jCD
Journal of Cosmetic Dentistry

3D Composite Artistry
Dr. Brian P. LeSage

Partial Extraction Therapy

Color in Modern Materials

2021 VOLUME 37 ISSUE 3
American Academy of Cosmetic Dentistry®

Evanesce™

Nano-Enhanced Universal Restorative

"The Evanesce system rivals the esthetics of porcelain restorations and mimics the beauty of natural tooth structure."

- David Chan, DMD, AAACD

Strong. Simple. Beautiful.

Simple or complex. Single shade or layering technique, anterior or posterior. Whatever your technique or indication, **Evanesce™ Universal Restorative** is designed for truly natural, life-like esthetics.

- Evanesce nano-hybrid composite's **non-sticky formulation** makes it **easy to manipulate** and **highly adaptable.** Once placed, Evanesce can be **sculpted without slumping** to save on finishing time.
- Evanesce is available in 30 VITA shades and 3 opacities and **polishes to an ultra-high, long-term shine in seconds.**
- High strength Evanesce is **82% filled** and boasts a **high compressive strength**, **low wear**, and **low shrinkage** to give you confidence for both anterior and posterior restorations.

Request a Complimentary Sample!

Scan the QR code or visit:
findtherestoration.com

Clinician's Choice®
Designed for better dentistry.

Dentistry and photography courtesy of David Chan, DMD, AAACD

jCD
volume 37 issue 3
Journal of Cosmetic Dentistry

A PEER-REVIEWED PUBLICATION OF THE
AMERICAN ACADEMY OF COSMETIC DENTISTRY

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.

ADVERTISING POLICY

All advertising appearing in the *Journal of Cosmetic Dentistry* (*jCD*) is approved by the editorial team. Advertisements are not endorsed by the *jCD* or AACD.

AACD OFFICE

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

Reprints

High-quality reprints with possible customization are available for authors and advertisers. Please contact publications@aacd.com and the *jCD* editorial staff will work with you to get the exact reprint you would like for your presentations, lectures, or patient literature.

Journal of Cosmetic Dentistry 2021 • Volume 37 • Issue 3

A peer-reviewed publication and member benefit of the AACD
Peer-reviewed articles are denoted with the following symbol in the Table of Contents: ❖

Features

26 Clinical Cover Article
Artistically Emulating Nature with Direct Composite Restorations ❖
Brian P. LeSage, DDS, FAACD, FAGD, FAAED

40 **Prosthetically Driven Minimally Invasive Implantology** ❖
Attila Bodrogi, DDS

52 **Effects of Material Selection, Light Curing, and Polishing on the Color Stability of Direct Composite Resins: A Photographic Study** ❖
Taiseer Sulaiman, DDS, PhD

58 CE—Clinical Application
Gingiva-Colored Restorative Material as a Substitute for Onlay-Inlay Grafting Following Trauma ❖
Phelan R. Thomas, DDS, AAACD

66 ***jCD* Self-Instruction Continuing Education—CE** ❖

Column

8 Editor's Message
Succeeding Together!
Edward Lowe, DMD, AAACD

Cover credits: Brian P. LeSage, DDS, FAACD, FAGD, FAAED (Beverly Hills, CA), clinical typodont images. Zach Turner (Pearl River, NY), illustrations.

2021 Statement of Ownership, Management and Circulation

Statement of Ownership, Management and Circulation, required by Title 39, United States Code 3685. Title of publication: Journal of Cosmetic Dentistry. Date of filing: September 28, 2021. Publication number: 1532-8910, USPS# 10452. Frequency of issue: quarterly. Annual subscription price: members, included in the membership dues; non-members/subscribers, $200.00 (U.S. 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 Director of Publications: 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): 4166; mailed outside-county paid subscriptions stated on PS Form 3541: 3289; paid distribution by other classes of mail through the USPS: 8; total paid distribution: 3297; free or nominal rate copies mailed at other classes through the USPS: 30; free or nominal rate distribution: 0; total free or nominal rate distribution: 30; total distribution: 3327; copies not distributed: 839; percent paid: 99. Number of copies of single issue published nearest to filing date: total number of copies (net press run): 4070; mailed outside-county paid subscriptions stated on PS Form 3541: 3399; paid distribution by other classes of mail through the USPS: 9; total paid distribution: 3408. Free or nominal rate copies mailed at other classes through the USPS: 30; free or nominal rate distribution outside the mail: 0; total free or nominal rate distribution: 8; total distribution: 3416; copies not distributed: 654; percent paid: 99. I certify that all information furnished is correct and complete. Signed Tracy Skenandore, Director of Publications.

