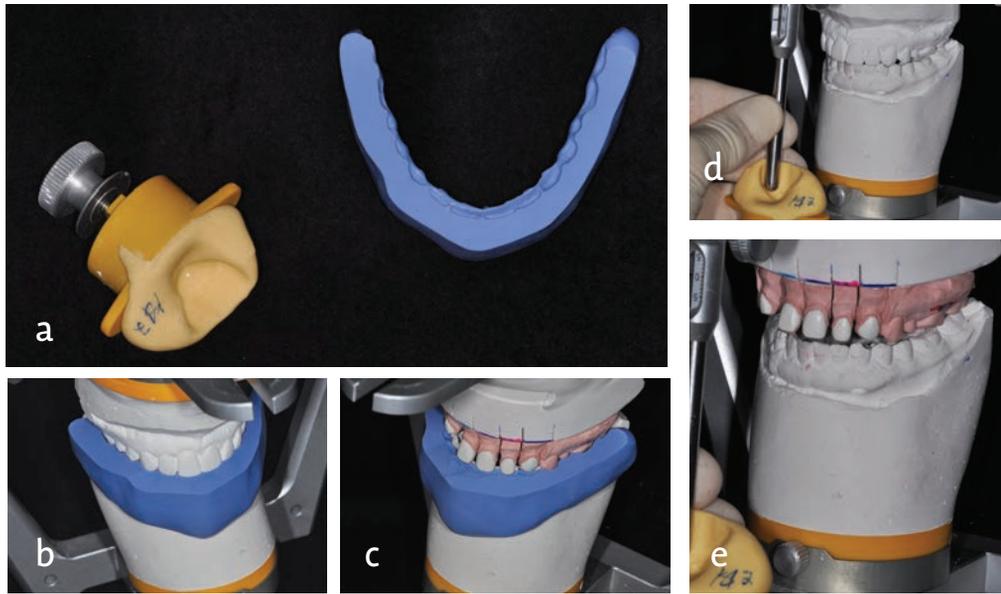
that requires very little modification. There should be no surprises at this point, and the final focus prior to delivery should simply be the refinements related to micro esthetics.

### Summary

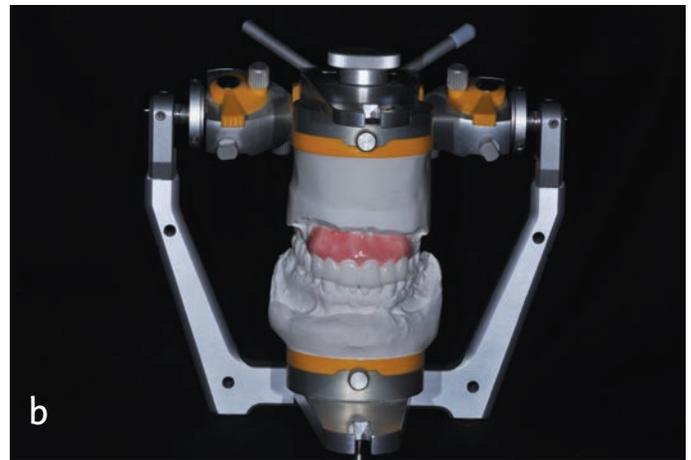
Predictable, durable, and esthetic dental restorations can only come from the implementation of a reproducible protocol. This protocol must honor the functional and esthetic parameters that are found in nature. In the end, each case is treated via four different methods:

- visually, through the tools of functional esthetic analysis (Fig 8a)
- virtually, through the use of mounted models and a diagnostic wax-up (Fig 8b)
- through the use of prototype restorations as a trial test in the patient's mouth (Fig 8c)
- with definitive restorations (Fig 8d).

The commitment to a successful protocol will eliminate errors due to ineptness and help to ensure a functional, beautiful result (Figs 9a-9g).



**Figures 7a-7e:** The approved provisional model allows the laboratory to fabricate key matrices that will effectively reproduce essential contours that have now been tested and proven in the patient's mouth. These prototype restorations are the single most important element in predictability.



**Figures 8a-8d:** The four-step protocol of the functional-esthetic matrix.



**Figures 9a-9g:** Commitment to this timeless protocol will help to ensure beautiful, durable and, most importantly, predictable results for patients.

## References

1. Brown M, Orsborn C. Boom: marketing to the ultimate power consumer—the baby-boomer woman. New York: Amacom; 2006.
2. Furlong MS. Turning silver into gold: how to profit in the new boomer marketplace. Upper Saddle River (NJ): Financial Times Press; 2007.
3. Terry DS, Leinfelder KF, Geller W. Aesthetic & restorative dentistry: material selection & technique. Stillwater (MN): Everest Publishing Media; 2009. p. 82-5.
4. LeSage B. Revisiting the design of minimal and no-preparation veneers: a step-by-step technique. J Calif Dent Assoc. 2010 Aug;38(8):561-9.
5. Dawson PE. Functional occlusion: from TMJ to smile design (ch. 1). St. Louis: Mosby; 2007.
6. Dawson PE, Cranham JC. Aesthetics and function: conflict or complement? Dent Today. 2007 Oct;26(10):80, 82-3.
7. Dawson PE. Position paper regarding diagnosis, management and treatment of temporomandibular disorders. J Prosthet Dent. 1999 Feb;81(2):174-8.
8. Calamia JR, Levine JB, Lipp M, Cisneros G, Wolff MS. Smile design and treatment planning with the help of a comprehensive esthetic evaluation form. Dent Clin North Am. 2011 Apr;55(2):187-209.
9. American Academy of Cosmetic Dentistry (AACD). A guide to Accreditation criteria. Madison (WI): AACD; 2001.
10. Hussain K. Challenging nature: wax-up techniques in aesthetics and functional occlusion. Br Dent J. 2011 Dec 9;111(11):575-6.
11. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent. 1978 May;39(5):502-4.
12. Pound E. Utilizing speech to simplify a personalized denture service. 1970. J Prosthet Dent. 2006 Jan;95(1):1-9.
13. Regish KM, Sharma D, Prithviraj DR. Techniques of fabrication of provisional restoration: an overview. Int J Dent. 2011;2011:134659.
14. Strassler HE, Lowe RA. Chairside resin-based provisional restorative materials for fixed prosthodontics. Compend Contin Educ Dent. 2011 Nov-Dec;32(9):10, 12 14.
15. Clements WG. Predictable anterior determinants. J Prosthet Dent. 1983 Jan;49(1):40-5.
16. Kaiser DA. Fabricating a custom incisal guide table. J Prosthet Dent. 1981 May;45(5):568-9. **JCD**



Dr. Cranham is the director of education at The Dawson Academy. He owns a private practice in Chesapeake, Virginia.



Dr. Finlay is an AACD Accredited Fellow and is a senior faculty member at The Dawson Academy. Dr. Finlay owns a practice in Arnold, Maryland.

Disclosure: The authors did not report any disclosures.

# Freedom to Believe

Peter E. Dawson, DDS

## An Interview with Dr. Peter Dawson

Dr. Peter E. Dawson is one of the most influential clinicians and teachers in dentistry. He is the founder and director of the Dawson Academy, which was established in 1979 and is committed to bringing logic and understanding of the masticatory system to dental professionals. Dr. Dawson is an entrepreneurial pioneer, compassionate educator, and inspirational mentor to many. In this Q&A, he shares his experiences regarding occlusal philosophies, the most beneficial developments today, and what he hopes we will commit to for the future.

*"I will continue to advocate that the dentist do the bulk of the diagnostic workup because that is when important decisions are made regarding treatment."*



Q & A

**Q: With changes in digital technology and restorative materials, what role do you see dental technicians playing in dentistry of the future?**

A: In analyzing the role of technicians, dentists often make the mistake of failing to consider a comparison of the technician's time versus their own time doing what the technician could do for them. Even with CAD/CAM technology it often is counterproductive to use valuable clinical time in fabricating restorations. There is no better combination than a highly skilled technician working with a dentist who is willing to provide the technician with all the information needed to perfect the end result. I don't see that changing, at least among dentists who value high quality...and who have thought through the trade-off of clinical time versus laboratory time. I will continue to advocate that the dentist do the bulk of the diagnostic workup because that is when important decisions are made regarding treatment. However, after a treatment plan is confirmed and proper clinical time is established, the most valuable use of the dentist's time is at the chair.

**Q: The demand for and demographics of dental continuing education (CE) have been constantly changing for the last 15 years. What trends and needs do you see developing for the future?**

A: I genuinely believe CE is more important now than it has ever been. Not only is it essential to keep up with all the new developments in materials and technology, but it also is more important than ever to have sound principles for functional occlusion, esthetics, new approaches to imaging, implantology, and all the progress that is constantly being made in diagnosis of dysfunction, orofacial pain, and other significant advancements in the practice of complete dentistry. I don't see any way that dentists can stay up to date without constantly upgrading their knowledge through CE. I also think that a major focus should be put on understanding basic principles; if these are not understood, dentists can actually do more harm than good with the increased productivity that is possible with new technology.

**Q: What do you feel are the three most beneficial developments in dentistry that you have seen during your career?**

A. Without any doubt, I would list our better understanding of functional occlusion and its relationship to the total masticatory system as the most beneficial advancement in dental practice. I put this as number one because it influences everything else that we do in dentistry. I am appalled that so few dentists have this essential understanding.

The second most beneficial development is related to the first—it is our tremendous progress in understanding the causes and treatment of temporomandibular joint (TMJ) disorders and the differential diagnosis of orofacial pain. Almost no guesswork is needed today in treating problems that every dentist sees on a regular basis (but too often ignores due to being unaware that dentists can treat these problems with an extremely high level of predictability).

The third most beneficial development includes a whole constellation of advances in equipment, materials, and techniques. Included in that group are improvements in adhesives and materials that allow near perfection in esthetics. Fantastic improvements in dental implantology...imaging capabilities that allow us to see what we could never see before so that nothing can "hide" from us, whether it be for placement of an implant or for diagnosis of a structural TMJ disorder...advances in periodontics that include a tremendously important role in improved smile design. And as a dentist who started practice standing up, using a belt-driven handpiece, I can personally attest that the development of high-speed handpieces, lasers, and high-volume suction was a major turning point for modern dentistry.

**Q:** Dr. Dawson, we sometimes forget that the current “occlusion wars” are nothing new. During the 1970s, many people, including Drs. Charlie Stuart, Charlie Dodge, Peter K. Thomas, LD Pankey, and you yourself were quite active in passionate debate centered around occlusion theory and objectives. Please contrast those times to today’s “occlusion wars.”

**A:** I’ve often described those times as “blood on the walls” debates at dental meetings. There were so many opinions, passionately held, that had no basis in factual information. The plus side of those wars was that it forced us to “put up or shut up” about our beliefs. As an example: When I tried to change the definition of centric relation (CR) from “most retruded” to “most superior” I was ridiculed, but that forced me to research the concept from every viewpoint, including doing countless dissections to understand how the biomechanics of the masticatory system worked. Working closely with Dr. Parker Mahan to develop clear concepts of physiology plus setting up a research team to study the reproducibility of CR, we were able to confirm that the uppermost position was reproducible to needle point precision. We could document that by centri-check studies. As we learned more about the relationship between occlusion and the temporomandibular joints, it led to disagreement with some of the dogmatic viewpoints held by the leaders in gnathology. When it could be proven that an immediate side shift was not possible from CR, that put a whole new light on fully adjustable instrumentation. It would take an entire book to note all the disagreements related to occlusion. However, by being open to intense scrutiny from antagonistic practitioners, most of the arguments have been settled to the point where there is very little disagreement among knowledgeable practitioners today...at least in comparison with the bloody occlusion wars of the past. Unfortunately there are still opportunistic viewpoints that have never been tested. We should demand evidence-based or verifiable criteria for success before making changes to concepts that have been tested and proven to be valid by objective standards.



This was a challenge group invited to demonstrate on live patients at a Dawson Academy “think tank” session. The issue was whether an immediate side shift from CR could be demonstrated. Experts in gnathology including Dr. William McHarris and researcher Dr. Gene Williamson participated. Dr. Parker Mahan was an observer. Testing was done by pantograph, stereographic, axiograph, and central-bearing point-tracing devices. No side shift could be demonstrated from a CR starting point. It is this kind of open-minded willingness to look for facts rather than just opinions that helped to form current concepts of complete dentistry.



Concepts of occlusion that were challenged were resolved by actual demonstration and research. This historical photograph shows Dr. Dawson demonstrating bilateral manipulation (on Dr. Parker Mahan) to achieve a “most superior” position of the condyles. This was in response to a challenge regarding its accuracy and repeatability. Observers include Dr. James Casper, Dr. Alvin Fillastre, Dr. Niles Guichet, Dr. L.D. Pankey, and Dr. Loren Miller. The comparison between bilateral manipulation and chin point guidance was verified by needle point recordings. This is how many differences between controversial viewpoints were settled.

**Q: Dentists may forget that at one point in time, you and Dr. L.D. Pankey had significant differences over occlusal theory, especially over the concept of “freedom in long centric.” How were those differences reconciled?**

A: Any differences Dr. Pankey and I had were minor. He was one of the most open-minded persons I’ve ever known, and he was one of the greatest supporters of my work. He and I had no disagreement about long centric, except that I felt it should be freedom *from* centric rather than freedom *in* centric. At the time, some of the influential voices in dentistry were looking at CR as an “area.” When I proved that it was a precise, repeatable point of rotation for the condyles, Dr. Pankey immediately accepted that as fact. I had some differences with Dr. Clyde Schuyler regarding anterior guidance. When he came to my office on several occasions to watch me work out my customized anterior guidance for anterior restorations, he would tell me I was overly complicating anterior guidance. However, he wrote Dr. Pankey that he thought I was right. Before L.D. died, he sent me the letter.

**Q: Twenty to 30 years in the past, dental education usually included a strong curriculum in occlusal study. This is largely missing from undergraduate training today. Do you see implications from this change in direction in the education of our junior colleagues?**

A: It is a tragedy that the teaching of functional occlusion concepts does not receive a major emphasis in every dental curriculum. It is a mystery to me why a subject of such great importance in every dental practice is given such minimal importance in education. Dentists who try to practice without a thorough understanding of occlusion pay a huge price in wasted time and frustration with unsatisfactory results. Dentists who do not have a basic foundation in occlusal principles also may be prone to adopt treatment approaches that are not valid.

**Q: How do you see digital technology being used in the future in terms of occlusion? Do you think dentists and labs will someday be routinely working with “digital articulators”?**

A. I think that digital technology will indeed someday be the standard. It has already progressed to a point where it is precisely accurate. The advantages in patient comfort in avoiding impressions, as well as the ability to provide complete information to the technician via e-mail offer too many pluses to be ignored. As the materials used in CAM/CAD have become stronger and more esthetic, it signals the logical direction for the future. It is possible now to achieve excellent occlusal results, and that will only get better and easier in time. It's important to recognize, however, that principles of occlusion still must be understood by both the dentist and the technician to achieve an acceptable standard of care. Also, there is no technology that will replace the necessity of proper treatment planning.

**Q: What would you like your dental legacy to be?**

A: Dentistry is one of the greatest professions anyone could be involved with. If we do it right... if we are totally honest with our patients... if we appreciate the wonderful life that dentistry provides without becoming greedy... if we balance our professional life with our personal time, we can live a joyful life with enough benefits to share. I know that anyone who makes a commitment to be a continuous student can have a multiplier effect on thousands of patients. I will be grateful if my efforts at educating dentists contribute to that multiplier effect.



Dr. Dawson a clinician and teacher of the concepts of complete dentistry, with emphasis on becoming a "physician of the masticatory system." He is the founder of The Dawson Academy.

Disclosure: The author did not report any disclosures.

*"I don't see any way that dentists can stay up to date without constantly upgrading their knowledge through continuing education."*

---

# IPS e.max<sup>®</sup> from Aurum Ceramic

---

Brilliant Esthetics  
World Class Precision  
Ultimate Performance

---

For aesthetically sensitive cases, no material performs like IPS e.max<sup>®</sup>. No other laboratory can match Aurum Ceramic<sup>®</sup> in making the most of your IPS e.max<sup>®</sup> restorations.

- A perfect fit in your practice ... for strength, precision and aesthetics.
- Beautiful, durable all-ceramic restorations - Crafted by the leader in Comprehensive Aesthetic and Implant Dentistry.
- Unique optical techniques create the ultimate IPS e.max<sup>®</sup> result.
- Can be combined with IPS Empress<sup>®</sup> Esthetic restorations in the anterior.
- Indicated for everything from single units to full mouth aesthetic cases. A great choice for 3 unit anterior bridges (from 2nd bi-cuspid forward).
- Can be adhesively bonded or conventionally cemented.



**Learn about IPS e.max<sup>®</sup>  
from Aurum Ceramic<sup>®</sup>.**

Request your information package  
(with prep chart) today!

Visit us at [www.aurumgroup.com](http://www.aurumgroup.com)

Go to [www.emaxfromCore3d.com](http://www.emaxfromCore3d.com) or Call Toll Free!

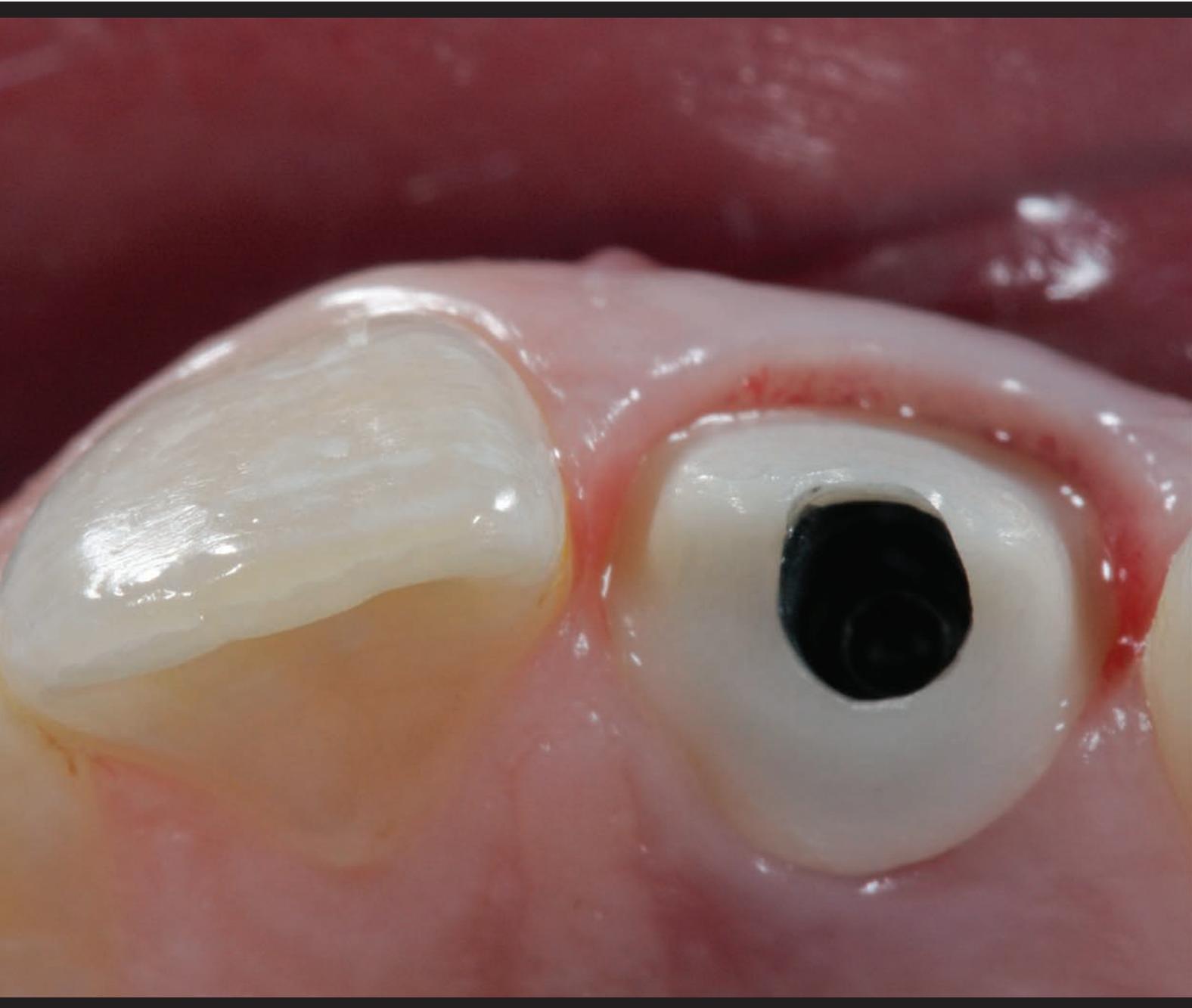


NEVADA, UTAH, NEW MEXICO AND ARIZONA: 1-877-254-5334  
WASHINGTON, OREGON, MONTANA AND IDAHO: 1-800-423-6509  
OTHER NORTH AMERICAN LOCATIONS: 1-800-661-1169



Designed and Manufactured in North America

# FUNCTIONAL and Esthetic



# Challenges

## Replacing a Single Anterior Tooth with an Implant

Amanda N. Seay, DDS  
Brad Patrick, BSc

### Abstract

Key aspects of achieving success in the replacement of anterior teeth with implants require an interdisciplinary approach. The collaboration between the surgeon, restorative dentist, and laboratory technician mandates communication of expectations and understanding of surgical and restorative requirements. Even with ideal implant placement there must be synergy between the dentist and technician to deliver the patient with the desired esthetic outcome. The purpose of this article is to highlight the key principles, from a restorative team approach, to deliver single-tooth implant esthetics with conservative techniques and material choices. The essentials addressed cover provisionalization, laboratory communication from both the dentist and ceramist perspectives, and utilization of simple materials and techniques to handle final esthetic challenges.

**Key Words:** Immediate implant, implant provisional restorations, custom impression coping, single tooth implant restorations

## Introduction

It is always preferable to have a clear plan and understanding of how the interdisciplinary team is to handle the replacement of a single anterior tooth before commencing any treatment. The restorative dentist must understand the minimum space requirements for treatment and utilize other specialists (e.g., an orthodontist) if necessary to establish proper results. Circumstances may arise, such as dental emergencies and/or trauma, that limit the amount of pretreatment data collected by the dentist to anticipate all the possible esthetic challenges that can occur. In these situations the restorative dentist must first treat the immediate trauma that is causing the patient pain or is threatening to the patient's health.

## Patient Description

A 17-year-old male in good health presented with a complete mid-root fracture on tooth #9, the result of a swimming accident. The coronal half of the tooth was mobile and the patient was in considerable discomfort (Fig 1). The patient was seen immediately after the accident and swelling was minimal. A periapical radiograph was taken to further assess the degree of trauma and evaluate the bone on adjacent teeth (Fig 2). Review of the radiograph aided in assessment of any potential esthetic shortcomings, assuming atraumatic extraction of #9. The patient was promptly sent to the surgeon's office to have #9 extracted and, if conditions were determined favorable, for placement of an immediate implant (3i, Biomet; Warsaw, IN) (Fig 3). The patient returned immediately to the restorative dentist for fabrication and placement of a provisional restoration. It would be desirable to, at the very least, give the surgeon an understanding of final restorative tooth position and deliver all necessary models and stents to accomplish this task. However, due to malposition of #9 from the accident, the surgeon was asked to mirror the coronal tooth position of #8 in determining the final position for #9 as bone heights and tissue contours surrounding #8 were all esthetically desirable.<sup>1</sup>

## Treatment

### Immediate Provisional Technique

Under more ideal scenarios, the restorative dentist would have obtained more comprehensive data on the patient such as historical photographs, radiographs, and the diagnosis and risk assessment in the biomechanical, functional, periodontal, and dentofacial categories.<sup>2</sup> In this particular case, the patient was new to the practice and there was insufficient time to



Figure 1: Tooth #9 avulsed after a swimming pool accident.



Figure 2: Complete mid-root fracture on #9.



Figure 3: Immediate implant placed.



**Figure 4:** Provisional #9, one week postoperative.



**Figure 5:** Provisional, one month postoperative.



**Figure 6:** Provisional, four months postoperative (1:1 view).

collect all the pretreatment data. An occlusal and functional evaluation was done and tooth positions were found to be acceptable. The surgeon was asked to return the extracted tooth to the restoring dentist so it could be used as a guide in making a provisional restoration. The apical aspect of #9 was carefully contoured until it could be positioned intraorally in a position that mirrored #8. The tooth fragment was secured to the adjacent teeth with a small amount of flowable composite. A putty matrix (Ivoclar Vivadent; Amherst, NY) was used to capture the new position and allowed to fully set.

A polyform temporary abutment (Biomet 3i) was secured into place and a coarse diamond bur (Brasseler USA; Savannah, GA) was used for incisal reduction. The matrix was repeatedly tried in to ensure there were no areas that were binding and preventing the matrix from fully seating. When using the putty matrix technique, the clinician does not have the ability to evaluate implant angulation in relation to desired provisional location, so it is prudent to verify that there is enough clearance from the incisal, facial, and lingual aspects. A clear plastic vacuum-formed stent technique can be used to allow visualization of the polyform abutment position. This technique simplifies reduction evaluation, especially in cases where implant angulations are not ideal. The putty matrix will, however, establish more detail in the provisional than the plastic stent. A combination of both techniques can be used to maximize the benefits if needed.

In this case, only the putty matrix technique was used. Once it was verified that a positive seat was obtained, a cotton pellet was placed into the screw access, the matrix was filled with bis-acryl (Luxatemp Ultra, Zenith/DMG; Englewood, NJ), seated in the mouth, and allowed to fully set. The access hole was then located, the cotton pellet removed and the provisional was unscrewed and retrieved. Flowable composite (Ivoclar Vivadent) was added to the cervical portion of the provisional to fill the deficient areas and create a smooth transitional surface. It is important to create a facial emergence profile that will allow the tissue to be in harmony with the teeth surrounding it. By under-contouring or flattening the emergence profile, the free gingival margin may provide a thicker collar of tissue that is more incisally positioned. Likewise, by over-contouring the emergence profile, the tissue may be more apically positioned.<sup>3-5</sup> Once proper emergence profile and form was verified, the provisional was positioned, the screw hand tightened, and the access hole filled with a cotton pellet and flexible resin (Systemp.inlay, Ivoclar Vivadent). The patient had a fair amount of white hypocalcification marks present on his teeth; a mixture of white tint (SDI; Bayswater, Victoria, Australia) that was thinned with some clear glaze (Anaxdent; Ardmore, OK) was applied to the provisional to mimic his natural

characterizations (Figs 4-6). It is sometimes necessary to make modifications to the provisional during the three-to-six-month healing phase. It is desirable to keep those alterations closer to the beginning of the healing phase to limit disturbance during final site development.<sup>6</sup>

### Functional Perspective

From a functional occlusal perspective, the patient had minimal wear, an absence of symptoms, and was considered to be low risk. The provisional occlusion was checked in maximum intercuspation with Troll-foil (TrollDental; Trollhattan, Sweden) and adjusted accordingly. Shimstock (Almore Int.; Beaverton, OR) was used to verify that the provisional and opposing tooth were free of contact within the 12 $\mu$  range. The final equilibration, to remove any interference on the lingual of the provisional when chewing, was accomplished with the patient sitting up and chewing gum in the posterior region while 200 $\mu$  articulating paper (Bausch; Nashua, NH) was placed in the anterior region. All chewing streaks on the lingual of the provisional were removed, as these illustrate areas of friction within the chewing envelope. Most of the occlusal reduction in this case was due to the chewing envelope and resulted in a rather thin incisal edge (Fig 7). In retrospect, slight incisal wear of #24 can be seen and the original position of #9 most likely was more facial than #8. However, the lack of patient historical photographs limited the clinician in recognizing this until the restorative phase.<sup>7</sup>

### Five Diagnostic Keys

To accurately predict the peri-implant esthetic outcome, the five diagnostic keys include relative tooth position, form of the periodontium, biotype of the periodontium, tooth shape, and position of the osseous crest.<sup>8</sup> While the determinants of peri-implant esthetics are not dependent upon a provisional restoration, they can serve as a valuable communication tool for both the restorative dentist and the laboratory technician. The ability to see the tissue contours with a provisional before going to a final restoration will allow the restorative team to know the esthetic limitations of what can be achieved.<sup>9,10</sup> In this case the patient, doctor, and technician all approved the esthetics of the provisional and it was decided to proceed with the final restoration after a four-month integration period. A customized impression coping technique was used to capture the cervical tissue contours of the provisional (Figs 8 & 9).<sup>11,12</sup>



**Figure 7:** Thin incisal edge due to adjustments made for the chewing envelope.



**Figure 8:** Groomed tissue contours after four months.



**Figure 9:** Custom impression coping technique. Note the blanching of tissue collar after only a few minutes of the provisional being out of the mouth.



**Figures 10a-10d:** Photographs at different angles to communicate texture, characterizations, and luster.

## Laboratory Perspective

### The Single Central

The replacement of a single central incisor remains one of dentistry's great challenges. When the tooth is being replaced with an implant, unique obstacles to ultimate esthetics arise. If the implant site is perfectly developed and pink esthetics are ideal, these are usually limited to implant position, tooth form, and color.

An edentulous site provides a technician with a blank canvas to work with free of existing tooth discolorations. If communication is excellent, impressions are perfect, photography is immaculate, and color in the images has been calibrated and verified, a single crown in the esthetic zone can be made satisfactorily in a laboratory without the patient actually visiting the ceramist (Figs 10a-11). The technician had all of the benefits of a perfect site and excellent communication when making the crown presented in this article. The crown still required three separate try-in appointments prior to final modifications being made to the contralateral incisor to bring the case together esthetically.



**Figure 11:** Shade communication.



**Figures 12a & 12b:** The first crown displayed tooth width discrepancies and too much translucency. The patient also presented, unaware, with slight screw loosening and peripheral inflammation as a result.

### First Fabrication

An esthetic hybrid abutment with zirconium luted to a titanium base was fabricated (Core3d Milling Centers; Calgary, Canada) following the design developed by the clinician, and an IPS e.max (Ivoclar Vivadent) core was waxed and pressed from an MO1 ingot.<sup>1</sup> The first crown attempted mimicked the provisional in width and recreated esthetic deficiencies due to the difference in tooth widths of the original #8 and #9. The surface morphology was acceptable, as the working casts were made from impressions that were perfect and communicated surface in great detail.

### Second Fabrication

Translucency is one of the most difficult parameters to evaluate in photographs of teeth. Incisal translucency is relatively simple compared with that of the middle and gingival thirds of teeth. The technician failed to recognize the color density of the natural #8 and applied layering techniques that expressed too much translucency in the body of the crown, thereby lowering its value. Great care should be taken by the dentist to provide verbal confirmations of similarities and differences to and from our known references (shade tabs) in the images sent to the laboratory. The technician should take great care in his or her evaluation of the references in the images to avoid costly corrections and remakes (Figs 12a-13).

The second crown attempted better managed the spatial discrepancy by manipulation of line angles but could not correct the width difference perfectly (Figs 14a-14c). IPS e.max Ceram enamel porcelains were modified with dentin powders and stains to better mimic the density and value of #8.



**Figure 13:** First crown try in and shade photographs.

“Circumstances may arise, such as dental emergencies and/or trauma, that limit the amount of pretreatment data collected by the dentist.”



**Figures 14a-14c:** Second crown try in. Color match is excellent but tooth width discrepancy is still evident. Tooth #9 is also more facial to #8 due to occlusion. Note the facial embrasure discrepancy.

### Occlusal Analysis

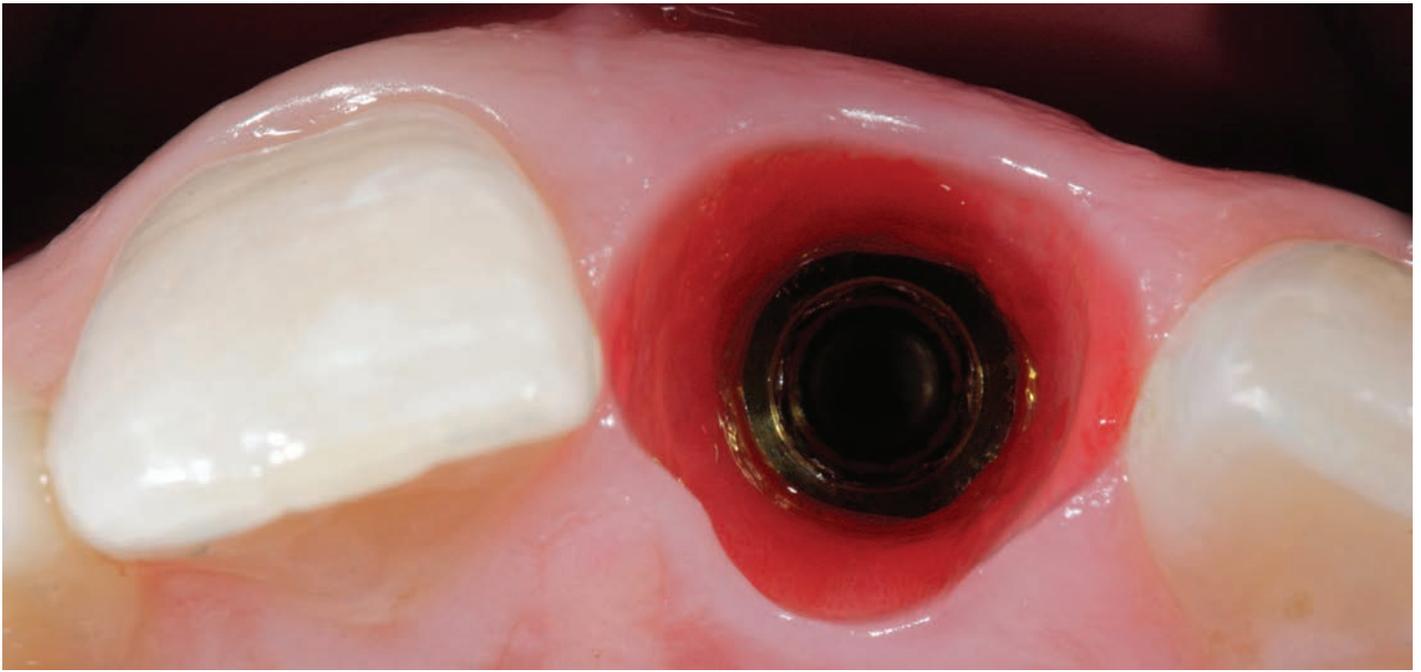
A minor occlusal problem was discovered that affected the positioning and shaping of the crown. Fabrication of a restoration for #9 with a worn, esthetically compromised incisal edge was not desirable to the patient. Positioning a restoration with an unworn incisal edge in the same arch plane as #8 was not considered a reasonable option. To avoid interfering with the opposing mandibular incisors and match the incisal edge profile of #8 it was necessary to position the incisal edge of the crown labial to that of #8. Other options included adjustment to mandibular teeth on the opposing cast (which would have necessitated further reduction of already worn incisal edges in the patient's mouth). The new crown was sent to the dental office for try in.

Upon evaluation of the crown many things were considered acceptable. The width discrepancy and relative labial position were not. Options were discussed. The technician suggested modification of #8 with composite in order to perfect shade, width, symmetry, and labial positioning relative to the crown made for #9. Minor shade modification was performed in the laboratory prior to returning the crown to the dental office for delivery.

### Clinical Delivery of Final Implant Crown

#### Direct Composite Technique

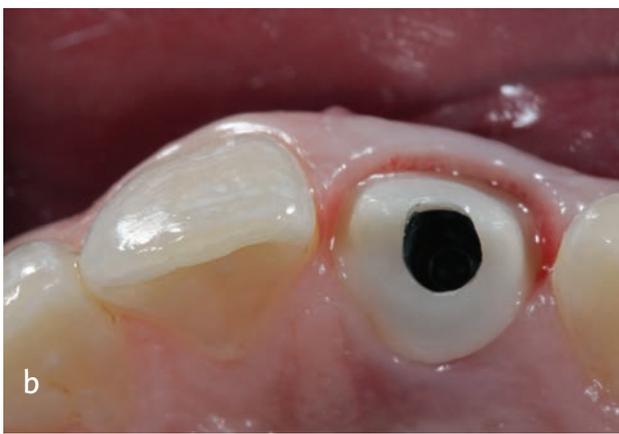
Once the final implant crown was tried in, evaluated, and determined to be the correct shade and best possible form, the clinician then had to assess the esthetic changes needed to alter #8 in order to replicate #9 as accurately as possible (Figs 15-16b). When trying to choose restorative materials, a clinician often considers not only the cost for the patient and limitations of certain materials, but most importantly, a conservative option that will preserve enamel. Composite (Venus Diamond, Heraeus Kulzer; South Bend, IN) was selected as the material of choice for its chameleon-like ability to match a particular shade and cost savings to the patient. It is both authors' opinion that it is easier to accurately obtain a proper shade match with composite than it is with porcelain. Composite allows multiple and instant shade try ins and color verification. Before commencing the final composite procedure, several shades of composite (A1, CL, AM) were applied to the tooth to visualize and color map a mock-up of the final esthetics. The patient had notable white hypocalcification marks that would need to be replicated using some white tint and layered with a translucent enamel composite shade. Previewing the



**Figure 15:** Tissue site development.



a



b

**Figures 16a & 16b:** Zirconium custom abutment.

various materials to be used allowed the clinician to begin the procedure with a clear understanding of layering and shade requirements to achieve an accurate color match.

While color accuracy was important in the restoration of the composite, it was just as critical to ensure the contours of #8 resembled those on the implant crown of #9. A pencil was used to draw the heights of contour and transitional line angles of the two teeth to more readily assess if proper match had been achieved, as well as evaluation from an occlusal view. The final polish also had to match that of the implant crown and surrounding teeth, which had considerable texture. A fine diamond flame bur (Brasseler USA) was used at low speed and light pressure to create some horizontal lines and a fine disc (Sof-Lex, 3M ESPE; St. Paul, MN) was used to bring the whole restoration to a satin luster. A super-fine polishing cup (Cosmedent; Chicago, IL) was then used to highlight the line angles and create a high shine in those areas (Figs 17a-17d).<sup>13-17</sup>

## Summary

Implant esthetics is influenced by a variety of factors throughout the treatment process. Proper understanding of goals and limitations must be communicated throughout the process between the surgeon, restorative dentist, and laboratory technician. The restorative team, in turn, must also have a grasp on the material choices and their capabilities for selective situations. This is essential in any given clinical circumstance to achieve the desired esthetic outcome.



Figures 17a-17d: Final implant crown on #9 and direct composite on #8.

“Proper understanding of goals and limitations must be communicated throughout the process between the surgeon, restorative dentist, and laboratory technician.”

## References

1. Su H, Gonzalez-Martin O, Weisgold A, Lee E. Considerations of implant abutment and crown contour: critical contour and subcritical contour. *Int J Periodontics Restorative Dent*. 2010 Aug;30(4):335-43.
2. Kois JC. Predictable single-tooth peri-implant esthetics: five diagnostic keys. *Compend Contin Educ Dent*. 2004 Nov;25(11):895-6, 896, 900.
3. Kan JY, Rungcharassaeng K, Umeza K, Kois JC. Dimensions of peri-implant mucosa: an evaluation of maxillary anterior single implants in humans. *J Periodontol*. 2003 Apr;74(4):557-62.
4. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol*. 1992 Dec;63(12):995-6.
5. Furhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. *Clin Oral Implants Res*. 2005 Dec;16(6):639-44.
6. Abrahamsson I, Berglundh T, Lindhe J. The mucosal barrier following abutment dis/reconnection. An experimental study in dogs. *J Clin Periodontol*. 1997 Aug;24(8):568-72.
7. Kois JC. *Functional occlusion: science driven management manual*. Seattle (WA): Kois Center; 2011.
8. Kois JC. Predictable single tooth peri-implant aesthetics: five diagnostic keys. *Compend Contin Educ Dent*. 2001 Mar;22(3):199-206.
9. Small PN, Tarnow DP. Gingival recession around implants: a 1-year longitudinal prospective study. *Int J Oral Maxillofac Implants*. 2000 Jul-Aug;15(4):527-32.
10. Phillips KM, Kois JC. Aesthetic peri-implant site development. The restorative connection. *Den Clin North Am*. 1998 Jan;42(1):57-70.
11. Spyropoulou PE, Razzoog M, Sieraalta M. Restoring implants in the esthetic zone after sculpting and capturing the peri-implant tissues in rest position. *J Prosthet Dent*. 2009 Dec;102(6):345-7.
12. Polack MA. Simple method of fabricating an impression coping to reproduce peri-implant gingival on the master case. *J Prosthet Dent*. 2002 Aug;88(2):221-3.
13. Cerutti A, Barabanti N. New resin composites used to restore both anterior and posterior teeth. *Br Dent J*. 2005 Apr;198(7):447.
14. Fahl N. Jr. Achieving ultimate anterior esthetics with a new microhybrid composite. *Compend Contin Educ Dent Suppl*. 2000(26):4-13.
15. Milnar FJ. Selecting nanotechnology-based composites using colorimetric and visual analysis for the restoration of anterior dentition: a case report. *J Esthet Restor Dent*. 2004;16(2):89-100.
16. Chalifoux PR. Composite tints: mixing composite materials to alter color and techniques to simulate hypocalcification and craze lines. *Compend Contin Educ Dent*. 2004 Aug;25(8):583-4, 586, 588.
17. Terry DA. Dimensions of color: creating high-diffusion layers with composite resin. *Compend Contin Educ Dent*. 2003 Feb;24(2 Suppl):3-13. **JCD**



Dr. Seay has a private practice in Mount Pleasant, South Carolina.



Mr. Patrick owns a dental laboratory in Bend, Oregon.

Disclosures: Dr. Seay receives honoraria from Ivoclar Vivadent and Heraeus Kulzer.

Mr. Patrick did not report any disclosures.

*Nothing Compares to Knight*

**KAMELEON™**

**Precision Flexible partial denture that is hard to see!**



**The Kameleon™ precision, flexible partial denture is the latest in Knight technology.**

- **Color Adaptive** – Kameleon has the ability to blend into the oral environment unlike heavy metal and acrylic partial dentures.
- **More comfortable** – Kameleon is a light weight, thin and flexible polymer replacement for bulky metal appliances.
- **Nonporous** – Bacteria and stain resistant – no odors.
- **Fits better** – Kameleon appliances flex when being placed in the mouth to provide ease of insertion and ideal adaptation.
- **Excellent retention** – The transparent clasps flex and return to their original shape and will not lose their retention over time.
- **Biocompatible** – this FDA approved material is monomer free with no known allergic reactions.
- **Strong and durable** – Kameleon stands up to the stress of normal daily use, providing years of service.

## Removable Solutions

Kameleon Clasp



Old Style metal Clasp



**Extend™**

**Implant Attachment & Removable Solutions**

3659 Tampa Road  
Oldsmar, FL 34677  
[www.knightdentalgroup.com](http://www.knightdentalgroup.com)

**For more details, contact us at; 800-359-2043**

# FORCE and Failure

There are few of us who have not experienced the anxiety, the frustration, the pain, and the loss of confidence that occurs when results fail to meet a patient's expectations.

## "Owning" the Occlusion

Lee Ann Brady, DMD  
Gary M. DeWood, DDS, MS

### Abstract

This article discusses occlusal considerations that the restorative dentist can observe prior to treatment and outcome design, thereby improving predictability in the blending of form and function to create exquisite esthetics. When occlusal forces are understood for each patient, the occlusal design can be individualized to control muscle force applied and/or distribute the occlusal forces that can be applied. This individualized approach to diagnosis and treatment planning of occlusion improves functional success.

**Key Words:** Biomechanics, comprehensive rehabilitation, occlusion

# Occlusion is a factor in dentistry that we... have learned to address by necessity.

## Introduction

As professionals who embrace the power of cosmetic dentistry, we are committed to creating life-changing experiences for the benefit of our patients (Figs 1 & 2). AACD members have the opportunity to experience the satisfaction felt by patient and doctor when the expectations of those we are privileged to serve are exceeded. Nothing is quite so intoxicating as the emotional reaction of a patient whose expectations have been surpassed. But everything has two sides. There are few of us who have not experienced the anxiety, the frustration, the pain, and the loss of confidence that occurs when results fail to meet a patient's expectations, or having met them initially, fail to do so for an acceptable period of time.

## Types of Treatment Failures

### Immediate Failures

In the authors' experience, the first types of treatment failures are those that are immediate. These failures are the result of a misunderstanding regarding what was actually possible, inadequate or improper tooth preparation, inadequate impressions, inadequate records, improper laboratory fabrication of the restorations, or bonding and cementation errors. Of all the immediate failures, the type most difficult to control is misunderstandings regarding what was possible. This is especially true when the patient has insisted on a compromise to the recommended treatment solution. Unfortunately, it is the rare patient who can actually see and understand the limitations created by the compromise until the final result is not what they envisioned.

### Force Failures

The second type of failure, occurring over time after completion of the treatment, is the result of force (when we speak of "force," we are speaking about occlusion).<sup>1,2</sup> Even those who pay very close attention to occlusion are affected by what the patient does with the restorations once they are placed in the active oral environment. The goal of this article is to assist the restorative dentist with planning and implementation regarding the occlusion and occlusal forces.



Figure 1: Preoperative smile.



Figure 2: Postoperative smile.

## Questions

Several questions regarding occlusion occur as treatment is planned and undertaken:

- If I use the existing occlusion will I be successful?
- What will happen if I change the occlusion?
- If I must change the occlusion, what do I change it to?

The answers to the first two questions are highly patient-dependent and have to do with the concept of adaptability and the amount of treatment required. The third is a philosophical question that will hinge upon the doctor's training and experiences.

### Philosophical Question

We address the philosophical (last) question first. The primary occlusal philosophies utilized today include gnathology, bioesthetics, neuromuscular, and what we will call Pankey-Dawson. Three of these philosophies preferentially use centric relation (CR) as their reference when the occlusion is being designed. One of them uses myocentric occlusion. The reference position determines the interaction of the teeth at all of the positions where they can be brought together, and is the beginning point of occlusal planning, a reference that we plan *from*, not *to*. That difference may seem inconsequential, but in fact it drives our philosophy in deciding what occlusions we must treat. We do not feel a mandatory compulsion to get all of our patients to our preferred reference position. We have referred to two reference positions above, but there is in fact a third choice, maximum intercuspal position (MIP). We find that planning from MIP is the fastest, easiest, and frequently the most appropriate of the three possibilities. When treating patients with physiologic occlusion and minimal dental needs, why would we want to change what they have? This is a departure from past occlusal thinking. We felt that there was one "right" occlusion, and patients who presented with other occlusions would definitely receive treatment to make their occlusion "right." Our training and experience was in the CR "camp," and we can both claim a period of time as zealots in trying to get the dental community to accept the "right" occlusion, which for us meant CR. Times have changed, our observational and experiential databases have grown, our education has broadened our view, and we have changed our approach. For us today, there is not a "right" occlusion if the one the patient currently possesses is working for him or her. We observe a wide variety of functional patterns that the stomatognathic system has adapted to. When that adaptability has been exceeded, changes begin to make themselves evident and we see the



**Figure 3:** Preoperative, maximum intercuspal position.

maladaptive response (i.e., signs and symptoms).<sup>3,4</sup> Pain, sensitivity, loose teeth, functional limitations, pathologic wear, cracks, fremitus, and mobility are indications that the system is changing negatively and action must be considered. In the absence of these signs and symptoms we do not feel compelled to change the patient's occlusion, even if we are planning dentistry.