Diagnose, Treat, Protect & Heal with QuickSplint®

QuickSplint® is the Quick & Easy Temporary Splint that Improves Patient Care. Use QuickSplint® for 2-4 weeks, as an anterior bite plane and night guard, to help diagnose, treat, protect and heal your patients. ***Ready in 5 minutes.***

- ✓ **First Aid for Acute Jaw Pain**
- ✓ **Protect Newly-Placed Restorations**
- ✓ **Diagnose Parafunction & Bruxism**
- ✓ **Post-op Healing Aid**
- ✓ **Deprogrammer**

Save Now With These Special Introductory Offers!

Save 20% on any QuickSplint® 12-Pack

12-Pack or Combo Pack.
Use code AACD20.

Save 25% on the New Take-Home Kit for Jaw Pain

Our Cosmetic Dentistry Special features QuickSplint® and the Speed2Treat® Home Healing Kit for jaw pain!

"I'm Using QuickSplint® for Cosmetic Cases. This includes everything from recording open bite centric occlusion records to provisional protection and final prosthesis protection. As a diagnostic tool, a first line of treatment or as a step in treatment, QuickSplint® is a valuable tool.

Our patients & practice also benefit greatly by providing the Speed2Treat® Home Healing Kit. For patients with jaw pain, Speed2Treat® is a take-home solution they can use at their own pace."

John Weston, DDS, FAACD
Scripps Center for Dental Care, La Jolla
3-time AACD EVY Award-winner

DIAGNOSE TREAT PROTECT HEAL

Visit QuickSplint.com To Learn More & Save!

Or Call Customer Service at
1-800-760-0526

Orofacial Therapeutics is a proud member of the American Academy of Cosmetic Dentistry.

AACD American Academy of Cosmetic Dentistry
CORPORATE GOLD MEMBER

Journal of Cosmetic Dentistry 2021 • Volume 37 • Issue 3

A peer-reviewed publication and member benefit of the AACD
Peer-reviewed articles are denoted with the following symbol in the Table of Contents: ❖

Departments

10 Scientific Session
AACD Orlando 2022
Moths to a Flame: Guidelines for Emotive Dental Photography to Attract Customers, Colleagues, and Companies ❖
Miles R. Cone, DMD, MS, CDT, FACP
Cornelia Cone, MA

18 Accreditation Essentials
The Missing Tooth: How the General Dentist and a Multidisciplinary Approach Can Achieve an Excellent Clinical Outcome ❖
Danièle Larose, DMD, AAACD

24 Examiners' Commentary
Case Type III: Planning for Success ❖
William J. Rowe, Jr., DDS, AAACD

American Academy of Cosmetic Dentistry®

AACD Mission Statement

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

Member Publication AADEJ American Association of Dental Editors & Journalists

FSC www.fsc.org MIX Paper from responsible sources FSC® C008955

The *Journal of Cosmetic Dentistry* (ISSN 1532-8910), USPS (10452), is published quarterly, in the spring, summer, fall, and winter. $200 per year (U.S. & Canada) or $240 per year (all other countries), single issues available upon request, by the American Academy of Cosmetic Dentistry®, 402 West Wilson Street, Madison, WI 53703. 800.543.9220 OR 608.222.8583. Periodical postage paid in Madison, WI, and additional offices.

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 in the Table of Contents with the following symbol ❖

PHILIPS

ZOOM!

The gift of professional take-home whitening

Help patients fit take-home whitening into their busy holiday schedules with Philips Zoom delivered.

This new, innovative program ships Zoom whitening gels and custom trays directly to patients' homes. All you need to do is send their oral impressions or scans to our lab partner, and we'll ship a professional, personalized whitening kit to your patients within 7 business days.

$35 trial price
for your first kit

Contact your Philips sales rep or call (800) 278-8282 to book your live demo.

Follow us on social media

@philipssonicarepro

linkedin.com/showcase/oral-healthcare

Succeeding Together!

> The *jCD* could not exist without our readers' valuable contributions.