### Impact of Dentistry

If the patient's occlusion is determined to be physiologic, but dentistry is required, the impact of the dentistry on the occlusion must now be considered. If the current occlusion will not be greatly affected by the planned dentistry, we plan from MIP. If the patient's current occlusion will be significantly altered or removed, we believe that it is necessary to design an occlusion for the patient; in other words, to effectively "own" that occlusion. We make the determination regarding ownership by posing a series of questions:

- Is the occlusion pathologic or physiologic? Do we see maladaptation?
- If the occlusion is physiologic, why would we change it?
- If it is physiologic and dental treatment is to be completed, how will the treatment change the occlusion?
- If it is pathologic, "ownership" is required. How will we change it?

Dentistry that impacts the teeth anywhere from first point of contact at the seated joint position to MIP carries risk. That risk is greater with posterior teeth.<sup>5,6</sup> We both have treated many patients who presented with "slides"—shifts from first point of contact at seated joint position to MIP, placing restorations that changed anterior teeth but did not impact first contact to MIP. To this point the vast majority of those cases are still successfully serving our patients, or served them until they no longer had need of the service.

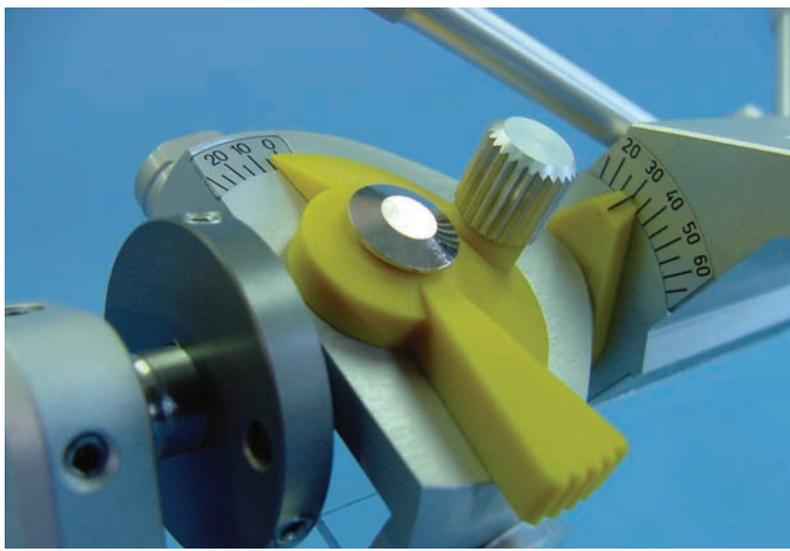
When we have determined that we need to own the occlusion, we select a reference and plan from it. For us that is usually CR, but occasionally we locate and plan from a muscle-mediated reference position. It is beyond the scope of this article to fully outline when utilization of a muscle-mediated position is the appropriate selection, but for us it always involves joint issues that make CR impossible, such as an articular disc displacement.

Once located and referenced on the articulator, the requirements for designing the occlusion do not differ dramatically from those designed from a CR reference as outlined below.<sup>7,8</sup>

Patients are able to put their teeth together in the four following ways: MIP (Fig 3), end-to-end and crossover, pathway movements between MIP and end-to-end, and retruded from MIP. All patients with anterior coupling are able to place their teeth in the first three positions. The fourth position, retruded from MIP, can be reached only by patients whose MIP is forward of their seated condylar position, forward from CR. While this is not an uncommon finding, when the ability to isolate posterior teeth is combined with dysfunctional activity, significant damage to the dentition can occur.<sup>9,10</sup> The questions one must ask are as follows:

- Where is the wear?
- Where is the sensitivity?
- Where is the mobility?
- Where are the cracks?
- Where are the fractures?

Attempting to solve the patient's desire for a more attractive smile frequently means replacing structural loss with cosmetic dentistry, a solution that can put the dentistry at significant risk. The risk varies depending on the dysfunctional activities that the patient engages in. Doing dentistry with occlusal changes at MIP carries the risk that the patient will be unable to recreate their engrams, the recorded muscle commands in the central nervous system that bring their teeth into MIP when they close. These recordings are dependent upon input from tooth contacts. When the tooth surfaces are changed, some patients are unable to "find" their bite again by creating new engrams. For patients with pathway wear, the risk is creating interference with the envelope of function and the envelope of motion. Treating patients with end-to-end and crossover wear carries the risk of removing a position or pattern that the patient has become used to and will



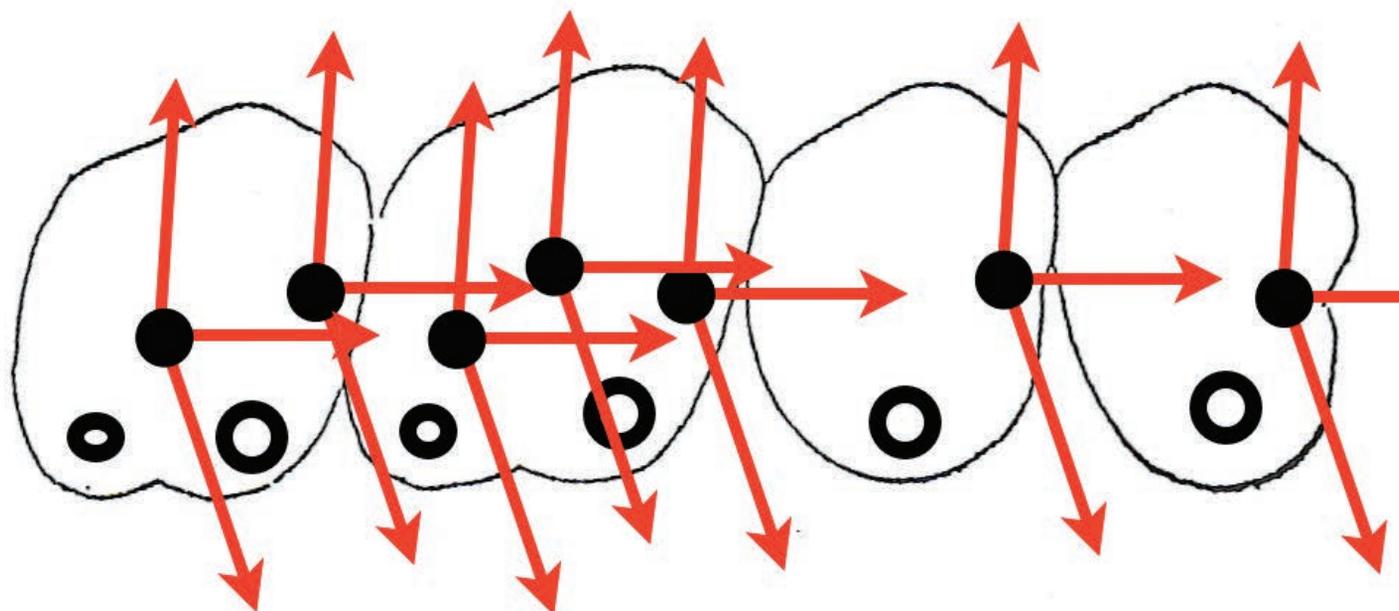
**Figure 4:** Articulator showing condylar setting.

try to regain. For patients who retrude their condyles and wear posterior teeth, the risk is broken restorations, sensitivity, and pain; in other words, that they will destroy the dentistry the way they destroyed their teeth. Minimizing the risks entails creation of occlusal interfaces that minimize the forces and control the mechanical advantages that patients were able to use while applying force to their teeth. This can be accomplished by decreasing the muscle activity that occludes the teeth, or by distributing the occlusal forces generated by the muscles over multiple teeth, or by utilizing some combination of these two strategies in the occlusal design.<sup>11-13</sup>

## Occlusal Planning

### Guidance

We always begin occlusal planning by mounting the diagnostic casts on an articulator.<sup>14</sup> The upper casts should be mounted so that the hinge axis is appropriately approximated and the casts will arc against each other as the teeth do in the patient's mouth. When the casts are hinged together all teeth should touch simultaneously. In movements away from this fully contacted position, guidance will determine what teeth contact each other, in what order they contact each other, and how long they contact each other. Guidance in occlusion has an anterior and a posterior determinant. The posterior determinant is the movement of the condyle against the articular surface of the glenoid fossa. This movement separates the teeth as the condyles move forward and down the eminence. The anterior determinant is the movement of teeth against each other and separates the teeth if there is vertical overlap of the maxillary teeth over the mandibular teeth. Since it is a skeletal form, the posterior determinant is not a controllable factor. It should be recorded so that its effect on the occlusal



**Figure 5:** Mandibular movement. Solid black dots represent the mandibular cusp tips; black circles represent the maxillary cusp tips.

design is accounted for, but it cannot be changed. To adjust the articulator for the posterior determinant, a protrusive bite record or lateral check bite should be completed and the appropriate adjustment made on the articulator (Fig 4). The anterior determinant, commonly called the *anterior guidance*, is a controllable factor and can be changed to increase or reduce the disclusion of the posterior teeth.

If canine guidance is the planned design, the canines will carry the contact in excursive movements until the edges of the central incisors are contacting each other. No posterior teeth touch after movement begins and the mandibular cusp tips must have a clear pathway for all movements away from their “tap-tap” position (Fig 5, solid black dots). The “hand-off” from canine to central may also involve lateral incisor contact, but lateral incisors should not be asked to carry the guidance alone. When canine guidance is the choice, protrusive movement is usually carried by the central incisors forward on the marginal ridges of maxillary and incisal edges of mandibular out to their edges. If group function is the planned design, the type of group function needs to be selected before

Attempting to solve the patient's desire for a more attractive smile frequently means replacing structural loss with cosmetic dentistry, a solution that can put the dentistry at significant risk.

completing the design. With full group function, the design strives to keep as many teeth in contact as possible through all movements of the mandible. This design was used for many years in dentures, where it was described as “balanced” occlusion. With dentate patients, group function usually means a limited number of teeth in contact with the canine for variable amounts of time throughout the movement. When we use group function occlusions with natural teeth we try to refrain from molar contacts, preferring to use premolar contacts that release as soon as practical in the guidance scheme. Our goal is to move the guidance as far forward as quickly as possible. We enlist the aid of teeth on the working and/or non-working side as appropriate to meet the goals of supporting the guidance and distributing the load over multiple teeth. When group function guidance is the choice, the guidance in protrusive movements can be designed to begin on premolars and can include as many of the anterior teeth as possible to share the load.

Our selection of a guidance pattern is based on what the patient has told us they do. When it comes to functional interactions it is not the relationship of the teeth to each other that determines the occlusal risk; rather, it is what the patient does when they move the teeth against each other. Class II Division I occlusions may exhibit severe pathway wear, or they may not. It is not what they have, it is what they do with what they have.<sup>15</sup> They tell us what they do through the evidence that exists on their dentition. In our experience, patients can be expected to keep doing whatever it is they have been doing in the past regardless of our changes to their occlusion. If the patient has created a parafunctional pathway, increasing the overjet and reducing the overbite while accommodating the pathway will reduce the forces that can be applied. If the patient has created an end-to-end parafunctional “play area” we create free, easy, and smooth movements at that position so the patient cannot “grab” an area and apply force. For a patient who shows no evidence of parafunctional movements, we find that canine guidance works well regardless of the functional contacts that could be created in the teeth before treatment. When the patient is “telling a different story” through the patterns of wear on their teeth, we find that getting help in movements is not just a good idea, it is a necessity. Even with careful

#### Requirements for Occlusions We Have Decided to Own

- condyle/disc appropriately positioned
- posterior teeth touch simultaneously
- forces directed down the long axis of all posterior teeth
- front teeth have slightly lighter contact
- under clench, neither teeth nor jaw deflect
- molars do not contact in lateral movements
- anterior guidance moves forward as quickly as possible
- if group function is appropriate, premolars and canines carry it
- no balancing interferences
- lateral crossover supported by anterior teeth
- straight protrusive has no lateral movements and ends on both centrals evenly

design, we protect our occlusions with nightguards to improve the predictability and the lifespan of the restorations.

The design of an occlusion on the articulator, when we have complete control of all surfaces, often is easier than designing an occlusion in the mouth on natural teeth. The requirements are no different, but equilibration can bring us to more decision points as we strive to achieve the goals and satisfy the requirements without mutilating teeth. If the contacts on teeth are all in an excellent position, but we are missing some of those contacts, what do we do? Keep reducing, move the teeth together, add material, leave the teeth alone and wait for them to erupt? All of these strategies work and we have utilized them all. If the trial equilibration has been completed on the mounted casts (a prerequisite to equilibration from which we never vary), the questions would already have been considered and decided.

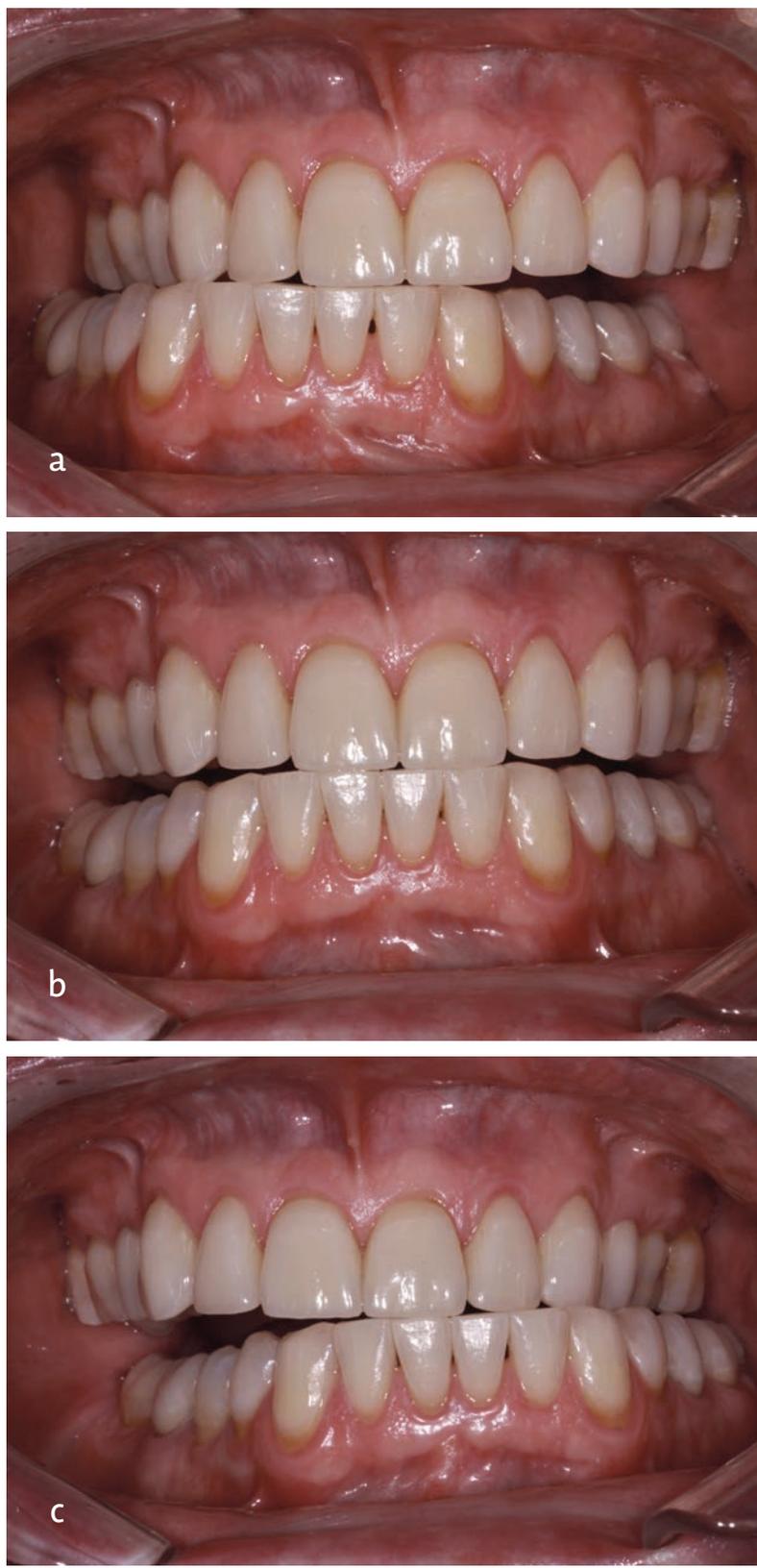
When it comes to “rules,” we believe that LD Pankey said it well: Occlusion is simple. When the jaw is closed all the teeth hit at the same time with equal force. When power is applied the jaw does not move and no teeth move. In movements away from this position no back tooth hits before, harder than, or after front teeth. Occlusion is simple, but it is not easy.<sup>16</sup>

## Summary

Occlusion is a factor in dentistry that we, like most of our colleagues, have learned to address by necessity...the necessity of failure. Most dental education provides a broad overview in the academic design regarding philosophy of occlusion, and the result is a large group of professionals who have intentionally not developed a philosophy...and who eventually discover that simply not thinking about it does not work for them. Knowing that this patient (Figs 6a-6c) spends so much of his time on the edges made it easier for us to attain success because he can still “play” on those edges. The disappointment, frustration, pain, and anger of both patient and dentist when beautiful esthetics are destroyed by forces that were not fully understood is the painful wake-up call that many of us have received. We hope that you never experience that.

## References

1. Mansour RM, Reynik RJ. In vivo occlusal forces and moments: I. Forces measured in terminal hinge position and associated moments. *J Dent Res.* 1975 Jan-Feb;54(1):114-20.
2. Mansour RM, Reynik RJ. In vivo occlusal forces and moments: II. Mathematical analysis and recommendations for instrumentation specifications. *J Dent Res.* 1975 Jan-Feb;54(1):121-4.
3. Ramjford SP, Ash, MM. *Occlusion.* 2nd ed. Philadelphia: WB Saunders; 1971.
4. Shikhoslam A, Holmgren K, Riise C. Therapeutic effects of the plane occlusal splint on signs and symptoms of craniomandibular disorders in patients with nocturnal bruxism. *J Oral Rehabil.* 1993 Sep;20(5):473-82.
5. MacDonald JW, Hannam AG. Relationship between occlusal contacts and jaw-closing muscle activity during tooth clenching: part I. *J Prosthet Dent.* 1984 Nov;52(5):718-28.



Figures 6a-6c: Postoperative function on the edges.

6. MacDonald JW, Hannam AG. Relationship between occlusal contacts and jaw-closing muscle activity during tooth clenching: part II. *J Prosthet Dent.* 1984 Dec;52(6):862-7.
7. Schuyler CH. Principles employed in full denture prosthesis which may be applied to other fields of dentistry (occlusion). *J Am Dent Assoc.* 1929;16:2045-54.
8. Schuyler CH. The function and importance of incisal guidance in oral rehabilitation. *J Prosthet Dent.* 1963 Nov-Dec;13(6):1011-29.
9. Riise C, Shikholeslam A. The influence of experimental interfering occlusal contacts on the postural activity of the anterior temporal and masseter muscles in young adults. *J Oral Rehabil.* 1982 Sep;9(5):419-25.
10. Widmalm SE, Ericsson SG. Maximal bite force with centric and eccentric load. *J Oral Rehabil.* 1982 Sep;9(5):445-50.
11. Williamson EH, Lundquist DO. Anterior guidance: its effect on electromyographic activity of the temporal and masseter muscles. *J Prosthet Dent.* 1983 Jun;49(6):816-23.
12. Manns A, Chan C, Miralles R. Influence of group function and canine guidance on electromyographic activity of elevator muscles. *J Prosthet Dent.* 1987 Apr;57(4):494-500.
13. Manns A, Miralles R, Valdivia J, Bull R. Influence of variation in anteroposterior occlusal contacts on electromyographic activity. *J Prosthet Dent.* 1989 May;61(5):617-23.
14. Zuckerman GR. The geometry of the arbitrary hinge axis as it relates to the occlusion. *J Prosthet Dent.* 1982 May;48(5):725-33.
15. Lavigne GJ, Khoury S, Abe S, Ymaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. *J Oral Rehabil.* 2008 Jul;35(7):476-94.
16. Pankey LD, Davis WJ. A philosophy of the practice of dentistry. 1st ed. Toledo (OH): Medical College Press; 1985. **jCD**



Dr. Brady earned her DMD from the University of Florida College of Dentistry. She is a guest faculty member at The Pankey Institute and maintains a private practice in Glendale, Arizona.



Dr. DeWood earned his DDS from Case Western Reserve University in Cleveland and his MS from the University of Toledo College of Medicine. He is executive vice-president for curriculum and clinical education at the Spear Institute, in Scottsdale, Arizona.

Disclosure: The authors did not report any disclosures.

## In Memoriam

### Norman L. Feigenbaum, DDS

The AACD extends its condolences to the family, friends, and colleagues of AACD Past President Dr. Norman L. Feigenbaum, who passed away recently. Dr. Feigenbaum served as AACD President from 1999-2000 and received the AACD's Lifetime Achievement Award in 2007. His leadership and contributions to the Academy and to the field of esthetic dentistry were plentiful, enlightening, and respected. Dr. Feigenbaum will be missed by many.



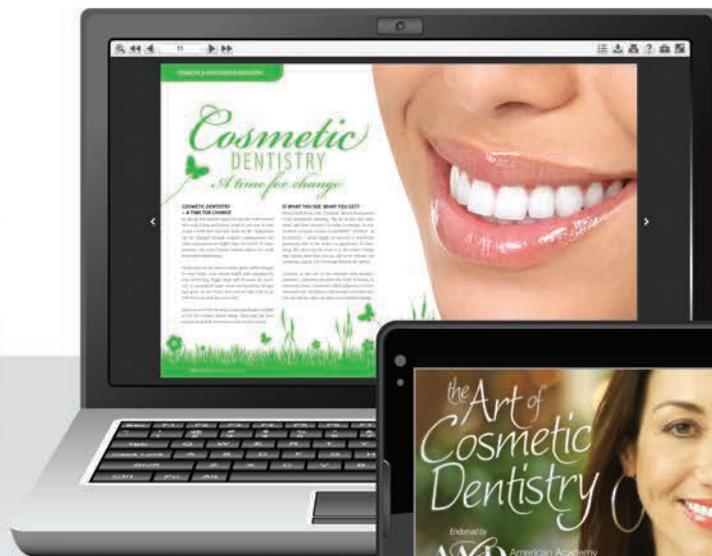
AACD Past President Marty Zase presents fellow Past President Norman Feigenbaum with a Lifetime Achievement Award at the AACD's 2007 Annual Scientific Session.

# Dear DOCTOR<sup>®</sup>

DENTISTRY & ORAL HEALTH

## The Leader in Patient Education

The American Academy of Cosmetic Dentistry (AACD) has partnered with Dear Doctor to provide the very best in patient education. Now your practice can impress and educate patients while they are in your treatment room, reception area, on the go, or at home with easy-to-understand educational information.



FREE COSMETIC DENTISTRY VIDEOS



Featuring Cosmetic Dentistry content endorsed by the



Ask about special AACD member pricing!

(866) 821-5458

[www.DearDoctorMarketing.com](http://www.DearDoctorMarketing.com)

# Minimally Invasive & Comprehensive Rehabilitation of Severe Tooth Wear & Extensive Decay

A Conservative, “Hybrid” Approach

Didier Dietschi, DMD, PhD

## Abstract

The retention of natural teeth thanks to a decreased incidence of carious and periodontal diseases, combined with occlusal parafunctions (bruxism) and erosion have created a new form of pathology. It represents a true challenge for the dental team. When conventional prosthetic, full-mouth rehabilitation is not yet indicated (or also in the case of financial limitations), original solutions must be explored, taking advantage mainly of adhesive techniques. These solutions include “prepress” anatomical and functional enhancements using freehand composite application, direct composite and indirect composite, or ceramic restorations. This case report illustrates this treatment philosophy. A 60-year-old patient presenting with severe tooth wear and multiple direct and indirect restorations (in variable conditions) was treated with a combination of adhesive techniques. In particular, new prefabricated composite veneers were utilized to protect residual tooth structure, replace missing hard tissues, and restore a better occlusal scheme and esthetics. In addition to other important restorative objectives, treatment cost was kept relatively low.

**Key Words:** Tooth wear, vertical dimension of occlusion (VDO), direct bonding, pressed ceramics, prefabricated veneers





a

## Introduction

The decreasing incidence of carious and periodontal diseases has allowed many of our patients to retain their teeth. However, this otherwise positive impact on dental health has triggered the emergence of other pathologies, often facilitated by lifestyle factors. Tooth wear (attrition and erosion) has become a major concern. Erosion occurs due to unbalanced dietary habits with high consumption of acidic food/drinks, as well as from abnormal acid production from conditions including bulimia nervosa, acid regurgitation, and hiatal hernia. Insufficient saliva flow rate or buffer capacity and saliva composition changes caused by various diseases, medications, and aging are other etiological co-factors.<sup>1-3</sup> Abrasion and attrition are induced in particular by awake and sleep bruxism.<sup>4-6</sup> These two forms of pathologies can severely impact tooth integrity. Initial complaints reported by patients are often of an esthetic nature, such as a shortening of teeth, discolorations, and tooth displacement. Without proper attention and treatment, biological problems will then also occur, with dentin sensitivity, increased carious risk, and premature loss of restoration marginal adaptation.

Treatment strategy for these patients involves proper diagnosis followed by the improvement of existing medical conditions (whenever possible); then, appropriate preventive and restorative measures must be planned. Lately, a major focus has been given to conservative, adhesive restorations to treat such pathologies.<sup>7-14</sup> Various procedures and even restorative materials must be considered, depending first upon the biomechanical status of each tooth and also on the patient's age and financial resources; needless to say, finding an optimal balance between these three considerations is a true challenge. A conservative approach using various forms of adhesive, partial restorations proved its potential to restrict ongoing tissue destruction and restore function without any additional tissue damage or loss, thus limiting biological complications.<sup>12-16</sup>

The following case report describes the treatment of an adult patient suffering from severe tooth wear. Treatment involved a combination of direct partial restorations, prefabricated composite veneers, and indirect ceramic restorations; the goal was to achieve the best possible compromise between treatment quality and cost.



b



c



d



e

**Figures 1a-1e:** Preoperative full-face and intraoral views showing severe tooth wear accompanied by numerous fractures to the natural and restored teeth. The patient sought a comprehensive treatment approach but also had limited financial resources. An innovative therapeutic scheme was needed, making great use of adhesive techniques wherever possible.

“ The decreasing incidence of carious and periodontal diseases has allowed many of our patients to retain their teeth. ”

## Patient History

The patient was a 60-year-old male with good oral hygiene. He had been in a regular dental maintenance program but had not had a comprehensive treatment approach (Figs 1a-1e). The patient's main complaint was esthetic; he was unhappy with an irregular smile line, broken and worn incisal edges, retruded incisor position, and upper right premolar and dark tooth color. Clinical evaluation confirmed the patient's self-perception of esthetic deficiencies but also revealed other clinical problems:

- generalized tooth wear due mainly to sleep (and probably awake) bruxism
- deep-bite and Class II occlusion, with edge-to-edge relationship on the left side lateral segments
- broken restoration on the lower left second molar, temporarily restored
- missing lower right molar, replaced by an implant but not yet restored
- defective porcelain-fused-to-metal (PFM) crowns on upper left incisors and first premolar.

The patient had financial limitations and wanted to achieve a better appearance through conservative restorative solutions.

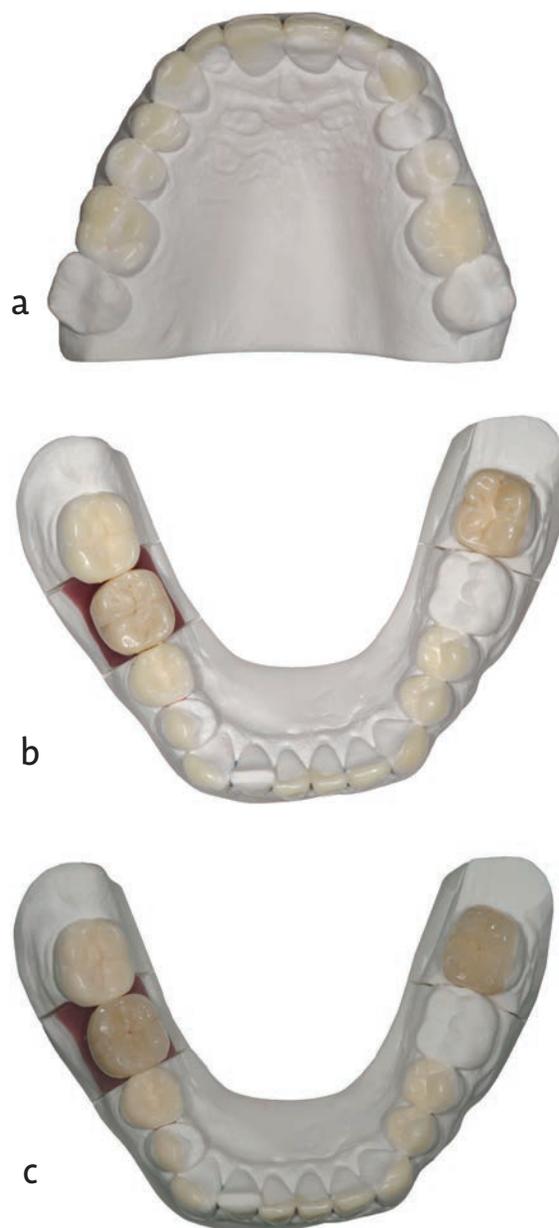
## Treatment

### Pretreatment Phase

Study casts were made and mounted in a semi-adjustable articulator, in order to perform a functional and occlusal analysis preceding a full mouth wax-up aimed to correct or improve posterior and anterior function as well as restoring proper tooth anatomy and smile line. This treatment rationale logically implied an elevation of vertical dimension of occlusion (VDO); in order to maintain anterior contacts, the addition of material usually corresponds to approximately 1 mm ( $\pm 0.5$  mm) at the first molar level. Within this range of VDO augmentation, the author does not suggest any pretreatment trial using a bit plate or any form of temporary solution. An anterior index (made of hard silicone or resin) was made at this point and served as a reference during and after the placement of direct restorations in the upper jaw.

### Restorative Phase

The restorative phase started with the fabrication of indirect posterior restorations (lower right first molar and left second molar with e.max Press (Ivoclar; Schaan, Liechtenstein) at the new VDO, taking into consideration the anatomical changes needed in the upper jaw, as defined by the wax-up (Fig 2a-2c). At the time of



**Figures 2a-2c:** Models of upper (a) and lower (b, c) jaw illustrating the first treatment phase, which included the fabrication of indirect posterior restoration (here, pressed IPS e.max crown and overlay, respectively, for the first right and second left molars) (b). Those restorations were produced at the new VDO, defined by the wax-up in both the lower and upper jaw (a and c).

placement, other posterior teeth in the lower jaw were corrected and fitted to the same VDO, using direct composite application (Edelweiss Direct, Edelweiss Dentistry; Hörbranz, Austria) (Figs 3a-3e). The antagonist upper teeth (premolars and molars) also were anatomically and functionally corrected with direct composite (Edelweiss Direct) to complete the necessary VDO correction (Figs 4a-4h). The lower first molar restored with a large gold onlay presenting no decay was left untouched for financial reasons and also because of its superior mechanical resistance. The rationale applied here follows Dahl's concept<sup>17</sup> (i.e., to allow this tooth to move passively until once again in occlusion), which was locally applied.

### Anterior Guidance

The third step consisted of creating a new anterior guidance and improved anatomy of the lower front teeth (Edelweiss Direct, Body i2 and Skin Bleach shades) (Figs 5a-5e) as well as the lingual profile of the upper teeth (Figs 6a & 6b). After having set the new VDO in the posterior areas, the aforementioned correction of front teeth (length and shape of lower incisors, canine guidance as well as lingual upper teeth anatomy) comprising two treatment sessions are usually planned within the next few days so that a proper and stable occlusal situation is created. This treatment step is logically followed by two short visits during which occlusal contacts and movements are checked and corrected if needed; then, esthetic restoration of the front teeth can start.

### "Hybrid" Solution

To minimize treatment cost, a "hybrid" solution was chosen to restore the smile. This consisted of prefabricated composite veneers (Edelweiss by Ultradent, Ultradent; South Jordan, UT) for the natural teeth (upper right incisors and both canines) and veneered, pressed full ceramic crowns (e.max) for the left upper incisors being restored with PFMs; e.max was selected due to its optimal mechanical and optical properties. After having placed two temporary crowns on the left incisors with proper position and thickness, the placement of the composite veneers could begin with size and shade selection (using the specific size and shade guides [Edelweiss Dentistry]) (Figs 7a & 7b). Natural tooth surfaces had to be lightly prepared; preparation aimed to create a very thin cervical chamfer delineating the veneer apical extension and, together with veneer corrections to eliminate a few interferences, preventing a correct veneer placement (Figs 7c-7e). A trial with either body (dentin) or skin (enamel) shades helped to obtain the best possible esthetic integration (Fig 7f). A discrete blue halo was created by depositing some effect shade (Color Plus Blue, SDS Kerr; Orange, CA) into a shallow groove prepared with a fine diamond, following the coating of the internal veneer surface with a special hydrophobic primer (Edelweiss adhesive) (Figs 8a & 8b). The four veneers were cemented with an enamel shade (Skin Bleach), except the right central incisor, for which both dentin and enamel masses were needed due to the important



**Figures 3a-3d:** Occlusal surfaces were prepared with sandblasting before adhesive procedures, for both aged composite and tooth surfaces. Then, a highly filled hybrid or nano-hybrid composite was placed and sculpted. The final view (3d) shows the anatomy obtained, following the wax-up layout.



**Figure 3e:** Postoperative image of full lower arch with improved occlusal anatomy and VDO through direct composite placement and two indirect pressed ceramic restorations (right first and second left lower molars).



**Figures 4a-4h:** After rubber dam placement, with exception of the left second molar, all upper teeth and restoration surfaces were sandblasted and treated as described in Figure 3, which allows extremely conservative and effective anatomical and functional enhancements. The same sculpting approach was used to recreate a proper functional scheme and VDO.





**Figures 5a-5e:** Following the correction of the VDO, the anterior teeth must also be restored, creating the new anterior guidance, with reduced overbite, such as defined with the wax-up and models mounted on an articulator. A silicone index helps to build up dentin and enamel masses with appropriate three-dimensional position and thickness. A caliper also serves to make fine width adjustments. After proper finishing and polishing, the first part of the new anterior esthetic configuration is set. The final view demonstrates the new configuration of lower front teeth with improved smile line.



**Figures 6a & 6b:** The Class III restorations are replaced simultaneously with the correction of the lingual anatomy of the upper front, natural teeth. A direct restorative approach is also used here. This step completes the preparation work needed before esthetic restoration.



**Figures 7a-7f:** Shade and veneer size are selected using the specific look of the Edelweiss veneer kit. Teeth are only minimally prepared, creating a discrete chamfer along the gingival margin to seat the veneers during cementation; enamel is simultaneously roughened. The incisal view shows that a significant repositioning of both central and lateral veneers is programmed while it will be well fitting at the canine level. The canine and lateral veneers are tried with composite to evaluate hue and value.

“ To minimize treatment cost, a “hybrid” solution was chosen to restore the smile. ”

facial repositioning of the veneer. A highly filled restorative material was used to provide optimal wear and physico-chemical properties (Fig 8c); a vibrating instrument (Compothixo, KerrHawe; Bioggo, Switzerland) was used to evenly distribute the material (Fig 8d). The individual cementation of all veneers is recommended to allow for proper adaptation and cleaning of luting composite (Figs 9a-9c). Proximal and cervical margins still required minor finishing and polishing, using discs and fine diamonds (Fig 9d); great care was required to avoid damaging the laser vitrified surface and to obtain optimal surface gloss.

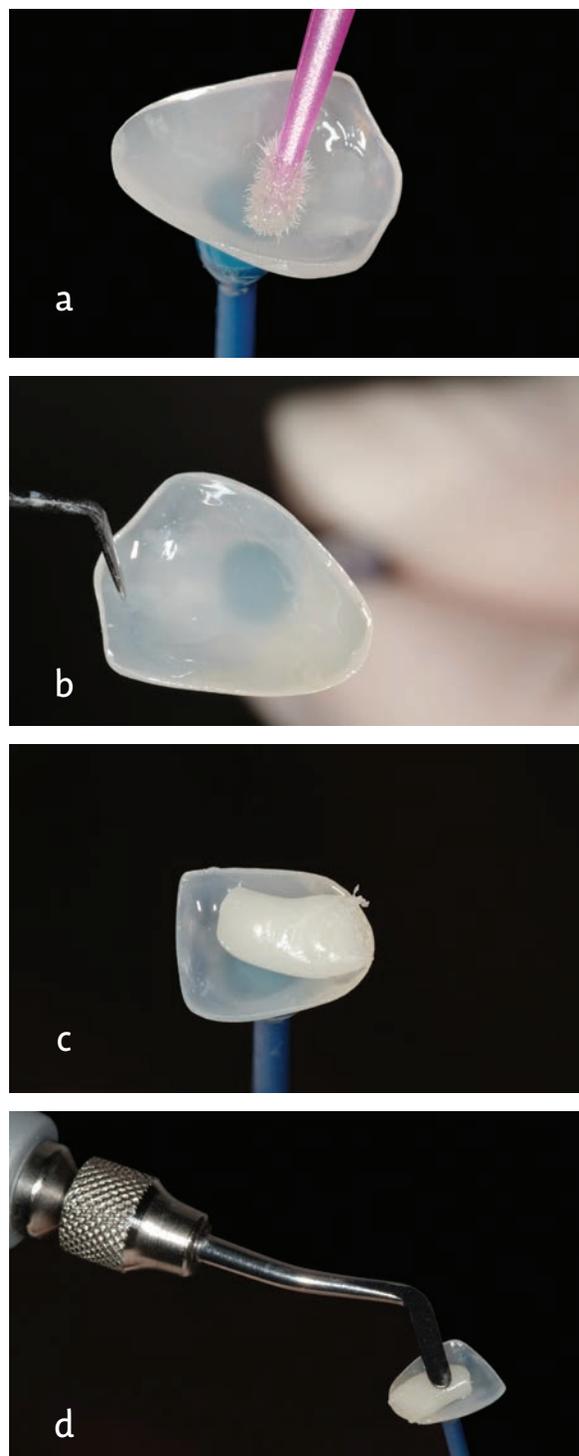
Post-treatment images demonstrate a pleasing esthetic integration of both anterior and lateral restoration within the smile frame as well as a younger-looking smile configuration, although still in balance with the patient's age and physical appearance (Figs 10a-10c).

## Discussion

In such cases, the therapeutic scheme is logically oriented toward reestablishing both esthetics (usually the patient's first priority) and function. The first step after diagnosis is to determine proper central incisor length and anterior guidance, which governs the new VDO. Proper anterior tooth anatomy and function is designed according to objective esthetic guidelines, existing and former tooth anatomy, and functional and phonetic components; a partial wax-up (in the case of moderate posterior tissue loss) or, more often, a full-mouth wax-up (advanced generalized tooth wear/erosion) help the restorative team to establish this important reference.<sup>7-11</sup> Increasing the VDO is also a key parameter in reversing the consequences of pathological wear.<sup>18-20</sup> Actually, the passive eruption that accompanies the continuous tissue destruction and loss greatly restricts the space available for restorations, which, due to their limited thickness, would be very fragile or otherwise would invade residual tooth structure. Recent clinical reports have largely validated this treatment rationale.<sup>21-23</sup>

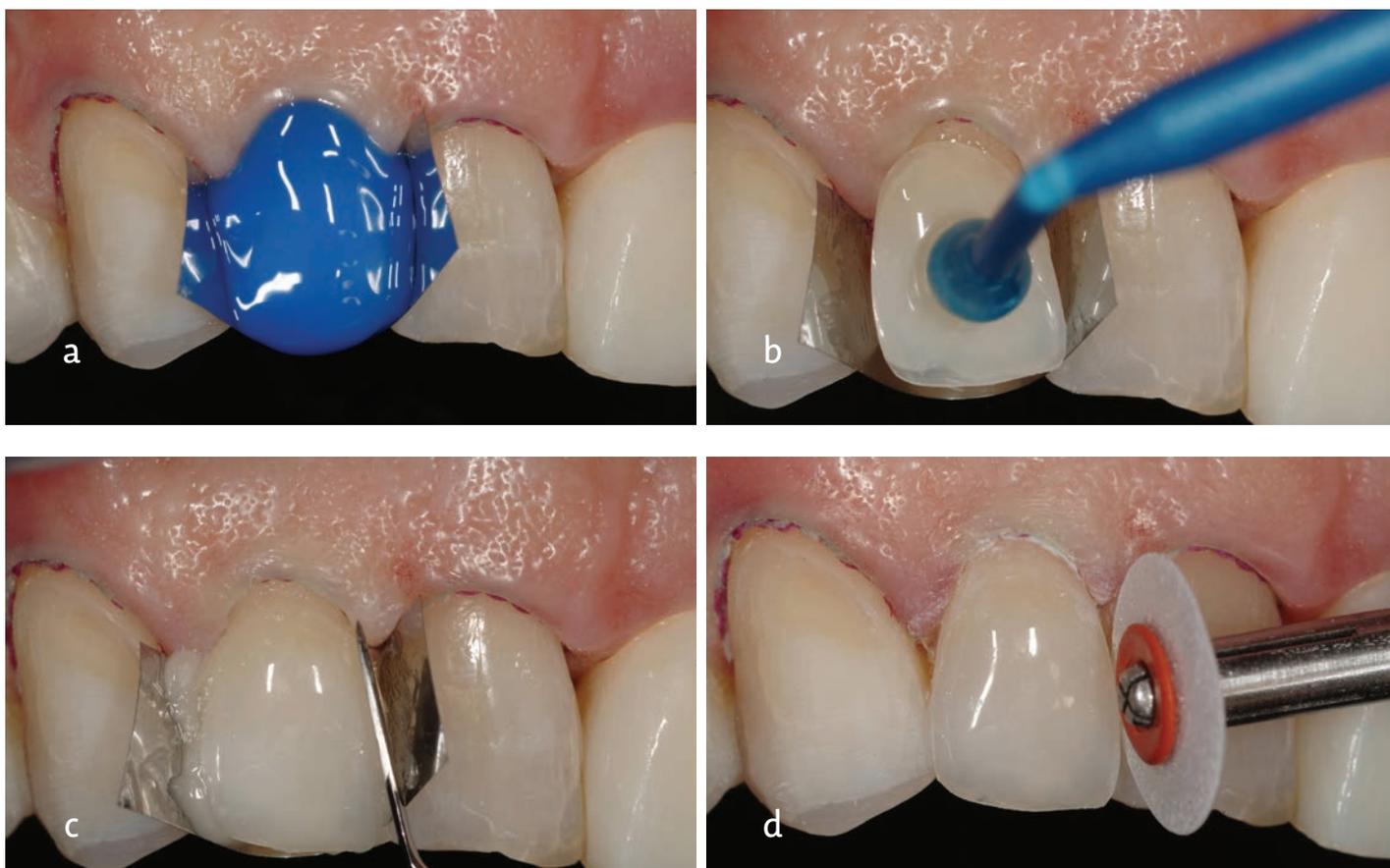
## Restorative Options and Material Selection

In regard to restorative options (direct or indirect) and material selection (composite or ceramic), decisions usually are based upon the patient's preexisting dental condition (presence of decay, restoration size and condition, vital or nonvital 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). The direct option is selected when "limited" anatomical and functional corrections are needed; on the other hand, the replacement of large restorations or overlays mandates an indirect approach. The determination among various composite and ceramic materials is largely operator-dependent, as most of them provide decent longevity.<sup>24,25</sup>



**Figures 8a-8d:** First, a special adhesive was applied into the veneer. In this case a tiny amount of blue stain was painted along the incisal edge, following a groove made with a fine diamond bur. Finally, the luting material (highly filled restorative resin composite) was placed in the middle of the veneer and then spread with a vibrating instrument.

// Proper anterior tooth anatomy and function is designed according to objective esthetic guidelines, existing and former tooth anatomy, and functional and phonetic components; a partial wax-up (in the case of moderate posterior tissue loss) or, more often, a full-mouth wax-up (advanced generalized tooth wear/erosion) help the restorative team to establish this important reference. //



**Figures 9a-9d:** Cementation was performed, starting with etching and bonding of the facial enamel surfaces, followed by the individual placement of each veneer; this permits a better control of proximal adaptation and luting cement removal. Before proceeding with the next veneer placement, some finishing and polishing is mandated for the proximal surfaces.



**Figures 10a-10c:** Lateral, retracted, and full-face views demonstrate the final esthetic integration; the significant and positive impact of the rehabilitation on anterior function and anatomy can be appreciated. Despite the combination of partial and full-coverage restorations, a pleasing harmony was achieved.

In this case, a direct restorative approach was selected for the lower front teeth due to the amount of residual tooth structure and also because the shading concept was coordinated with the upper front prefabricated composite veneers. It was decided to face the upper front natural teeth with four prefabricated composite veneers (Direct Veneer, Edelweiss by Ultradent) to take advantage of a superior composite quality, obtained by high-pressure molding and heat-curing processes, followed by laser surface vitrification.<sup>26</sup> This allows the veneers to exhibit a hard, glossy, defect-free surface that facilitates the esthetic restoration of decayed or discolored single and multiple anterior teeth (necessary in this case). This chair-side composite veneering system does not aim to replace the well-established individualized porcelain veneer technique; rather, it offers an alternative to freehand composite veneers—a delicate and time-consuming technique.<sup>26</sup>

### Summary

The outcome for this 60-year-old male patient, following logical biomechanical concepts and treatment rationale, was highly successful in regard to function, tissue conservation, esthetics, and cost. This was achieved by combining various techniques and materials, based upon a highly individual tooth status analysis and therapeutic scheme. An outcome such as this requires broader understanding and more extensive experience with adhesive techniques, so as to optimize the treatment outcome and longevity. Presented with an ever-growing number of restorative systems and specific operative protocols, today's practitioner is increasingly challenged to provide highly individual therapeutic solutions. This makes such treatment perhaps more difficult, but also highly interesting—and with clear advantages for the patient.

### References

1. Lussi A, Jaeggi T. Erosion—diagnosis and risk factors. *Clin Oral Investig.* 2008 Mar;12 Suppl 1:S5-13.
2. Lussi A, Jaeggi T, Zero D. The role of diet in the aetiology of dental erosion. *Caries Res.* 2004;38 Suppl 1:34-44.
3. Mahoney EK, Kilpatrick NM. Dental erosion: part 1. Aetiology and prevalence of dental erosion. *NZ Dent J.* 2003 Jun;99(2):33-41.
4. Litonjua LA, Andreana S, Bush PJ, Cohen RE. Tooth wear: attrition, erosion, and abrasion. *Quintessence Int.* 2003 Jun;34(6):435-46.
5. Lavigne GJ, Khoury S, Abe S, Yamaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. *J Oral Rehabil.* 2008 Jul;35(7):476-94.
6. Lavigne GJ, Kato T, Kolta A, Sessle BJ. Neurobiological mechanisms involved in sleep bruxism. *Crit Rev Oral Biol Med.* 2003;14(1):30-46.