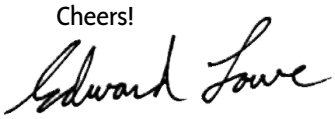
The *Journal of Cosmetic Dentistry* (*jCD*) benefits greatly from having authors from around the world, with diverse educations, knowledge, experiences, and perspectives, so we can all learn from one another. This issue of the *jCD* features AACD Accredited Fellow Member Dr. Brian LeSage's well-recognized talent with composites. In addition, AACD Accredited Member Dr. Phelan Thomas discusses a challenging case conservatively restored with "pink" ceramic materials; AACD Accredited Member Dr. Danièle Larose's Accreditation Case Type III describes a successful single tooth replacement employing an interdisciplinary approach; and AACD Accredited Member Dr. John Rowe provides a helpful summary of the Accreditation Examiners' perspective on Dr. Larose's case.

This extremely informative issue of the journal also presents Dr. Attila Bodrogi's responsible soft tissue preservation on an implant case, and research by Dr. Taiseer Sulaiman regarding staining on various restorative materials. Also, be sure to read Dr. Miles Cone and Cornelia Cone's insightful advice for taking emotive photographs. Dr. Cone will be a presenter at AACD Orlando 2022, which I'm sure we're all greatly looking forward to attending!

The end of the year is always an appropriate time for reflection. I am grateful to all the authors who generously shared their knowledge with their colleagues this past year. The *jCD* could not exist without our readers' valuable contributions—it is our collective responsibility to share our procedures and techniques so that we can continue growing our expertise and our Academy.

In closing, I challenge you to reflect on what you have considered sharing with your colleagues. What is holding you back? Think of how much you have learned from others to perform better cosmetic dentistry, and remember—we succeed together!

Cheers!



Edward Lowe, DMD, AAACD
Editor-in-Chief

After becoming an Invisalign provider, many dentists report having a closer relationship with their patients and seeing an increase in new patients. And we're here to make it easy with dedicated support every step of the way.

Start your Invisalign provider journey today.
Visit InvisalignClearAligners.com.

align

invisalign®
Transforming smiles, changing lives.

Moths to a Flame

Guidelines for Emotive Dental Photography to Attract Customers, Colleagues, and Companies

Miles R. Cone DMD, MS, CDT, FACP
Cornelia Cone, MA

In this article, the authors give readers a glimpse of what they can expect at Dr. Cone's presentation scheduled for AACD Orlando 2022, titled "Exposed: The Art & Science of Emotive Dental Photography" on Friday, April 29, from 2:00 to 3:30 pm. Register at https://aacd.com/conference

“Composition, albeit important, is meaningless without the essential element in all of dental photography—light.”

Abstract

Dental professionals utilize photography predominantly as a means of clinical documentation. However, the artful manipulation of lighting, color, contrast, and composition in images can serve to elicit specific emotions in the viewer. When incorporating these features into dental photography, clinicians are able to create an emotional connection to attract the attention of patients, colleagues, businesses, and manufacturers. Certain visual features, techniques, and photographic principles have been found to produce images that are generally accepted to be more visually pleasing. Basic guidelines of composition and ambiance are discussed to explain why these specific photographic elements and attributes trigger human emotions.

Key Words: dental photography, emotive photography, photography guidelines, esthetic dentistry, dental marketing

Introduction

Dental photography is an esthetic, visual language that utilizes subjective properties and principles of lighting,[1] color,[2] contrast,[3] and composition[4] to translate tangible images into palpable emotions.[5-7] When the human brain perceives an esthetically pleasing photograph, the neurotransmitter dopamine is released into the visual cortex and generates a sensation of pleasure.[8-10] This unconscious response is the impetus that causes many dental professionals to purposefully move beyond the traditional protocols of static and inert clinical documentation to incorporate such features into their dental photography. They thereby can create an emotional connection to attract the attention of potential customers (patients), colleagues (referral sources), and partner companies (product advocates/key opinion leaders).[11]

The subjective nature of human-centric preferences related to the beauty and emotive capacity of certain dental photographs has often proven to be a challenge to discern.[12] Despite the lack of objective rules and a universal standard for what constitutes esthetic and emotionally driven dental photography, certain visual features, techniques, and photographic principles have been found to produce images that are generally accepted to be beautiful.[6,7] The following guidelines, while not exhaustive, provide basic principles of composition and ambiance for a select group of the most salient image features that explain why human emotions are triggered by certain photographic elements and attributes.