7. Dietschi D, Argente A. A comprehensive and conservative approach for the restoration of abrasion and erosion. part I: concepts and clinical rationale for early intervention using adhesive techniques. *Eur J Esthet Dent.* 2011 Spring;6(1):20-33.
8. Dietschi D, Argente A. A comprehensive and conservative approach for the restoration of abrasion and erosion. part II: clinical procedures and case report. *Eur J Esthet Dent.* 2011 ;6:142-59.
9. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 1. *Eur J Esthet Dent.* 2008 Spring;3(1):30-44.
10. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 2. *Eur J Esthet Dent.* 2008 Summer;3(2):128-46.
11. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part 3. *Eur J Esthet Dent.* 2008 Autumn;3(3):236-57.
12. Ibsen RL, Ouellet DF. Restoring the worn dentition. *J Esthet Dent.* 1992 May-Jun;4(3):96-101.
13. Christensen G. A new technique for restoration of worn anterior teeth. *J Am Dent Assoc.* 1995 Nov;126(11):1543-6.
14. Marais JT. Restoring palatal tooth loss with composite resin, aided by increased vertical height. *SADJ.* 1998 Mar;53(3):111-9.
15. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. *J Prosthet Dent.* 2003 Jul;90(1):31-41.
16. 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.
17. Briggs PE, Bishop K, Djemal S. The clinical evolution of the "Dahl Principle." *Br Dent J.* 1997;183:171-6.
18. Satterthwaite JD. Indirect restorations on teeth with reduced crown height. *Dent Update.* 2006 May;33(4):210-2, 215-6.
19. Cutbirth ST. Increasing vertical dimension: considerations and steps in reconstruction of the severely worn dentition. *Pract Proced Aesthet Dent.* 2008 Nov-Dec;20(10):619-26.
20. Robinson S, Nixon PJ, Gahan MJ, Chan MF. Techniques for restoring worn anterior teeth with direct composite resin. *Dent Update.* 2008 Oct;35(8):551-2, 555-8.

The challenge in treating severe tooth wear lies in the need to prevent or reduce further tissue loss and faster degradation of existing restorations. To date, the use of adhesive restorations (direct or indirect) represents the best treatment approach until a full conventional prosthetic rehabilitation is indicated, with obvious biomechanical and financial implications. A proper treatment plan using wax-up techniques is mandatory as it will drive the placement of direct restorations, making the treatment less cumbersome, even for non-specialized operators; silicone indexes can be used to control the VDO and restoration anatomy. Where extended anatomical and occlusal corrections are needed, indirect restorations can also supplement composite freehand buildups.

The treatment presented in this article is a cost-effective alternative to a conventional approach for complex esthetic and functional disharmonies, while preserving most of existing restorations and worn, residual tooth structures. It limits the use of indirect prosthetic restorations to a missing tooth and other existing, failing crowns.

21. 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 Mar;83(3):287-93.
22. 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;19:613-67.
23. 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 Prosthodont Restor Dent.* 2002 Sep;10(3):101-5.
24. Manhart J, Chen H, Hamm G, Hickel R, Buonocore. Memorial Lecture. Review of the clinical survival of direct and indirect restorations in posterior teeth of the permanent dentition. *Oper Dent.* 2004 Sep-Oct;29(5):481-508.
25. El-Mowafy O, Brochu JF. Longevity and clinical performance of IPS-Empress ceramic restorations—a literature review. *J Can Dent Assoc.* 2002 Apr;68(4):233-7.
26. Dietschi D, Devigus A. Prefabricated composite veneers: historical perspectives, indications and clinical application. *Eur J Esthet Dent.* 2011 Summer;6(2):178-87. **jCD**

**//** An outcome such as this requires broader understanding and more extensive experience with adhesive techniques, so as to optimize the treatment outcome and longevity. **//**



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 did not report any disclosures relevant to the content of this article.

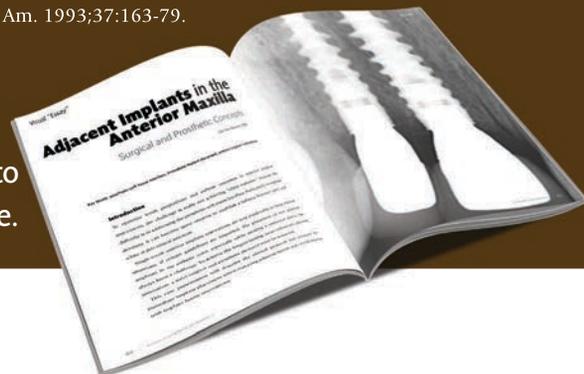
## Erratum

In the Summer 2012 (volume 28, number 2) issue of *jCD*, the references were inadvertently omitted from Dr. Eric Van Dooren's article, *Adjacent Implants in the Maxilla Anterior* (p. 42).

The references are as follows:

1. Fradeani M. Esthetic rehabilitation in fixed prosthodontics: esthetic analysis—systematic approach to prosthetic treatment. vol. 1. Hanover Park (IL): Quintessence Pub.; 2004.
2. Grunder U. Crestal ridge width changes when placing implants at the time of tooth extraction with and without soft tissue augmentation after a healing period of 6 months: report of 24 consecutive cases. *Int J Periodontics Restorative Dent.* 2011 Feb;31(1):9-17.
3. Fagan MC, Owens H, Smaha J, Kao RT. Simultaneous hard and soft tissue augmentation for implants in the esthetic zone: report of 37 consecutive cases. *J Periodontol.* 2008 Sep;79(9):1782-8.
4. Fickl S, Zuhr O, Wachtel H, Kepschull M, Hürzeler MB. Hard tissue alterations after socket preservation with additional buccal overbuilding: a study in the beagle dog. *J Clin Periodontol.* 2009 Oct;36(10):898-904.
5. Araújo MG, Sukekava F, Wennström JL, Lindhe J. Ridge alterations following implant placement in fresh extraction sockets: an experimental study in the dog. *J Clin Periodontol.* 2005 Jun;32(6):645-52.
6. Chu SJ, Tan JH, Stappert CE, Tamow DP. Gingival zenith positions and levels of the maxillary anterior dentition. *J Esthet Restor Dent.* 2009;21:113-20.
7. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. *Clin Oral Implants Res.* 2005 Dec;16(6):639-44.
8. Allen EP. Surgical crown lengthening for function and esthetics. *Dent Clin North Am.* 1993;37:163-79.

**\*The digital version of *jCD* will provide a link to Dr. Van Dooren's full published article.**



# One Website

ELEGANTLY CRAFTED

# for All Screen Sizes & DEVICES



Responsive Websites Are Here

**LEADERS IN RESPONSIVE WEB DESIGN & MARKETING**



Call Today  
**800.491.8623**

# CRITICAL

## Factors of Occlusion

**“**In recent years, the subject of occlusion has received minimal attention in dental education, both in universities and seminars.**”**

# They Can Make You or Break You!

DeWitt C. Wilkerson, DMD

## **Abstract**

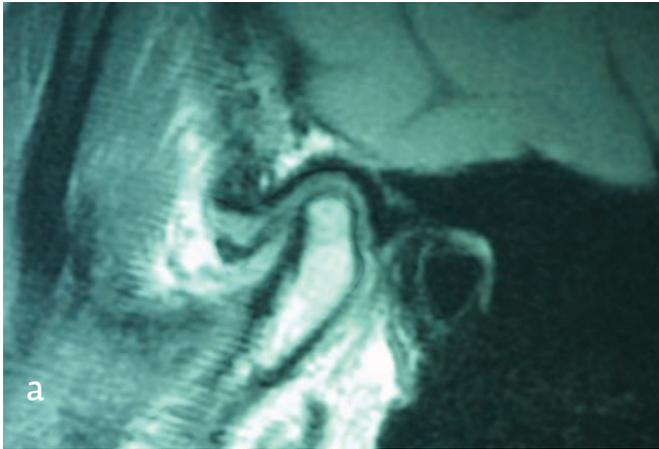
In an age of extensive cosmetic procedures, we must never forget the critical importance of creating functionally stable occlusions; form does indeed follow function.

Two key considerations of dental occlusion include joint condition/position and anterior guidance.

A review of pertinent research and clinical observation guides the clinician in making decisions for each patient.

Several principles for predictable outcomes are recommended.

**Key Words: Occlusion, centric relation, anterior guidance, masticatory system, temporomandibular joints**



**Figures 1a & 1b:** Unstable joints lead to unstable occlusion, as demonstrated in this 20-year-old patient with bilateral discal displacements.

## Introduction

For many years, education in restorative dentistry concentrated on occlusion. How to locate and record the condylar hinge axis, so that the teeth were restored in maxillo-mandibular harmony, was a major topic. Developing idealized anterior guidance, in lateral and protrusive excursions, was considered a critical discussion. Vertical dimension of occlusion, envelope of function, neutral zone, incisal edge position, and stable centric stops were all explained in great detail. Pioneers such as Beyron, Ramfjord, Schuyler, Pankey, Mann, Thomas, Stewart, D'Amico, Lundeen, Gibbs, Mahan, and Dawson clarified the art and science of functional occlusion.

In recent years, the subject of occlusion has received minimal attention in dental education, both in universities and seminars. Young dentists are typically unfamiliar with any specific guidelines for functional esthetics/cosmetics...and it shows. In the excitement of the "Esthetic Revolution," prepress veneers, and "California white," something critically important was lost (only temporarily, it is hoped).

## Form Follows Function

This was true 25 years ago, it is true today, and always will be.

Occlusion is so critical that it can make you or break you as a dentist. Following are two fundamental principles regarding occlusion:

- Occlusal stability should be predictable.
- Failure to adhere to sound occlusal principles can result in many problems for both the dentist and the patient.

The author's private practice emphasizes resolving occlusal problems, including unfortunate remakes of cosmetic/restorative failures. There are patterns to the problems dentists and patients encounter that often represent shortcomings in understanding and applying sound occlusal principles.

## Two Key Considerations

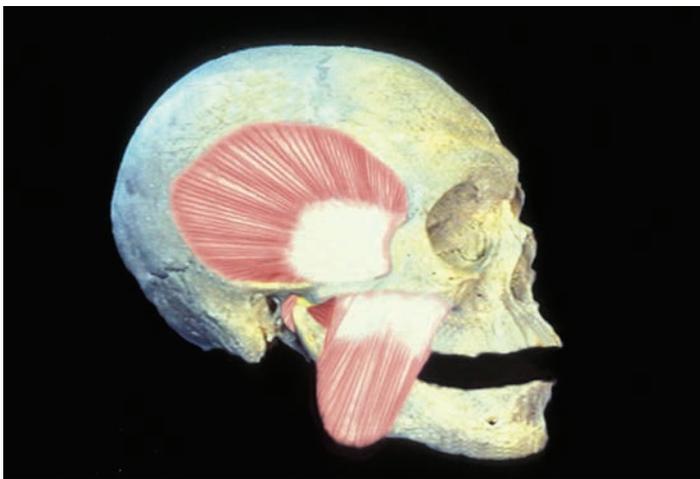
Two key considerations of occlusion that affect the stability of cosmetic/restorative cases are:

1. joint condition and position
2. anterior guidance.

### Joint Condition and Position

**Principle:** *If the joint condition is unstable, the occlusion will be unstable (Figs 1a & 1b).*

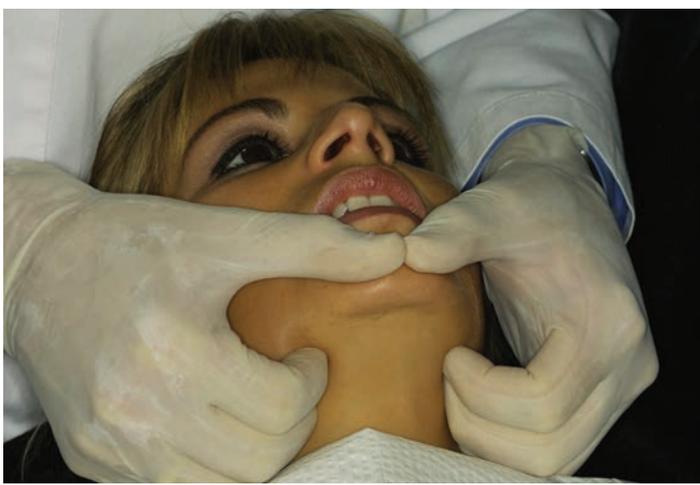
Dentistry involves the management of the masticatory system. First and foremost, dentists are the physicians of the masticatory system. A complete system analysis should precede irreversible dental therapy. This includes an evaluation of the health of the temporomandibular joints. Anterior open bites, excessive posterior wear, and Class II skeletal relationships are common examples of possible underlying joint instability.<sup>1,2</sup> If these occlusions are restored without first addressing the joint condition, the resulting occlusions may be unstable.<sup>3</sup> Screening of the joints is a simple matter of asking history questions regarding joint discomfort, noises, locking, or trauma; clinical evaluation includes range-of-motion observation; palpation of the joints; orthopedic load testing of the joints; and in-office joint testing methods, such as Doppler auscultation and joint vibration analysis (JVA). When signs or symptoms of derangement screen positively, imaging of the joints through CT scan or MRI may be indicated.<sup>4,5</sup> When joint inflammation or partial internal disc derangement is present, occlusal splint therapy will often help stabilize the joints and occlusion prerestoratively.<sup>6,7</sup>



**Figure 2:** The elevator muscles contract on closure, fully seating the joints to CR.



**Figure 3a:** "Clearing the dancefloor."



**Figure 3b:** Fully seating the joints to CR.

Complete disc derangement may result in chronic degenerative changes manifested in chronic instability of both the joints and occlusion.<sup>8</sup> It is always prudent to consider, when observing an unstable occlusion, whether there may be an underlying joint problem. It is also prudent to understand, that as long as the joint is changing dimension, the occlusion will shift, like a house built on sand.

**Principle:** *Joint position is a critical factor of the overall occlusal scheme.*

Currently, three joint positions are commonly discussed in dentistry: maximum intercuspation position (MIP), centric relation (CR), and myocentric. The question is, are all three equal?

What can we learn from research? The most exhaustive longitudinal study of mandibular function in mastication and occlusion was undertaken by Drs. Harry Lundeen and Charles Gibbs. Their research included nearly 400 subjects using a "gnathic replicator" to follow exact jaw-to-jaw and tooth-to-tooth relationships on chewing. They consistently observed the joint on the side of the bolus of food fully seated very quickly, with the opposite side joint lagging, but also fully seating before the teeth contacted on closure. The conclusion of their 13-year study at the University of Florida was as follows:

"Centric relation is the ending location of good chewing strokes and is a comfortable physiologic position for all people who have relatively healthy temporomandibular joints and good mandibular muscle control."<sup>9</sup>

CR is a physiologic border position of mandibular function, whereby the healthy mandibular condyles are fully seated on jaw closure by the elevator muscles (temporalis, masseters, medial pterygoids).<sup>9</sup> Okeson describes this as "musculo-skeletal stable seating" (Fig 2)<sup>10</sup> (i.e., the physiologically seated joints, by the appropriate influence of elevator muscle contraction, on mandibular closure).

A very useful clinical tool in observing muscle-directed joint position is the simple Lucia jig/flatplane anterior deprogrammer. By "clearing the dancefloor" of occlusal influences we can objectively observe where the elevator muscles take the joints, superiorly and coincident with the vector of force generated by elevator muscle contraction. When muscles are relaxed, Dawson's bilateral manipulation technique is utilized to orthopedically load test the joints, to evaluate for any response of tenderness in the joints. A positive load test is indicative of either lateral pterygoid resistance, a disc derangement, or intracapsular pathosis (Figs 3a & 3b).<sup>11</sup>

**Principle:** The goal of all occlusal therapy is non-interference of teeth to normal jaw function, from border to border (CR is one border, lateral and protrusive movement limits are the other border).

It is critically important that no teeth touch in an unbalanced manner when the joints are seated by muscles in CR. This represents the “static occlusion,” whereby all teeth touch simultaneously and with equal intensity.

**Principle:** CR is the starting position for predictable occlusal therapy.

An occlusion built anterior to CR will touch heavily on the most posterior teeth when the healthy joints are fully seated by the elevator muscles on closure. This can be true of MIP if a “hit and slide” is present. This is always true with myocentric, where pulsed muscles result in an anterior jaw position, by an average of 3.8 mm forward of CR.<sup>12</sup> A true “neuromuscular occlusion” is one where there is harmony between the central nervous system and the muscles of mastication. Lundeen and Gibbs’ observations in laboratory trials demonstrated the action of the elevator/closing muscles is to seat the joints superiorly and anteriorly to a bone-braced position, medially in the fossae.<sup>9</sup> This sets the position of the posterior end of the mandible on closure. If the teeth contact uniformly at that mandibular position, there is no stimulation for contraction of the lateral pterygoid, and inferior and superior bellies.<sup>13</sup> An occlusion developed in any other position requires the joints to be downwardly displaced, contrary to the action of the jaw-closing muscles. To hold the teeth together in MIP in such cases requires the continued active contraction of both elevators (temporalis, masseters, medial pterygoid) and the antagonistic positioner muscles (lateral pterygoid, depressor group). In patients who actively engage their teeth, this has been clinically observed to produce symptoms of muscle fatigue.

When irreversible occlusal changes are being made, it is prudent to consider physiologic jaw movements and build the static occlusion in harmony with CR. Failure to follow these principles can result in occlusal instability such as sore, mobile, and fractured posterior restorations, as well as muscle incoordination (Figs 4a & 4b).

#### Anterior Guidance

Matos summarizes a consensus on anterior guidance as follows:

“Several authors believe that mutually protected occlusion (disocclusion through anterior teeth) is ideal, since the canine teeth present higher proprio-



**Figures 4a & 4b:** A shift of joint position from CR to MIP often results in “hot pterygoids.”

“Shallowing anterior guidance creates more functional freedom; steepening anterior guidance may stimulate increased dysfunction.”

ception, are ideally located (thus promoting immediate disocclusion of posterior teeth), have considerable volume and bone support and present lower electromyographic activity, i.e. they promote higher muscular relaxation, besides presenting better conditions to distribute and afford occlusal loads without harmful consequences to posterior teeth and supporting structures."<sup>13</sup>

Immediately touch the anterior teeth and disocclude the posterior teeth ("functional occlusion"), as the mandible leaves CR ("static occlusion") (Figs 5a & 5b).

#### Advantages of Properly Designed Anterior Guidance

There are several advantages to a properly designed anterior guidance:

- It reduces forces to the whole system because of reduced elevator muscle activity.<sup>14</sup>

**Principle:** *The more anteriorly teeth contact, the less elevator muscles contract. The more posteriorly teeth contact, the more elevator muscles contract.*<sup>15</sup>

- It protects the posterior teeth from overloading and attrition related to function (balancing and working side contacts) and parafunction (bruxism).

**Principle:** *Teeth that disocclude are free from loading effects.*

- Shallowing anterior guidance often creates a reported sense of functional/parafunctional freedom and reduced symptomatic muscle activity.

- Steepening anterior guidance often creates a reported sense of functional/parafunctional restriction and increased symptomatic muscle activity.

**Clinical observation:** Shallowing anterior guidance creates more functional freedom; steepening anterior guidance may stimulate increased dysfunction.

Though certainly a debatable observation, it is based upon working with hundreds of patients suffering from occluso-muscle disorders through both occlusal splint therapy and provisional restorations. These findings are consistent with the observations of many other clinicians with extensive problem-solving experience.

**Clinical application:** What potential occlusal problems may be present when wear has developed on natural lower anteriors opposing restored upper anteriors (Fig 6)?

In the absence of wear preresstoratively, the wear problem could have three potential causes:



**Figures 5a & 5b:** An idealized occlusion contacts exclusively on anterior teeth when the joints leave CR.

1. A posterior interference in CR. Frequently, wear on anterior teeth may reflect a hit and slide from a posterior tooth prematurity on an inclined surface.
2. Poor CR stops on the anterior teeth. Anterior teeth should touch and have perpendicular contact with each opposing tooth. Any scissoring of the occlusion anteriorly can create undesired wear.
3. Anterior guidance that is too steep. Restricting mandibular freedom, or "envelope of function" appears to potentiate a form of parafunction, resulting in wear.



**Figure 6:** Catastrophic cosmetic failure, due to violations of basic occlusal principles.

## Summary

Although this article just scratches the surface of the topic of functional occlusion, it has discussed the two most critical factors related to long-term occlusal stability:

- Critical factor of occlusion: Equal intensity contact of all teeth in CR (CR = MIP)
- Critical factor of occlusion: Anterior guidance in harmony with the envelope of function

The understanding and application of these factors in daily practice will help ensure that properly managed dental occlusion will make you predictably successful as both a cosmetic dentist and a physician of the masticatory system. The application of these principles will need to be tailored to the individual requirements of each patient. In restorative/cosmetic cases these principles will be verified and fine-tuned through provisional restorations.

## References

1. Defabianis P. Post-traumatic TMJ internal derangement: impact on facial growth findings in a pediatric age group. *J Clin Pediatr Dent.* 2003 Summer;27(4):297-303.
2. Schellas KP, Piper MA, Bessette RW, Wilkes CH. Mandibular retrusion, temporomandibular joint derangement, and orthognathic surgery planning. *Plast Reconstr Surg.* 1992 Aug;90(2):218-29.
3. Dawson PE. *Functional occlusion: from TMJ to smile design.* St. Louis: Mosby; 1985. 42 p.
4. Wiese M, Svensson P, Bakke M, List T, Hintze H, Petersson A, Knutsson K, Wenzel A. Association between temporomandibular joint symptoms, signs, and clinical diagnosis using the RDC/TMD and radiographic findings in temporomandibular joint tomograms. *J Orofac Pain.* 2008 Summer;22(3):239-51.
5. Güler N, Yatmaz PI, Ataoglu H, Emlik D, Uçkan S. Temporomandibular internal derangement: correlation of MRI findings with clinical symptoms of pain and joint sounds in patients with bruxing behaviour. *Dentomaxillofac Radiol.* 2003 Sep;32(5):304-10.
6. Beard CC, Clayton JA. Effects of occlusal splint therapy on TMJ dysfunction. *J Prosthet Dent.* 1980 Sep;44(3):324-35.
7. Mejersjö C, Wenneberg B. Diclofenac sodium and occlusal splint therapy in TMJ osteoarthritis: a randomized controlled trial. *J Oral Rehabil.* 2008 Oct;35(10):729-38. Epub 2008 May 9.
8. Schellhas KP, Piper MA, Omlie MR. Facial skeleton remodeling due to temporomandibular joint degeneration: an imaging study of 100 patients. *Cranio.* 1992 Jul;10(3):248-59.
9. Lundeen H, Gibbs C. *The function of teeth: the physiology of mandibular function related to occlusal form and esthetics.* Gainesville (FL): L & G Publishers; 2005.
10. Okeson JP. *Management of temporomandibular disorders and occlusion.* 6th ed. St. Louis: Mosby; 2007.
11. Dawson PE. *Functional occlusion: from TMJ to smile design.* St. Louis: Mosby; 2007. p. 75-83.
12. Azarbal MJ. Comparison of myo-monitor centric position to centric relation and centric occlusion. *J Prothet Dent.* 1977 Sep;38(3):331-7.
13. Mahan PE, Wilkerson TM, Gibbs CH, Mauderli A, Brannon LS. Superior and inferior bellies of the lateral pterygoid muscle emg activity at basic jaw positions. *J Prosthet Dent.* 1983 Nov;50(5):710-8.
14. Matos DA, Teixeira ML, Pinto JH, Lopes JF, da Silva Dalben G. Pattern of disocclusion in patients with complete cleft lip and palate. *J Appl Oral Sci.* 2006;14(3):157-61. Available from: <http://www.scielo.br/pdf/jaos/v14n3/a02v14n3.pdf>.
15. Kerstein RB, Wright NR. Electromyographic and computer analyses of patients suffering from chronic myofascial pain-dysfunction syndrome: before and after treatment with immediate complete anterior guidance development. *J Prosthet Dent.* 1991;66(5):677-86. **jCD**



Dr. Wilkerson served as president of the American Equilibration Society in 2011. He is the dental medicine curriculum director for The Dawson Academy. [dwwilkerson@dupontwilkerson.com](mailto:dwwilkerson@dupontwilkerson.com)

Disclosure: The author did not report any disclosures.