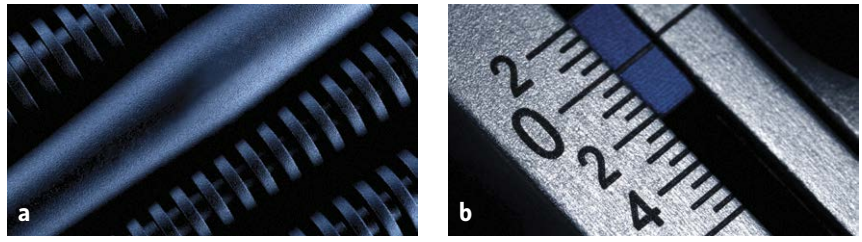
Guidelines

Composition

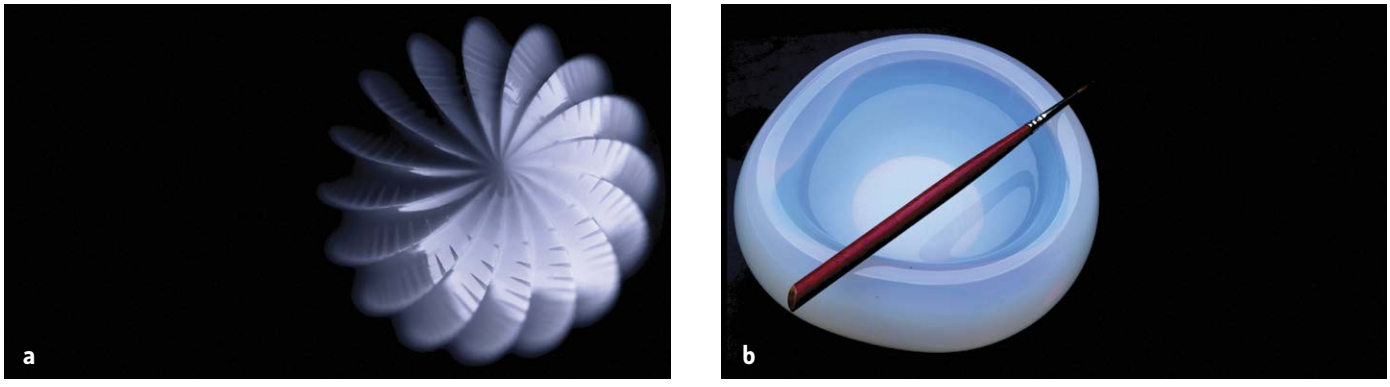
Leading lines, simplification, and Rule of Thirds: Composition refers to the intentioned placement of certain visual elements within the photograph. The most visually pleasing compositional format for dental photographic images has been well established to fall within the parameters of a 4:3 or 16:9 aspect ratio (e.g., contemporary television, computer, and smartphone screens **(Fig 1)**.[13] Within the portfolio of many dental photographers, commonly observed compositions include the use of parallel leading lines that guide the viewer's attention across the frame **(Figs 2a & 2b)**; simplified, minimalistic conformations employing isolated, stark elements to create drama **(Figs 3a & 3b)**; and a stand-alone image with the center of interest (e.g., a single macro object on a black or white background) positioned on one of four peripheral intersections within the frame. This layout aesthetic, known as the Rule of Thirds, tends to be more visually appealing than one in which the subject is situated in the center of the frame[12] **(Figs 4a & 4b)**.

Rule of Odds and symmetry: Another compositional style that impels the eyes to move around the frame is known as the Rule of Odds. Even-numbered items are easier for the brain to recognize and process, which ultimately leads to a less dynamic image layout. Utilizing an odd number of items within the photograph, therefore, helps to create movement and drama, while at the same time creating a more interesting and esthetic image[14] **(Fig 5)**. Once we appreciate and accept that these guidelines do not represent obstinate formulas, we are presented with an excellent excuse to break the previously mentioned Rule of Thirds, which is to create symmetry. Throughout the natural world, symmetry is ubiquitous, and therefore it is not at all surprising that the human visual system has evolved to have an exquisite sensitivity to and predilection for it **(Figs 6a & 6b)**.[15,16]