> THE SURPRISING CAUSES OF BAD BREATH

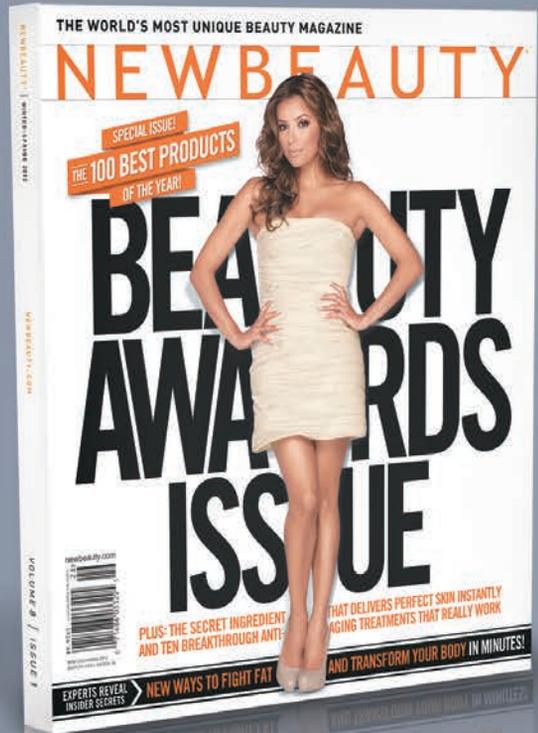


> HOW TO GET THE PERFECT SMILE FOR SPECIAL OCCASIONS



> MIRACLE SMILE MAKEOVER TREATMENTS

— THE ONLY —  
**BEAUTY MAGAZINE WITH  
 COSMETIC DENTISTRY  
 EDITORIAL**  
 — IN EVERY ISSUE —



# NEW BEAUTY<sup>®</sup> & AACD | A BEAUTIFUL PARTNERSHIP

To learn more, call 866-NEWBEAUTY or visit [www.newbeauty.com](http://www.newbeauty.com)

# Are Occlusion and Comprehensive Dentistry *Really that Important?*



A primary tenet of comprehensive dentistry is that all of the components of the masticatory system...are intimately related and dependent upon one another for ideal function.



## Learning Objectives:



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

1. Develop a better understanding of centric relation, how to use it, and ways to find and record it.
2. Recognize when an alteration in the existing occlusal scheme might be beneficial prior to case treatment.
3. Understand the value of earbow transfers and properly mounted models for case diagnosis.

# A Seven-Year Follow-Up: Addressing Structure First

Gary Alex, DMD, AAACD

## Abstract

Patient demand for cosmetic dentistry has never been greater. This has led many dentists to invest considerable time, effort, and money in mastering various cosmetic procedures and techniques. While this is commendable, it should be recognized that it is one thing to be able to make beautiful teeth, and an entirely different thing to make beautiful teeth that actually last and function in harmony with the rest of the masticatory system. An acceptable cosmetic result, without regard for function and/or parafunction, will often result in premature case failure. What the truly successful clinician of today requires is a logical and systematic methodology in approaching cosmetic/restorative cases that will lead to a reasonably predictable and durable end result. The following case presentation describes how a comprehensive approach to dentistry, one that integrates both function and esthetics, can be used to successfully diagnose, treatment plan, and predictably restore a cosmetic/restorative case. Seven-year follow-up images are also presented.

**Key Words:** Occlusion, comprehensive dentistry, centric relation, facebow transfers, congenitally missing laterals

## Introduction

A true understanding of occlusion and comprehensive dentistry is crucial in order to become the best dentist possible. The fact is, the longevity and predictability of all the beautiful dentistry that clinicians create, and the overall comfort and functioning of their patients, is predicated on just how well they understand and apply the principles of occlusion and comprehensive dentistry. A primary tenet of comprehensive dentistry is that all of the components of the masticatory system (teeth, soft tissues, skeletal structures, muscles, and joints) are intimately related and dependent upon one another for ideal function.<sup>1,2</sup> This interrelationship is mediated by the central nervous system via the exquisite proprioceptive nerve network that permeates the entire gnathic system.

## Comprehensive Dentistry

Comprehensive dentistry is really about seeing, understanding, and treating the “big picture.” This is a far different approach than the “see the hole, fill the hole” mentality often employed in restorative dentistry. Addressing esthetic concerns is also an integral component of comprehensive dentistry. Creating “ideal” functional and masticatory relationships and harmony without addressing esthetics will almost always lead to patient disappointment no matter how well the case functions from an occlusal standpoint. Conversely, an “ideal” esthetic result without regard for function and/or parafunction often leads to case failure and/or masticatory disharmony. The dentist who wants to practice truly excellent dentistry must be able to think comprehensively and address both function and esthetics.<sup>3-5</sup>

## Occlusion

An understanding of occlusion is essential to practicing comprehensive dentistry. There are at least five occlusal philosophies in use today (classic gnathology, bioesthetics, Dawson/Pankey, neuromuscular, and maximum intercuspation position [MIP]). While an in-depth discussion of each of these philosophies is well beyond the scope of this article, it is probably safe to say the vast majority of dentists use MIP (habitual closure) as a starting and ending point when developing an occlusal scheme. The reason for this is probably because it requires the least thought, time, knowledge, and effort. The dentist simply works with the occlusal relationship as it exists. The problem is that in many



**Figure 1:** Preoperative full smile.



**Figure 2:** Preoperative retracted view with teeth apart. Note the lingual thinning of the upper anterior teeth, chipping and wear of the lower anterior teeth, and abfraction-type lesions on several teeth.



**Figure 3:** The removable partial denture (“flipper”) that the patient was wearing on her initial visit.

cases the patient's existing MIP and occlusal scheme is far from ideal. In fact, it may be a destructive relationship, causing a problem, or problems, somewhere in the masticatory system. These problems can manifest as muscular pain, joint problems, wear and/or chipping of teeth, tooth mobility, tooth sensitivity, an uncomfortable bite, and a variety of other symptoms. By using the existing bite relationship in such a situation, dentists are in fact placing restorations into an occlusal scheme that may not be working particularly well for that patient. In such cases it would seem logical to try and improve the occlusal/masticatory relationships prior to, or in conjunction with, performing the restorative/prosthetic dentistry.<sup>6</sup> The questions to ask are, when does the patient's existing occlusal scheme need to be altered prior to performing restorative/prosthetic procedures and when is it acceptable to work with the occlusal scheme as it exists? The following case presentation, in which both functional and esthetic issues are addressed, demonstrates a comprehensive approach to restorative/cosmetic dentistry. In this particular case, for reasons that will become apparent, the existing occlusal scheme was altered prior to performing the prosthetic dentistry. A detailed rationale and methodology is described. The case demonstrates just how the science of occlusion and comprehensive dentistry can actually be applied to clinical dentistry.

### Case Presentation

The patient, a 37-year-old female in good health, was referred to our office for a consultation regarding the replacement of congenitally missing maxillary lateral incisors and improving the appearance of her teeth and smile (Figs 1 & 2). At the age of 20 she underwent 15 months of orthodontic treatment to reposition the upper anterior teeth in order to create space between the central incisors and canines. She had had three different Maryland-type winged bridges since that time (including one all-ceramic resin bonded bridge). All of these failed for various reasons and the patient stated she was never happy with how any of them looked and that they would fall out frequently. For the last six months she had been wearing a removable "flipper"-type partial denture that she said she hated (Fig 3). She stated that she had always been self-conscious about her teeth and smile, and often avoided smiling in photographs. She had recently consulted with a number of other dentists and had explored restorative options including implants, new resin-bonded bridges, and fixed bridgework. Both an oral surgeon and periodontist had determined that insufficient space existed for implants (Figs 4 & 5). The patient also mentioned

“ It is up to clinicians, through comprehensive diagnostic examination and evaluation, to develop a treatment plan that fulfills not just the esthetic but also the functional requirements of a case. ”



**Figure 4:** Occlusal view of the upper anterior teeth showing lack of sufficient interproximal space for implants.



**Figure 5:** Radiographic appearance of the anterior teeth showing insufficient space for dental implants.



**Figures 6 & 7:** The earbow is used to record the relationship of the maxilla relative to the TMJs. The data are then transferred to an articulator. The correct hinge axis starting position (or close approximation) is essential when taking an open bite record.

that her bite was not comfortable (“it feels off”) and that it often felt like she had “two bites.” She was not aware of any grinding or clenching habits. Her periodontal status was excellent and her medical history was unremarkable. When she was asked specifically what she would like as far as her teeth and smile were concerned, her reply was: “a whiter/brighter smile, something that looks really nice and I feel good about, something that will last, nothing I can put in and take out, and I would like my bite to feel comfortable because it has never felt right.”

## Treatment Planning

### Discussion

The fact is many dental patients have never been treated in a comprehensive fashion and the concept is new to them. It is often helpful to show patients another case that has already been worked up and treated comprehensively to help them better understand what is involved and the advantages of such an approach. A typical comprehensive exam requires 60 to 90 minutes and includes a visual examination of the dentition and soft tissues, full set of radiographs, full maxillary and mandibular alginate impressions, diagnostic digital photographs, an earbow transfer, and centric relation (CR) and/or MIP bite record. In addition to this, a TMJ,

range of motion, and muscle screening examination is performed. Stable and comfortable joints are essential prior to definitive treatment. Input from other dental specialists and/or other diagnostic imaging (in addition to conventional dental x-rays) may also be required. The information from the comprehensive exam is used to formulate a concise written narrative describing, among other things, just what it is the patient is looking to do, clinical findings, one or more treatment options, advantages and disadvantages of each option, time frames involved, and anticipated fees for treatment. Diagnostic photographs are an integral part of any comprehensive exam and it is imperative that dentists be adept with digital photography. It is also essential that dentists understand how to take an earbow transfer and why it is so important. The earbow is used to record the relationship of the patient’s maxillary arch relative to the temporomandibular joints and then transfer this relationship to an articulator (Figs 6 & 7). An earbow transfer is absolutely essential whenever an open bite record is taken as is typically the case when taking a CR bite record. The correct axis of condylar rotation (actually a close approximation) is recorded by the earbow and then an upper cast of the patient’s maxillary arch is mounted relative to this hinge axis position. If the correct hinge axis is not recorded

via an earbow or hinge axis recording when taking an open bite record, then the casts will not meet properly when the models are closed together. In addition, the starting hinge axis position will have an effect on excursive pathways. An incorrect hinge axis position during fabrication of the definitive restorations will usually result in considerably more time spent adjusting the case during placement. Even if the dentist chooses to take a closed MIP bite record, it is advantageous to take an earbow transfer and mount the case on an articulator. For one thing, a properly taken earbow transfer and upper cast mounting will enable the dentist and technician to visualize any cant of the maxillary teeth as they relate to the facial midline and horizon. In other words, the earbow transfer relates the “esthetic plane” (line from upper canine to canine) to the articulator just as it appears in the patient’s mouth with the head held straight and erect (Figs 8-10). In the author’s opinion, a properly taken earbow transfer is quicker and more accurate than “stickbite”-type registrations for evaluating horizontal and vertical planes (although stickbite, along with facial photographs, can be a useful adjunct). The use of a level is useful in helping to orient the earbow to the horizon. This is achieved by having the patient stand, or sit upright in a chair, and then orienting the head so it

appears level, straight, and erect, relative to the horizon (the head is not tipped or canted relative to the floor). The anterior component of the earbow is then positioned in the horizontal plane until the bubble in the level is centered (Fig 11). Although many dentists use the interpupillary line to orient the earbow, this is often incorrect because it is not uncommon to have one eye significantly higher or lower than the other (Fig 11). Anterior restorations created parallel to the interpupillary line in such a situation will typically appear canted. One of the treatment goals is to create an esthetic plane of occlusion that is parallel to the horizon, with the head straight and erect, regardless of any facial discrepancies.<sup>7</sup>

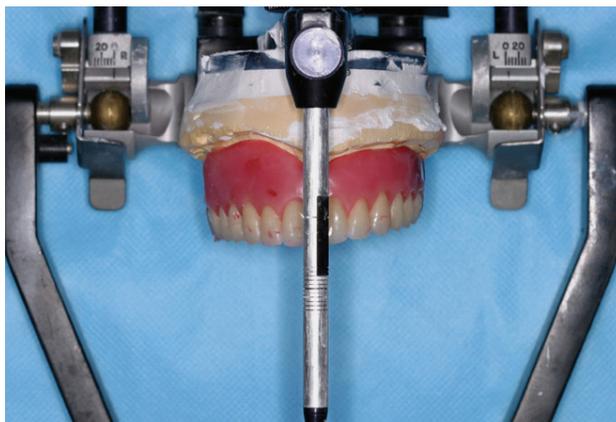
A TMJ and muscle-screening exam must be part of any comprehensive exam. The simple fact is that any change in condylar position and/or morphology will affect the way the teeth come together. Conversely, any change in tooth form or position has the potential to affect the position of one, or both, of the condyles in their respective sockets. It simply makes sense that we ascertain the condition of the joints and position of the condyles in the patient's existing MIP position, prior to definitive treatment. The author uses a simple, concise temporomandibular joint (TMJ) and muscle-screening exam form as a guide during this aspect of the comprehensive exam. It is important to establish baseline parameters in terms of joint and muscle health prior to treatment. If problems are suspected then other diagnostic information, such as joint imaging, may be required. Stable and comfortable joints are vital to overall case comfort, stability, and predictability.

### Red Flags

In this particular case, several "red flags" were evident regarding the stability and comfort of the patient's existing occlusal scheme. The patient stated that she was "not comfortable with her teeth touching" and her bite "felt off." She had also mentioned that it felt like she had "two bites." During the screening exam, consistent reciprocal clicking (clicking on opening and closing) of the left TMJ was noted. The patient also had pain in this joint with direct palpation. Lingual thinning of the upper anterior teeth, and chipping and wear of the lower anterior teeth were also evident (Fig 2). Both joints could be comfortably loaded with light and firm pressure via bimanual manipulation (Figs 12 & 13). A severe "hit and slide" from centric relation (CR) to MIP was noted. "Hit and slide" is the terminology used to describe the slide seen as patients squeeze their teeth together from the first point of tooth contact with the joints in CR to a MIP intercuspal position (Figs 14 & 15). Centric relation



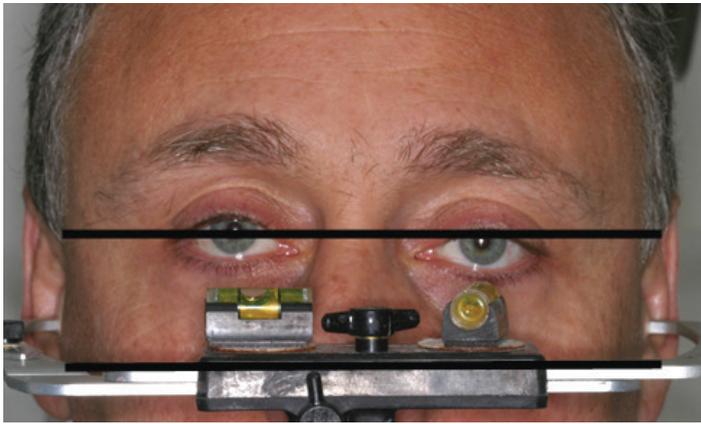
**Figure 8:** Wax try in of a denture with a canted esthetic plane. An earbow transfer was taken with the denture in place and used to mount the denture on a semi-adjustable articulator (also see Figure 9).



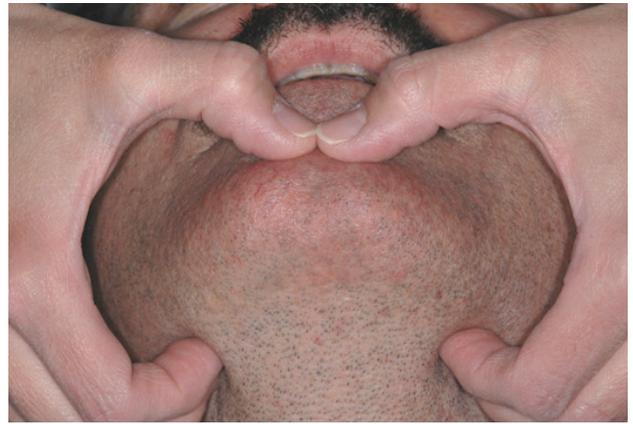
**Figure 9:** A properly taken earbow and upper cast mounting will enable the technician to visualize the cant as it actually appears in the patient's mouth, with the head straight and erect, allowing for easy correction (also see Figure 10).



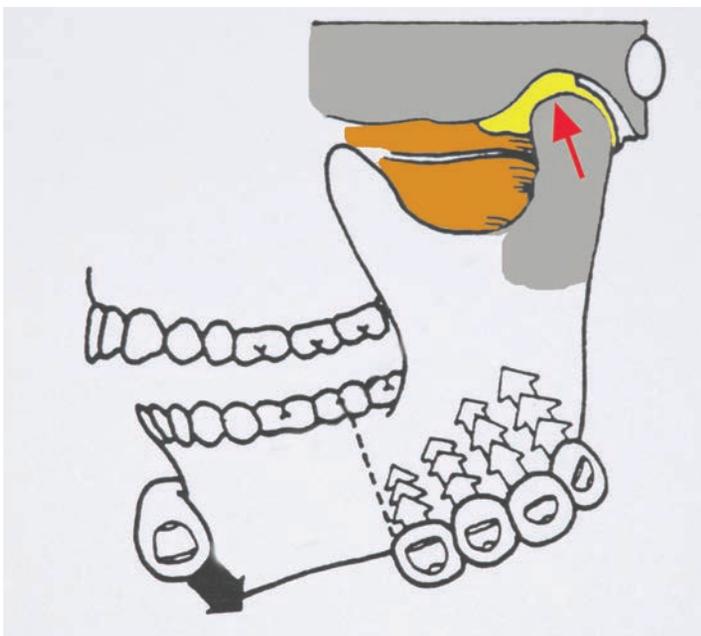
**Figure 10:** Denture with the corrected esthetic plane after resetting the teeth parallel to the horizon on the articulator (also see Figure 9).



**Figure 11:** The author often uses a level to help align the earbow parallel to the horizon. In this example, it is easy to see that if the interpupillary line were used to determine the esthetic plane, the final restorations would be canted relative to the horizon once they were placed in the patient's mouth. This is because one eye is significantly higher than the other.



**Figure 12:** Frontal view of proper finger position for bimanual manipulation. Bimanual manipulation uses a gentle hinging movement of the mandible to guide and fully seat the condyles up in the glenoid fossa.

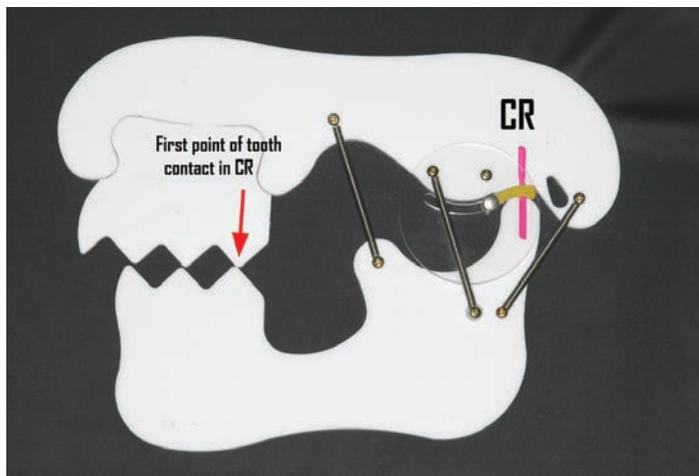


**Figure 13:** Sagittal diagrammatic illustration of bimanual manipulation demonstrating proper finger positioning and how the mandible is rotated to fully seat the condyles in their respective sockets. (Image courtesy of Dr. Peter Dawson.)

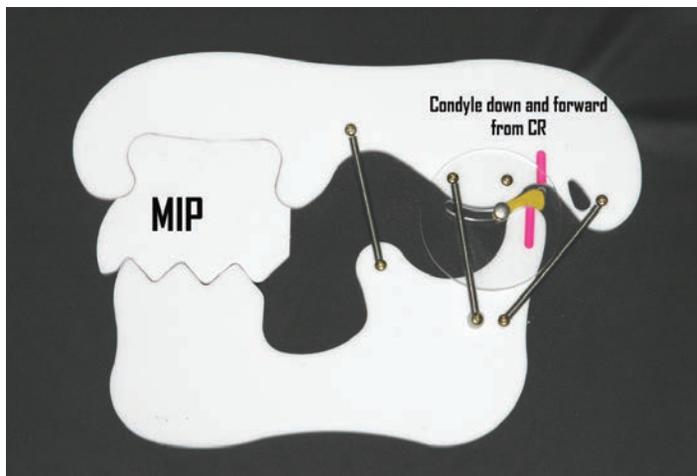
is a joint-based position where the condyles (medial poles) are fully seated in their most superior position in the glenoid fossa and the disks are in their proper position and orientation on the condylar heads. What clinicians need to understand is that CR is a repeatable, joint-based axial position found completely independently of the teeth.<sup>8-11</sup> The teeth are in fact totally superfluous to the location of CR.

### Centric Relation

Because there was clear evidence of occlusal disharmony in this case, the author felt a CR bite record and mounting was essential to properly diagnose the existing occlusal relationships. In the author's experience, CR can be determined in the vast majority of patients without prolonged splint therapy (as is advocated by some). CR can be determined by a number of methods, including bimanual manipulation, leaf gauge, central bearing point and Gothic arch tracing, and various types of anterior deprogrammers such as a Lucia jig and Kois deprogrammer.<sup>12-16</sup> Although the author has had experience with all of these, the technique he most often uses is bimanual manipulation (BMM) in conjunction with a simple anterior deprogrammer (Pankey deprogrammer). The deprogrammer is painted with a polyvinyl siloxane (PVS) adhesive and filled with a very firm and quick-setting PVS (Quick Bite, Clinician's Choice; New Milford, CT). It is then placed over the upper anterior teeth and the PVS is allowed to set. The surface of the deprogrammer should be kept parallel to the occlusal plane. The patient is then placed in a horizontal position with the deprogrammer in place for approximately 10 minutes. The idea is to keep the teeth apart for a period of time to assist in muscle relaxation and deprogramming. Some



**Figure 14:** TMJ illustrator demonstrating the first point of tooth contact (arrow) with the condyles in CR.



**Figure 15:** As the “teeth” close/slide together into MIP, the condyles are no longer in CR but are down and forward from that position. This movement, from the first point of tooth contact with the condyles in CR (see Figure 14) to an MIP tooth-based position, is called a “hit and slide” from CR to MIP.

patients can be deprogrammed very quickly while others require more time (a small percentage may require splint therapy). Muscle relaxation, especially of the lateral pterygoids, is one of the keys to locating a correct CR position.<sup>17</sup> To paraphrase Dr. Frank Spear: “CR is not a position you have to put people in, it is a position the condyles go to when the lateral pterygoids relax.” After deprogramming, BMM is used to gently hinge the mandible, helping to guide and seat the medial poles of the condyles up into CR as described by Dawson.<sup>1,2</sup> Once the dentist feels that CR has been found and verified,<sup>1</sup> the same hinging motion is used to guide the lower anterior teeth through a thin layer of unpolymerized composite, that is placed on the surface of the Pankey deprogrammer (Fig 16). As the incisal edges of the lower anterior teeth penetrate the soft composite, they contact the hard surface of the deprogrammer. At this point the composite is light-polymerized, creating a very precise incisal index of the lower anterior teeth on the surface of the deprogrammer (Fig 17). It is important to roughen the smooth surface of the deprogrammer and brush on a thin layer of unfilled resin prior to placing the layer of composite (to ensure the composite sticks to the deprogrammer). If the CR position is correct, then each and every time the mandible is hinged using BMM the lower incisal edges will fit precisely into the incisal index. In fact, once the patient is deprogrammed no external manipulation is generally necessary as the patient, on command, will consistently close into the index without any external guidance. If everything was done correctly, the condyles will be in CR when the patient closes into the index. All that remains to be done is to inject a very stiff and firm-setting PVS (Futar D Occlusion, Kettenbach US; Huntington Beach, CA)



**Figure 16:** View of a Pankey deprogrammer that has been filled with PVS and seated over the upper anterior teeth. The surface of the deprogrammer has been roughened and coated with a Bis-GMA resin that facilitates adhesion to a subsequently placed thin layer of composite.



**Figure 17:** Bimanual manipulation is used to hinge the mandible in CR until the lower incisal edges penetrate the soft composite and contact the hard surface of the deprogrammer. The composite is then light-polymerized, resulting in a very precise incisal index. A very firm-setting PVS is injected between the separated posterior teeth while the patient is closed into the index to take the CR bite record (Delar Wax can also be used).

between the separated posterior teeth while the patient is closed into the index. The resulting bite record and incisal index are then used to mount the case in CR on a semi-adjustable articulator (Figs 18 & 19). There are several acceptable variations to this technique (e.g., the use of Delar Wax for the bite record as opposed to Futar D) but the fundamental principle is the same, and that is the use of BMM to create an anterior incisal index on a deprogrammer with the condyles in CR. Having taught this procedure to hundreds of dentists, the author finds that most will pick up the technique relatively quickly. For those not comfortable with BMM (and some are not) then the use of a leaf gauge, Lucia jig, or Kois deprogrammer can be viable alternatives. However, a certain degree of “tactile” information is lost with these alternative techniques

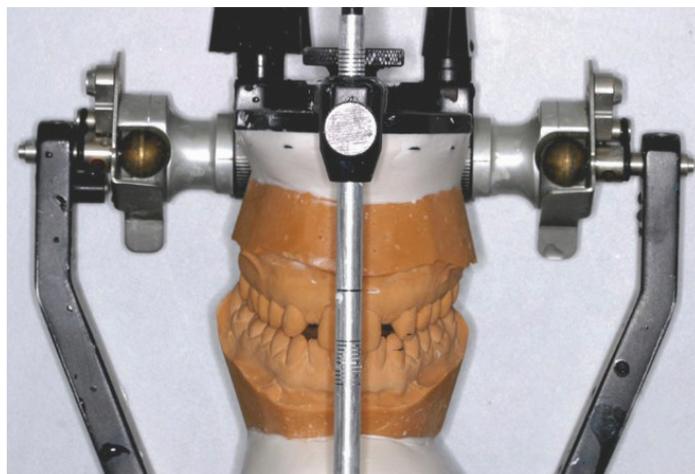
into an MIP position. Basically, the same thing is occurring in the patient’s mouth. In order for her to bring her teeth together, one—or both—of the condyles must translate out of CR and move down the eminence to some degree. It should be pointed out that this is not always a clinical problem and that it might be acceptable to place restorations into an occlusal scheme such as this. Specifically, if there are no signs or symptoms of occlusal disharmony, and the patient is comfortable and has no difficulty chewing, then a change in the existing occlusal scheme may be unwarranted. Even a seriously flawed occlusion may be working quite well for a patient, and dentists need to be very cautious about changing an occlusion that is already working. Some patients have an extraordinary adaptive capacity and some just do not bring their teeth

compared to a more hands-on approach such as BMM.

Once the case was mounted in CR (using the open bite record described) the only point of tooth contact when the models were closed together was the mesiolingual cusp of #16 (Figs 20-22). This was the same first (and only) point of contact seen in the patient’s mouth when BMM was used to hinge the mandible into CR (Fig 23). The fact that what we see in the mouth is duplicated precisely on the articulator confirms the accuracy of the CR mounting. The patient’s hit and slide from CR to MIP can be easily visualized by unlocking the articulator hinges and sliding the models together

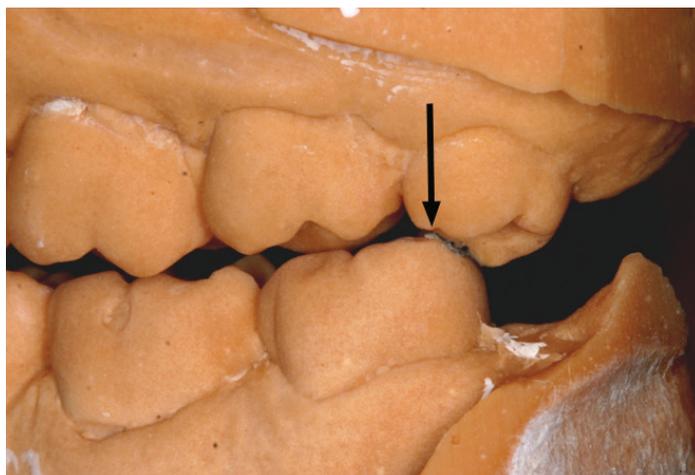
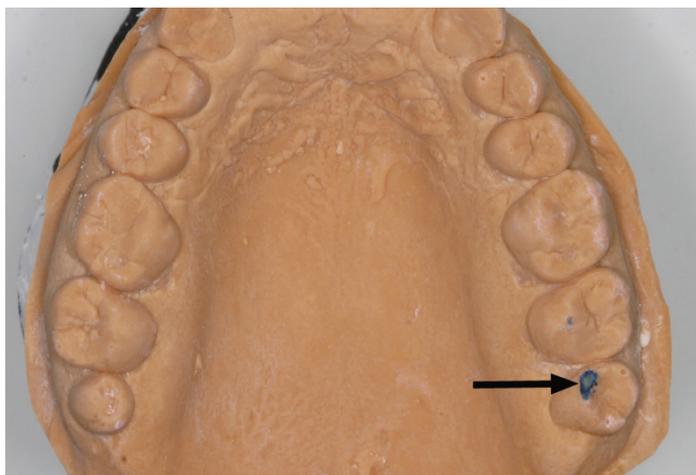
together very often. In regards to occlusion, it is not until opposing teeth touch that things begin to happen. In the author’s opinion, it is a mistake to alter an existing occlusal scheme that is already working solely to satisfy the “ideal” of any particular occlusal philosophy. Having said that, many patients have an occlusal scheme that is not working particularly well for them and dentists need to consider a change prior to placing definitive restorations. The key is to know when a change is warranted and when it is not.<sup>18</sup>

The clinical findings and history in this case clearly indicated a problem with the existing occlusal scheme, so the decision was made to modify the occlusion prior to doing the clinical dentistry. One of the goals in a CR-based occlusion is the harmonization of MIP with CR. In other words, when the patient closes into MIP the condyles are also in CR. In this case, the only point of tooth contact, with the condyles in CR, was the ML cusp of #16. This tooth was essentially a nonfunctional third molar that also had mesial caries. It was decided to “extract” this tooth on the upper model to ascertain what effect this would have on the occlusion. The tooth was removed with a heatless stone and the models closed together with the articulator hinges still locked in a CR position (Fig 24). Just removing this one tooth eliminated almost all the hit and slide from CR to MIP and bilateral posterior contacts were now evident (Figs 25 & 26). Anterior coupling (anterior tooth contact) was subsequently achieved by minor equilibration of the models (Fig 27). The occlusal scheme created on the models resulted in a new MIP position that was now coincident with CR (Fig 28). By performing the occlusal correction on the models first, it was determined that the same process could easily be repeated in the patient’s mouth without excessive removal of tooth structure.



**Figure 18:** After the upper cast is mounted with the earbow transfer, the lower model is mounted to the upper cast using the CR bite record and incisal index.

**Figure 19:** Properly trimmed and polished CR mounted models on a semi-adjustable articulator.



**Figures 20 & 21:** When the models are closed together with the hinges locked in CR, the only point of tooth contact is the mesio-lingual cusp of #16 (compare with Figure 23).



**Figure 22:** In CR, all the teeth are far out of occlusion when the articulator is closed down with the exception of #16.

**Figure 23:** The fact that the same (and only) point of tooth contact we see in the mouth using bimanual manipulation to seat the condyles in CR is exactly the same as what we see on the articulator confirms the accuracy of the mounting.

// Having taught this procedure to hundreds of dentists, the author finds that most will pick up the technique relatively quickly. //



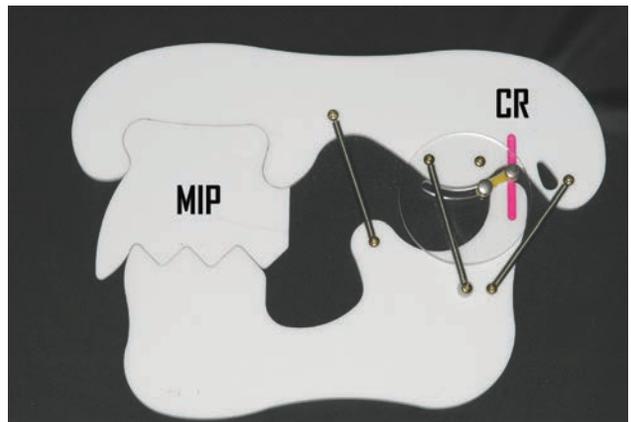
**Figure 24:** Tooth #16 is "extracted" on the model with a heatless stone.



**Figures 25 & 26:** Removing #16 eliminated almost all of the "hit and slide" from CR to MIP, and bilateral posterior contacts are now evident from the premolars back.



**Figure 27:** Anterior coupling (anterior tooth contact) was achieved by minor equilibration of the models after #16 was removed.



**Figure 28:** TMJ illustrator demonstrates the occlusal scheme created on the models that resulted in a new MIP position that is now coincident with CR.



**Figure 29:** Diagnostic wax-up of ##4-13. The diagnostic wax-up should be viewed as our “best guess” as to what the case should look like in its final form. It must be tested in provisionals. A matrix for provisionals, facial reduction guide, and incisal reduction guide are all fabricated from the diagnostic wax-up.



**Figure 30:** Exactly as was done on the models, #16 was extracted in the patient’s mouth, and the teeth equilibrated to CR. The patient’s “hit and slide” from CR to MIP was completely eliminated.

### Other Factors

In addition to the aforementioned occlusal issues, a number of other factors were considered in developing a treatment plan for this patient. She was not a candidate for dental implants and was not interested in orthodontic re-treatment. She was not willing to accept a removable appliance of any type and she had had negative experiences with three different fixed Maryland-type bridge replacements. She had very high esthetic expectations. Space management was also an issue because the interproximal distance between the central incisors and canines was inadequate for replacement with laterals of appropriate width.

### Treatment Plan

After considering all of the aforementioned factors and carefully evaluating the information obtained from the comprehensive exam, the following treatment plan was presented to the patient:

1. Diagnostic wax-up of ##4-13 on CR-equilibrated models with #16 removed. The anticipated treatment was porcelain veneers on #4, #5, #12, and #13 along with two three-unit Lava (3M ESPE; St. Paul, MN) bridges (##6-8 and ##9-11) with pontics at #7 and #10.
2. At the first appointment, #16 would be extracted and the teeth subsequently equilibrated with the condyles in CR to create a new MIP position that was coincident with CR (just as was done on the models). Deliver lower whitening tray for whitening of the lower anterior teeth (Nite White, Discus Dental; Culver City, CA).
3. The preparation appointment would consist of adjusting and evening out the lower incisal edges followed by the preparation of #6, #8, #9, and #11 for two separate Lava bridges with pontics at #7 and #10. Teeth #4, #5, #12, and #13 would be prepared for porcelain veneers. Final impressions would be taken along with a bite record and photographs of the prepared teeth. Provisionals would then be fabricated using the matrix made on the diagnostic wax-up.
4. Two days after preparation and provisionalization the patient would be seen and the provisionals evaluated for esthetics, phonetics, occlusion, and function (adjustments made as required). Once the provisionals were deemed acceptable, a series of photographs would be taken along with an alginate impression so a solid model of the provisionals could be fabricated. The model, along with the photographs, would help guide the ceramist in the fabrication of the definitive restorations.



**Figures 31 & 32:** The incisal edges of the lower anterior teeth were altered slightly to create a more esthetic and even incisal profile. Great care should be taken whenever lower incisal edges are altered. It is very important to preserve the proper incisal inclination and maintain a sharp buccal-incisal line angle.

5. During the placement appointment the case would be tried in and the final restorations evaluated. Once the case was approved by both the patient and the dentist, the restorations would be bonded and/or cemented into place. After the case was placed, impressions would be taken for the fabrication of a nightguard (which would also serve as a retainer).
6. Adjustments as required and insert nightguard/retainer.

## Treatment

The patient accepted the treatment plan as presented and was anxious to begin. The equilibrated models were sent to the laboratory and a diagnostic wax-up was returned along with matrixes for provisional restorations and reduction guides (Fig 29). The diagnostic wax-up should be viewed as our "best guess" as to what the case should look like in its final form. The only way to ascertain that this "guess" is correct is to try the case in provisionals that duplicate the wax-up and see what it actually looks like in the patient's mouth.

The treatment began by essentially doing exactly what was done on the mounted models. As on the models, #16 was extracted and the teeth equilibrated to CR (Fig 30). The patient's hit and slide from CR to MIP was complete-

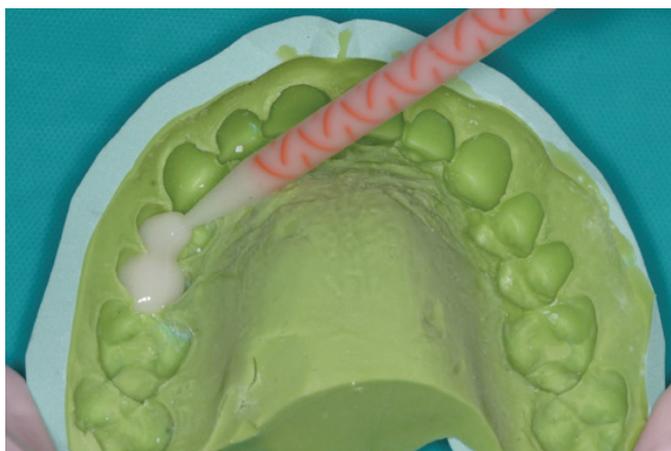
ly eliminated. The following week, the patient was reevaluated and she reported that she was very comfortable with her new bite. In her own words: "This is the first time since I can remember that my bite has felt comfortable and I know how my teeth should fit together."

Once the occlusion had been addressed, the teeth were prepared as treatment planned. First, the incisal edges of the lower anterior teeth were modified to create a more esthetic profile (Figs 31 & 32). Great care should be taken whenever lower incisal edges are altered. It is very important to preserve the proper incisal inclination and maintain a sharp buccal-incisal line angle. In this case, there was a degree of latitude in reshaping the lower incisal edges because the lingual contours of the upper anterior Lava bridges could be designed as required to ensure proper occlusion with the altered lower incisal edges. After the lower incisal edges were reshaped, the upper canines and centrals were prepared for Lava bridges and the premolars for porcelain veneers. Final impressions were taken with a polyether impression material (Impregum Penta Soft Quick Step, 3M ESPE). A closed bite record was also taken. (It should be noted that the closed MIP bite record was now also a CR bite record because the patient had been equilibrated to an MIP position that was now coincident

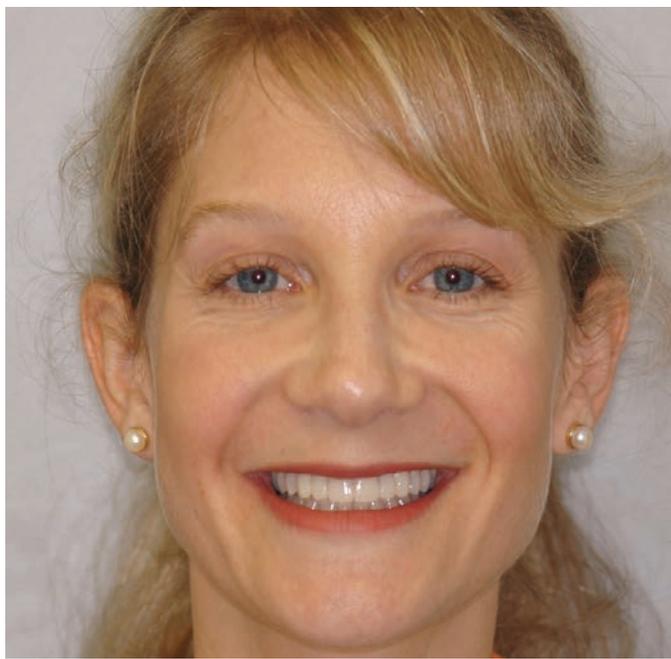
with CR.) Provisional restorations were fabricated using the matrix fabricated from the diagnostic wax-up in conjunction with Luxatemp Fluorescence B-1 shade (Zenith/DMG; Englewood, NJ). The matrix was filled with the Luxatemp and seated over the prepared teeth (Fig 33).

Once the Luxatemp was set, the provisionals were removed so that they could be smoothed and polished outside of the mouth. The occlusion was adjusted and the provisionals were placed by spot-bonding in the veneers and cementing the anterior bridge segment with TempBond (Kerr; Orange, CA).

The patient returned two days after the preparation appointment so that the provisionals could be evaluated for comfort, esthetics, phonetics, and function (Figs 34 & 35). The patient stated she was "very happy" with the look of the provisionals but wanted her final restorations to be whiter. Once the case had been worked out in provisionals, an incisal index was fabricated to precisely record the incisal edge position of the central incisors. In addition to this, various digital photographs were taken along with an alginate of the provisional restorations. A solid model of the alginate impression was fabricated and sent to the laboratory along with the photographs and incisal index.



**Figure 33:** Matrix fabricated from diagnostic wax-up being filled with Luxatemp.



**Figures 34 & 35:** The patient was seen two days after the preparation appointment so that the provisionals could be evaluated for comfort, esthetics, phonetics, and function.

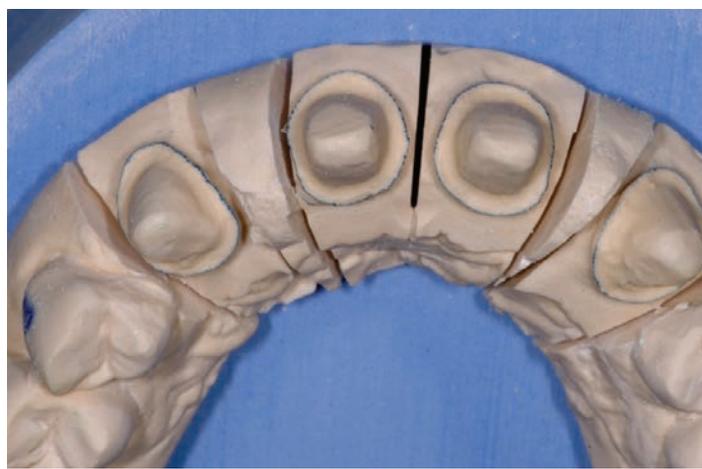
With this information, a good ceramist can duplicate everything that was right with the provisionals in the final restorations and/or make modifications as required. Using the provisionals as a guide<sup>19,20</sup> is a far more predictable approach than simply having finished restorations returned and “hoping” the case looks good, feels good, and functions well.

The master models and finished restorations were inspected after they were received from the laboratory (Figs 36 & 37). The restorations were subsequently evaluated in the patient’s mouth to ensure proper fit, occlusion, and esthetics. Once approved by the patient, the restorations were placed by first bonding in the porcelain veneers (Fig 38), followed by cementation of the anterior Lava bridges (Fig 39). The veneers were bonded in with the total-etch adhesive One-Step Plus (Bisco; Schaumburg, IL) using a wet bonding protocol.<sup>21-24</sup> Once the veneers had been placed, the intaglio surfaces of the Lava bridges were sandblasted with 50- $\mu$  aluminum oxide at 30 psi and cemented with a resin-modified glass ionomer cement (RelyX Plus, 3M ESPE).<sup>25,26</sup> After all the restorations were placed, final finishing and polishing was performed under high magnification and the occlusion checked in MIP and all excursive movements. The patient was given oral and written postoperative instructions.

The patient returned one week after the case was placed for final adjustments, photographs, and the insertion of a flat-plane hard/soft acrylic upper nightguard. She was delighted with the final results (Figs 39-41).

#### Follow-Up

This case was placed in August of 2005 and has been followed carefully since that time. The patient has been seen every six months for prophylaxis. She has excellent homecare and wears her nightguard every night. More than seven years after this case was placed there has been no structural breakdown of the porcelain, no problems with veneers debonding, and the patient states her bite and joints are “very comfortable” (Figs 42-44).



**Figure 36:** Model showing preparations for the Lava bridges on ##6-8 and ##9-11.



**Figure 37:** Definitive restorations (veneers for all four premolars and two Lava bridges).



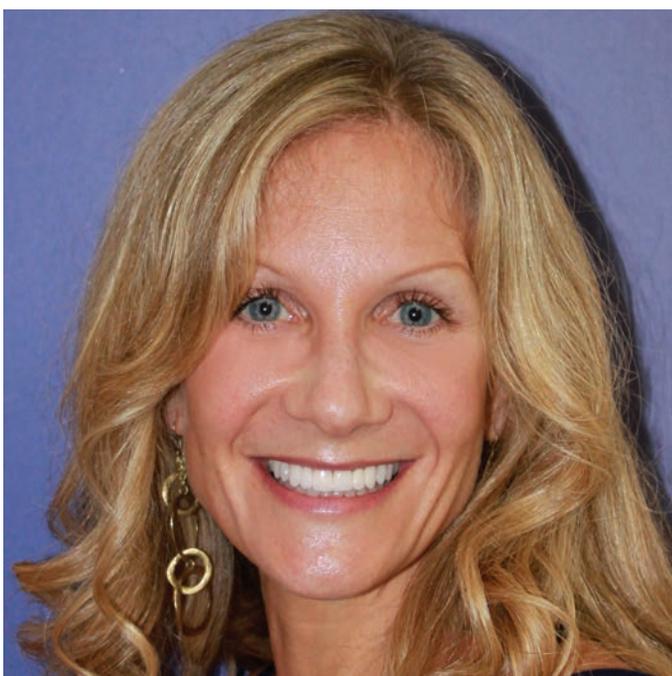
**Figure 38:** The porcelain veneers on the premolars were placed first using a total-etch adhesive system protocol.



**Figure 39:** The Lava bridges were cemented with a resin-modified glass ionomer cement.



**Figures 40 & 41:** Finished case.



**Figures 42-44:** Restorations nearly seven years after placement. At this point the patient has had no problems, is “delighted” with her new smile, and has a comfortable and stable bite relationship.

## Discussion

It is interesting to speculate on the cause of the damage to the patient’s anterior teeth at the time of her initial presentation (chipping, wear, lingual thinning of the uppers). It is also interesting to note that the posterior teeth had little to no wear. A chipping and wear pattern of this nature might be consistent with a protrusive bruxing habit where the front teeth touch but not the back teeth, anterior tooth interference with the patient’s envelope of function, a habit of some type, or a combination of these. The patient was not aware of any bruxing or clenching habits. She also could think of no habits (fingernail/cuticle biting, holding objects with her teeth, etc.) that might have contributed. It is unlikely that there were problems associated with the patient’s envelope of function. Envelope of function issues typically occur when there is a lack of horizontal freedom for the lower incisal edges during function (not enough “room to roam”). That is, the lower incisal edges are interacting in a destructive fashion with the upper anterior teeth (usually the lingual inclines and/or incisal edges) during normal chewing and functioning. In the author’s experience envelope of function problems are more often associated with deep overbite and/or constricted envelope dentitions (neither of which the patient had).

The severe “hit and slides” from CR to MIP the patient had prior to treatment is what the author believes caused the damage to the front teeth in this case. In other words, as the patient closed, the elevator muscles tended to pull the condyles up toward CR (which is exactly what they do). As soon as the teeth hit the prematurity to CR on #16 the mandible would slide into an MIP position, causing the front teeth to “crash” together. This likely did not happen every time the patient closed due to muscle memory (engrams). The fact is that most patients with “hit and slides” from CR to MIP do not typically do that when asked to close their teeth together; rather, they typically close right into their MIP position. This is because the muscles have already “learned” in what order and intensity they need to contract to bring the teeth together so they fit (MIP). It is also clear to the author that most patients do, at times, close and hit the interfering tooth or teeth to CR and then slide into their MIP position. Indeed, wear facets often seen on teeth starting from the first point of contact in CR and ending at an MIP position support this contention (Figs 45 & 46). In the author’s opinion, the most likely cause for the damage to the patient’s anterior teeth initially was the severe “hit and slide” that existed prior to treatment (“it feels like I have two bites”). It was the recognition and correction of this prior to definitive restorative/prosthetic treatment that was really the key to the long-term clinical success of this case.