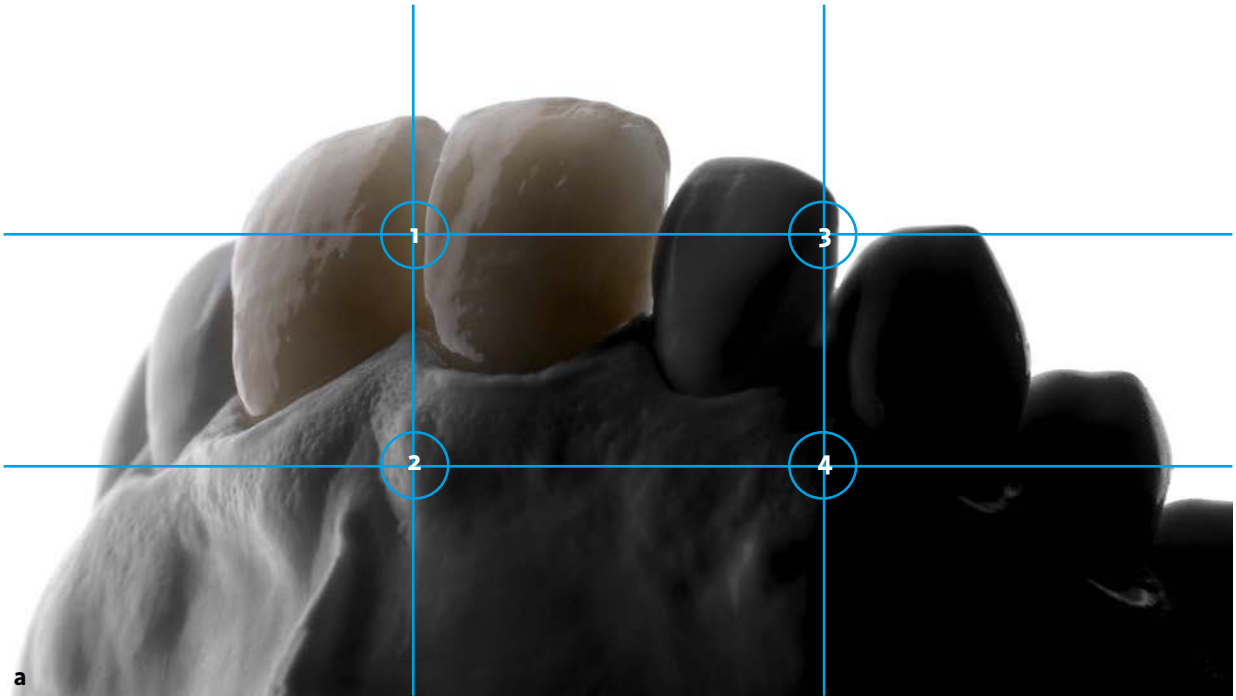
Figure 1: Visually appealing aspect ratios.

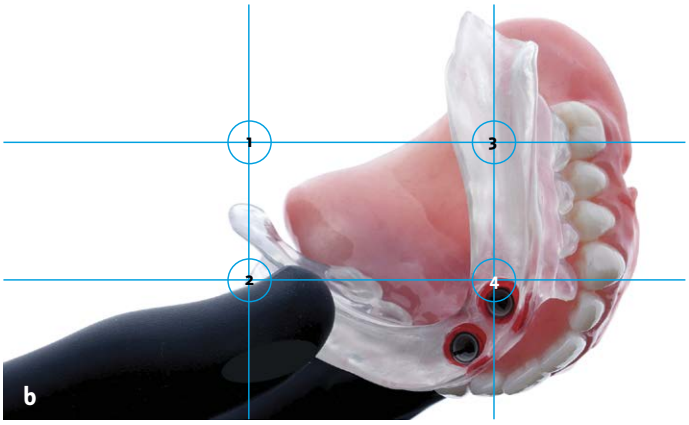


Figures 2a & 2b: Diagonal shadows create parallel leading lines that direct the viewer's attention from left to right across the image.



Figures 3a & 3b: A single subject isolated on an inky-black background creates a dramatic and minimalist aesthetic.





Figures 4a & 4b: Demonstration of the Rule of Thirds utilizing a simplified photographic composition and a monochrome white background, with the focus of the main subject placed at one of four intersected points to create visual interest.

Figure 5: The Rule of Odds creates interest by impelling the viewer's mind to actively search for comprehension among the uneven number of items present.