**Figure 45:** In this example the patient has tapped their teeth together in MIP. Note the articulating paper mark on #18. Also note the wear facet distal to this mark. This area was not contacting in normal excursive movements.



**Figure 46:** In this example, the patient was manipulated with BMM to CR. Note the first (and only) point of tooth contact in CR. The wear facet in this case was caused by a CR to MIP slide.

While an excellent cosmetic result is always a desirable goal, it was the recognition and treatment of the occlusal issues prior to doing the definitive restorative dentistry that made this case a true success.

## Summary

What is needed when approaching cosmetic/restorative cases such as the one presented here is a logical and systematic methodology that will lead to a reasonably predictable final result. The place to start should always be the comprehensive exam. It is up to clinicians, through comprehensive diagnostic examination and evaluation, to develop a treatment plan that fulfills not just the esthetic but also the functional requirements of a case. While an excellent cosmetic result is always a desirable goal, it was the recognition and treatment of the occlusal issues prior to doing the definitive restorative dentistry that made this case a true success.

**Editor's Note:** A description of this case was originally published in the February 2007 issue of *Inside Dentistry*. It has been updated by the author.

## Acknowledgment

The author thanks ceramist HakJoo Savercol (San Diego Aesthetic Dental Studio; San Diego, CA) for her extraordinary talents in helping to make this case a success.

## References

1. Dawson P. Evaluation, diagnosis, and treatment of occlusal problems. 2nd ed. St. Louis: Mosby; 1989.
2. Dawson PE. Want a thriving practice? Concentrate on clinical excellence. *Dent Econ*. 1992;82(10):78-9.
3. Alex G, Polimeni A. Comprehensive dentistry: the key to predictable smile design. AACD monograph. Mahway (NJ): Montage Media Corp.; 2006. 15-20 p.
4. Spear FM. The business of occlusion. *J Am Dent Assoc*. 2006;137(5):666-7.
5. Miller L. Symbiosis of esthetics and occlusion: thoughts and opinions of a master of esthetic dentistry. *J Esthet Dent*. 1999;11(3):155-65.
6. Tarantola GJ, Becker IM, Gremillion H, Pink F. The effectiveness of equilibration in the improvement of signs and symptoms in the stomatognathic system. *Int J Periodontics Restorative Dent*. 1998;18(6):594-603.
7. Lee RL. Standardized head position and reference planes for dento-facial aesthetics. *Dent Today*. 2000;19(2):82-7.
8. Tarantola GJ, Becker IM, Gremillion H. The reproducibility of centric relation: a clinical approach. *J Am Dent Assoc*. 1997;128(9):1245-51.
9. McKee JR. Comparing condylar position repeatability for standardized versus nonstandardized methods of achieving centric relation. *J Prosthet Dent*. 1997;77(3):280-4.
10. The glossary of prosthodontic terms. *J Prosthet Dent*. 2005;94(1):10-92.

11. Spear FM. Occlusion in the new millennium: the controversy continues. *Signature*. 2000;7(2):18-21.
12. McKee JR. Comparing condylar positions achieved through bilateral manipulation to condylar positions achieved through masticatory muscle contraction against an anterior deprogrammer: a pilot study. *J Prosthet Dent*. 2005;94(4):389-93.
13. Lucia VO. A technique for recording centric relation. *J Prosthet Dent*. 1964;14:492-505.
14. Long JH. Locating centric relation with a leaf gauge. *J Prosthet Dent*. 1973;29(6):608-10.
15. Carroll WJ, Woelfel JB, Huffman RW. Simple application of anterior jig or leaf gauge in routine clinical practice. *J Prosthet Dent*. 1988;59(5):611-7.
16. Dawson PE. Centric relation: its effect on occluso-muscle harmony. *Dental Clin North Am*. 1979;23(2):169-79.
17. Spear FM, Kokich VG. Interdisciplinary management of anterior dental esthetics. *J Am Dent Assoc*. 2006;137(2):160-9.
18. Yaffe A, Hochman N, Ehrlich J. Physiologic occlusion vs pathologic occlusion and rationale for treatment. *Compend Contin Educ Dent*. 1996;17(11):1093-8.
19. Fondriest JF. Using provisional restorations to improve results in complex aesthetic restorative cases. *Pract Proced Aesthet Dent*. 2006;18(4):217-24.
20. Terry DA, Moreno C, Geller W, Roberts M. The importance of laboratory communication in modern dental practice: stone models without faces. *Pract Periodontics Aesthet Dent*. 1999;11(9):1125-32.
21. Kanca J III. Improving bond strength through acid etching of dentin and bonding to wet dentin surfaces. *J Am Dent Assoc*. 1992;123(9):35-43.
22. Alex G. Adhesive dentistry: where are we today? *Compend Contin Educ Dent*. 2005;26(2):150-5.
23. Tay FR, Gwinnett AJ, Pang KM, Wei SH. Resin permeation into acid-conditioned, moist, and dry dentin: a paradigm using water-free adhesive primers. *J Dent Res*. 1996;75(4):1034-44.
24. Gwinnett AJ. Moist versus dry dentin: its effect on shear bond strength. *Am J Dent*. 1992;5(3):127-9.
25. Raigrodski AJ, Chiche GJ, Potiket N, Hochstedler JL, Mohamed SE, Billiot S, Mercante DE. The efficacy of posterior three-unit zirconium-oxide-based ceramic fixed partial dental prostheses: a prospective clinical pilot study. *J Prosthet Dent*. 2006;96(4):237-44.
26. Palacios RP. Retention of zirconium oxide ceramic crowns with three types of cement. *J Prosthet Dent*. 2006;96(2):104-14. **jcd**



Dr. Alex earned his DMD at Tufts University Dental School. He maintains a private practice in Huntington, New York.

Disclosure: The author did not report any disclosures

# AACD Self-Instruction Continuing Education Information



## 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](http://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](http://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](http://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](mailto:meetings@aacd.com) or by calling 800.543.9220 or 608.222.8583.



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](http://www.ada.org/goto/cerp).

The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article, "Are Occlusion and Comprehensive Dentistry Really That Important?" by Dr. Gary Alex. This article appears on pages 126-143.

The examination is free of charge and available to AACD members only. AACD members must log onto [www.aacd.com](http://www.aacd.com) to take the exam. **Note: Questions 1 through 5 appear in the printed and digital versions 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 608.222.8583.

1. An earbow is used to record the relationship of the patient's

- a. mandibular arch in relation to the horizon.
- b. maxillary arch in relation to the interpupillary line.
- c. maxillary and mandibular arch in relation to the temporomandibular joint.
- d. maxillary arch in relation to the temporomandibular joint.

2. According to the author,

- a. a stickbite with a level is as effective in treatment planning as an earbow transfer.
- b. esthetic planes should be solely based on the interpupillary line.
- c. a correct earbow transfer accurately relates the patient's esthetic plane.
- d. restorations created to the interpupillary line typically are esthetically correct.

3. The esthetic plane

- a. can be determined in part by a line from the patient's canine to canine.
- b. is defined as the line parallel to the patient's pupils.
- c. registration is a constant and is not dependent upon the patient's posture.
- d. must always be corrected to complement facial deformities.

4. In treatment planning for harmonious occlusion,

- a. a change in morphology unrelated to condylar position will not affect occlusion.
- b. morphological change associated with condylar stability will not affect occlusion.
- c. any change in tooth form or condylar morphology is not contributory to occlusal stability
- d. any change in tooth form or position can affect condylar position.

5. In the author's opinion, centric relation

- a. is a repeatable, joint-based axial position found following splint wear and the resulting position of the teeth.
- b. is a repeatable, joint-based axial position where the condyles are in their most inferior resting position in the fossa.
- c. is totally superfluous to the location and intercuspation of the teeth.
- d. bite records are typically taken in maximum intercuspation position.

To see and take the complete exam, log onto [www.aacd.com](http://www.aacd.com).

# Material Selection for Accurate Bite Registrations

## Plus Bite Registration Material Product Reviews

Sabiha S. Bunek, DDS

Editor's Note: The information contained in this article does not imply endorsement from *jCD* or the AACD.

### Introduction

Capturing bite relationships and managing occlusion are both critical components for successful restorations for a single-tooth, quadrant, or full-arch reconstruction. The accuracy of bite registration materials influences the relationship of the working casts and, therefore, the success of the final prosthesis. Casts mounted even slightly out of occlusion can lead to the need for time-consuming adjustments. Proper material selection and technique are imperative to increase predictability and reduce remakes and adjustments.

### Selecting the Right Bite Registration Material

To obtain an accurate bite registration, clinicians should select materials that exhibit the following characteristics: fast setting (minimizing the risk of distortions due to jaw movement), lack of adherence to teeth, mousse-like consistency in the tray but rigid when set, easy to trim (Fig 1), precise detail, and acceptable taste and odor.<sup>1,2</sup> One of the most important features for bite registration materials is to remain dimensionally accurate over time, since they are not used immediately (and, in some cases, are used multiple times).<sup>3</sup> To date, most clinicians use polyvinyl siloxane (addition silicone) bite registration materials due to their ease of use, relative stiffness, accuracy, and proven dimensional stability.

Traditionally, wax bite registrations were taken to record the bite relationship. While wax can produce accurate mountings, the material changes dimensionally when cooled. Consequently, inaccuracies are seen, including distortion upon removal, trimming, and transfer.<sup>4</sup> Due to the unreliability of wax, addition silicones and polyether bite registration materials are now commonly used.<sup>5</sup> Although polyethers and addition silicones are relatively similar in physical properties, addition silicones are used more frequently because they exhibit lower dimensional change after removal.<sup>3</sup>

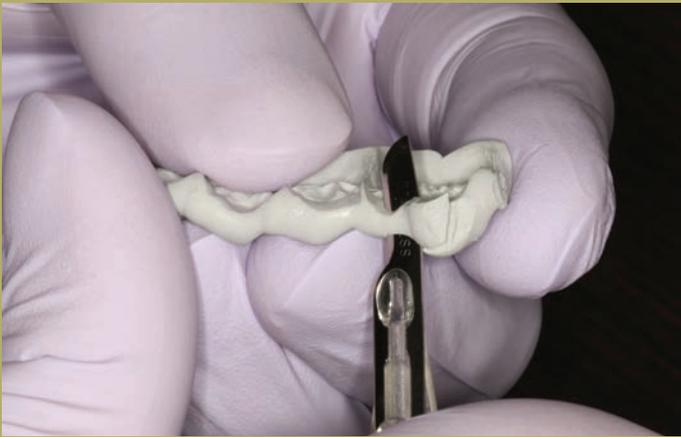
### Translating the Science: Understanding Physical Properties<sup>6</sup>

Understanding the different physical properties for a given material helps clinicians select the most suitable product for every situation. While mechanical tests have not reached the level where they simulate clinical performance in the mouth, they signify a critical parameter of analysis. The physical properties of three bite registration materials are highlighted in Table 1. There are many other materials on the market; however, only the three listed in Table 1 were tested by *The Dental Advisor*.

#### Ideal Physical Properties of Addition Silicones

- adequate working time
- low strain in compression (high stiffness)
- no measurable flow
- low dimensional change
- high elastic recovery

“ The accuracy of bite registration materials influences the relationship of the working casts and, therefore, the success of the final prosthesis. ”



**Figure 1:** Material trims easily with a scalpel. Note its lack of brittleness.

**Table 1**

Product	Manufacturer	Strain in Compression (%)*	Elastic Recovery (%)**
PerfectIM Systems Blue Velvet	J. Morita	1.5	99.2
Re'CORD	Harry J. Bosworth Co.	1.6	98.7
Registrado X-tra	VOCO	0.7	99.5

\*Strain in compression: A rigid bite registration material is desirable to minimize distortion in the mouth and when the cast is made in the laboratory. A low value (< 2 %) of strain in compression indicates that the bite registration material is very rigid. The rigidity is also measured by the Shore A or D hardness test.<sup>5</sup>

\*\*Elastic recovery: This property describes the ability of a bite registration material to be used without being permanently distorted when removed from the mouth. A high value (> 99%) of elastic recovery means very little distortion will occur.<sup>5</sup>

**Flexitime Bite +++++ (Heraeus Kulzer)**

Flexitime Bite is an addition silicone bite registration material that may be used for conventional bite registration or in conjunction with CAD/CAM systems. It can be scanned using an optical scanner intraorally, or in the lab without the addition of a reflective powder. Flexitime Bite is lavender in color and sets hard in 30 to 90 seconds. Consultants found the material to be hard but not brittle, and easy to trim without the material chipping or crumbling.

Forty-seven percent of consultants reported that Flexitime Bite was better than other bite registration materials, and 42% reported it was equivalent. Sixty-eight percent would switch to Flexitime Bite, and 84% would recommend it. Flexitime Bite was evaluated by 19 consultants in 311 uses. It received a 92% rating.

## Innovations: Scannable Bite Registration Materials for CAD/CAM Procedures

With the ever-growing popularity of CAD/CAM systems, some manufacturers are introducing scannable bite registration materials to their line of products. These additional silicone materials can be scanned by optical or laser systems without the use of powder during the design phases of a CAD/CAM restoration (Fig 2). Scannable bite registration materials recommended by *The Dental Advisor* include Flexitime Bite (Heraeus Kulzer; South Bend, IN), Futar Scan (Kettenbach LP; Huntington Beach, CA), Virtual CADbite (Ivoclar Vivadent; Amherst, NY), and R-Si-Line METAL-BITE (R-dental GmbH; Hamburg, Germany).

Dental laboratories and milling centers also utilize scannable bite registrations, particularly in large cases where the articulator does not fit into the laboratory model scanner. Figure 3 illustrates the use of a scannable bite registration, Virtual CADbite, in a long-span zirconia framework design.

### Acknowledgment

The author thanks Nelson Rego, CDT, AAACD, for the use of Figure 5.

### References

1. Tripodakis AP, Vergos VK, Tsoutsos AG. Evaluation of the accuracy of interocclusal records in relation to two recording techniques. *J Prosthet Dent.* 1997 Feb;77(2):141-6.
2. Warren K, Capp N. A review of principles and techniques for making interocclusal records for mounting working casts. *Int J Prosthodont.* 1990 Jul-Aug;3(4):341-8.
3. Powers JM, Wataha JC. *Dental materials: properties and manipulation.* 10th ed. St. Louis: Mosby Elsevier; forthcoming 2013.
4. Millstein PL, Clark RE. Determination of the accuracy of laminated wax interocclusal wafers. *J Prosthet Dent.* 1983 Sep;50(3):327-31.
5. Sakaguchi RL, Powers JM, editors. *Craig's restorative dental materials.* 13th ed. St. Louis: Mosby Elsevier; 2012.
6. Farah JW, Powers JM, editors. Impression and bite registration materials. *Dent Advisor* [Internet]. Available from: <http://www.dentaladvisor.com/publications/the-dental-advisor/articles/impression-and-bite-registration-materials-2011.shtml>. **jCD**



Figure 2: Digital impression of a scannable bite registration material.

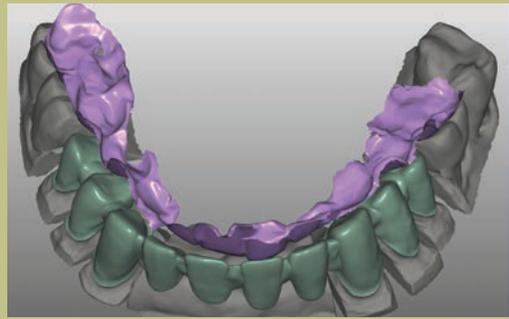


Figure 3: Scannable bite registration in a long-span zirconia framework design.



Figure 4: Bite registration capturing all buccal and lingual cusp tips.



Figure 5: Bite registration not seating properly on model. Too much material was used, causing the registration material to extend to the soft tissue.

### Clinical Tips for Taking a Bite Registration

- Addition silicone materials are inherently hydrophobic; therefore, it is important to dry the entire field before injecting the material. Failure to do so can result in lack of detail and lead to an inaccurate mounting.
- For posterior restorations in which posterior stops are being eliminated during preparation, take the bite before the most distal stop is reduced.
- Trim the bite registration with a scalpel or blade to ensure a proper fit on the models. It is important to trim excess material that extrudes into interproximal areas, buccal and lingual embrasures, and distal extensions.
- It is important to inject enough material to capture all buccal and lingual cusp tips. Injected material should be thick, as seen in **Figure 4**, allowing stability for easy trimming.
- Inject only enough material to capture teeth. If too much material is extruded, it may extend to the soft tissue, not allowing the bite registration to seat properly on the model, as seen in **Figure 5**.

### Futar Fast Bite Registration Material +++++ (Kettenbach LP)

Futar Fast Bite Registration Material is an elastomeric, addition silicone bite registration material with a working time of 15 seconds and an intraoral setting time of 45 seconds. Due to the shorter working time, Futar Fast Bite is indicated for “small application” myofunctional bite registrations and applications requiring a hard bite registration. The short time in the mouth reduces the chance of movement and is more comfortable for the patient. Futar Fast Bite is stiff when set without being brittle, and it trims easily with a scalpel blade or rotary instrument. Laboratory consultants also found that it trimmed nicely without breaking. Models could be set together accurately, as Futar Fast Bite does not exhibit any “spring” or rebound.

Fifty-seven percent of consultants found Futar Fast Bite to be better than other bite registration materials they have used, and 37% found it to be equivalent. Seventy-seven percent of consultants would switch to Futar Fast Bite, and 93% would recommend it. Futar Fast Bite was evaluated by 30 consultants in 514 uses. This bite registration material received a 96% clinical rating.

### R-SI-LINE METAL-BITE +++++ (R-dental)

R-SI-LINE METAL-BITE is an addition silicone bite registration material that can be used conventionally or scanned (without powder) for use with CAD/CAM systems. This bite registration material is hard when set and can be trimmed with a sharp instrument. R-SI-LINE METAL-BITE sets hard and fast, with a working time of 25 seconds, and setting time is 40 seconds in the mouth. Because it sets hard, consultants and laboratory technicians have the most success if only a small amount of material is used. Limiting its use to the occlusal surfaces avoids locking it into undercuts.

Ninety percent of consultants reported that R-SI-LINE METAL-BITE was equivalent to or better than their current bite registration material. Seventy-five percent would switch to R-SI-LINE METAL-BITE, and 93% would recommend it. This bite registration material received a 96% clinical rating.

### The Dental Advisor Evaluation Process

The clinical evaluation begins with the development of a custom survey by a member of the staff. The product and survey are sent to a randomly selected group of 20 to 30 clinical consultants.

Once the surveys are completed (there is a 95% survey return rate), the data are compiled. The product, plus rating, and clinical percentage rating are discussed and debated by the editorial board. This effort culminates in the final published article, plus rating, and clinical percentage rating.

### The rating is based on a scale of

1 to 5:

- +++++ = Excellent (96% - 100%)
- +++ = Very Good (86% - 95%)
- +++ = Good (76% - 85%)

[www.dentaladvisor.com](http://www.dentaladvisor.com)



Dr. Bunek practices in Ann Arbor, Michigan.

Disclosure: Dr. Bunek is editor-in-chief of *The Dental Advisor*.

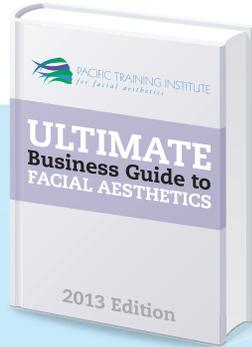
Upcoming courses in Florida, throughout the US and Vancouver, BC

# Uncover an Additional \$125,000 in Your Practice!

As you know, BOTOX Cosmetic and Facial Aesthetics are multi-billion dollar industries, growing every year. Discover how BOTOX and Facial Rejuvenation services will simply and systematically increase your practice revenue by more than \$125,000 in just one year.

Reserve your **FREE** copy today.  
**\$199 value.**

[www.ptifa.com/ultimateguide](http://www.ptifa.com/ultimateguide)  
(promo code: AACD)  
**1-855-681-0066**



BY **WARREN ROBERTS, DMD**

Founder of Pacific Training Institute and creator of the most comprehensive 2-day course on Botox, Dr. Warren is the #1 administrator of Botox across all Canadian dental practices and is a world renowned speaker and trainer on Botox and Facial Rejuvenation.

**\$199 value.  
FREE!**

# AACD 2013

Seattle

educate | inspire | connect



[www.AACDconference.com](http://www.AACDconference.com)

April 24 - 27, 2013

29<sup>th</sup> Annual AACD Scientific Session

## Advertiser Index —

3M ESPE .....	3MESPE.com .....	35
AACD .....	aacd.com .....	5, 22
Aurum Ceramic Dental Laboratories .....	aurumgroup.com .....	81
Cosmedent .....	cosmedent.com .....	45
DearDoctor .....	deardocor.com .....	103
DENTSPLY .....	dentsply.com .....	55
Heraeus .....	heraeus.com .....	63
Ivoclar Vivadent .....	ivoclarvivadent.com .....	IFC, IBC
Knight Dental Group .....	knightdentalgroup.com .....	93
LK Dental Studio .....	lkdentalstudio.com .....	9
MAC, by Dental Technologies Inc. ....	macvneers.com .....	BC
NewBeauty Magazine .....	newbeauty.com .....	125
Pacific Training Institute .....	ptifa.com .....	150
Rosemont Media .....	rosemontmedia.com .....	117
Speare Education .....	speareducation.com .....	7
Springstone Patient Financing .....	springstoneplan.com .....	11

# Multilink<sup>®</sup> Automix

Universal Adhesive Cement



## Multilink Automix and IPS e.max<sup>®</sup>, the **proven** combination.

Multilink Automix has been engineered to drive success of IPS e.max restorations by creating a strong and immediate bond. With **6 years of clinically proven** performance in more than **10 million restorations**, Multilink Automix has become the foundation for all types of restorative materials.

100% CUSTOMER SATISFACTION  
GUARANTEED!

[ivoclarvivadent.com](http://ivoclarvivadent.com)

Call us toll free at 1-800-533-6825 in the U.S., 1-800-263-8182 in Canada.  
© 2012 Ivoclar Vivadent, Inc. Multilink and IPS e.max are registered trademarks of Ivoclar Vivadent.

ivoclar  
vivadent<sup>®</sup>  
passion vision innovation

**MACSTUDIO**  
BY MICRODENTAL LABORATORIES

**AAO** American Academy  
of Cosmetic Dentistry  
CORPORATE GOLD MEMBER

Yones Kutlu

DENTISTRY BY  
Dr. Alex Naini, Washington DC

## **MACSTUDIO** BY MICRODENTAL LABORATORIES

Developed 15 years ago by dentists and MicroDental, MACSTUDIO restorations are the leading choice for dentists who are committed to life-changing dentistry. Through close collaboration, MACSTUDIO technicians offer dentists the ability to realize their treatment vision and delight their patients. In Yones Kutlu's case, Dr. Alex Naini's treatment focused on enhancing the form and function of his worn down and chipped teeth that resulted from severe bruxism. To accomplish a natural look, MACSTUDIO expert technicians considered teeth proportion, color value, facial texture and incisal translucency in the context of Dr. Naini's goals for Yones. The treatment outcome is an exceptional smile that embodies the MACSTUDIO passion for personalizing every case.

From full-mouth rejuvenations to single tooth restorations; MACVENEERS™ to crowns, bridges, implants and removables; MACSTUDIO restorations can create A SMILE FOR EVERY STORY™.



**SMILES MATTER™**  
MicroDental.com/macstudio  
800.229.0936

**MICRODENTAL**  
LABORATORIES