Figures 6a & 6b: Humans have evolved to search for and recognize symmetry within the natural world.

Ambiance

Light: Composition, albeit important, is meaningless without the essential element in all of dental photography—light. The essential elements to making photographs are not, as many believe, the camera or the lenses **(Figs 7a & 7b)**. Without light, after all, there can be no photographs. The word *photography* is derived from the Greek words *photos* (light) and *graphos* (writing or drawing), which literally means "writing with light." The manner in which this light is directed on three-dimensional objects within the oral cavity, or at the laboratory bench, largely dictates the overall esthetic and emotional atmosphere that the photograph conveys.[17]

Black and white and color: Evoking emotions even more visceral than pictures of teeth, portraits of the human face tend to be a very popular form of photography because they allow us to easily identify and relate to the subject.[18] When capturing headshots, a pure white background produces a clean, ethereal, and calming effect **(Fig 8)**. One of the most emotionally driven lighting techniques the clinician can employ, however, is the intense, side-lighting effect created with a single overhead light source for moody, darker patient portraits **(Figs 9-10b)**. Dark lighting creates shadows, can conceal information from the viewer, and adds depth and intrigue to the final image. Aside from portrait photography, many high-end product shots and advertisements use the high-contrast juxtaposition of bright and dark regions of the image to create a sense of refinement and sophistication **(Figs 11 & 12)**.[19]

Color in the environment has a deep impact on our mood and behavior[20]; it is widely believed to be the visual experience most important to human beings.[21] Dental photographers, however, often use monochromatic, or black and white imagery to create a separate aesthetic and an additional range of emotional content.[22] Black and white photography involves a simple change in the visual presentation of a stimulus so that instead of composing with color, the clinician is forced to compose with a variety of tones and contrasts. An impactful point of focus can be made with the careful placement of a subtle pop of color in an otherwise monochromatic background **(Fig 13)**. The utilization of black and white photography in dentistry allows the artist to emphasize features such as contours and boundary information, which is particularly useful when the photographer wants to highlight the global form or shape of an object **(Figs 14 & 15)**.[23]

Figures 7a & 7b: Proper lighting produces excellent photos taken with (a) a professional-quality lens, and (b) lower-end lens, demonstrating that high-end equipment is not always necessary to produce high-quality images.

Figure 8: A pure white background creates an ethereal feeling and a calming effect on the viewer. *(Model: Marina Gray, Bar Harbor, ME)*

Figure 9: A side-lighting effect creates a dark and moody image with the use of shadows.

Figures 10a & 10b: (a) Side-lighting adds depth and intrigue to patient portraits. (b) A single overhead parabolic octabox is used to create the side-lighting effect.

Figure 11: High-end product photographs commonly utilize dark light to create a sense of sophistication.

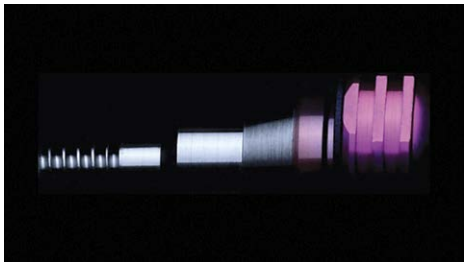


Figure 12: High-contrast areas of juxtaposed bright and dark areas add refinement to an image.

Figure 13: An area of color on an otherwise monochrome background creates strong visual interest and emotion.

Figure 14: Black and white images convey global form and shape.

Figure 15: Black and white images allow the photographer to artistically emphasize contours and boundary information.

> While determining if an image has high or low emotional and esthetic value is important, it is perhaps more imperative to ascertain which attributes contribute to this value and why.

Figure 16: Texture adds depth and highlights tactile sensory inputs.

Figure 17: Texture arouses the sense of touch, allowing the viewer to imagine whether the subject is cool, smooth, or glossy.

Figure 18: Texture triggers the viewer's emotions and promotes a haptic dimension of visuality.

Texture: Another way to influence the emotional register of the viewer is to make photographs that appeal to multiple sensory inputs. Creating unique depth and dimension to each object by highlighting their texture arouses the corporeal awareness of touch and promotes a haptic dimension of visuality for the surface of the object: is it coarse, smooth, glossy, matte, cool, or warm **(Figs 16-18)**?[24]

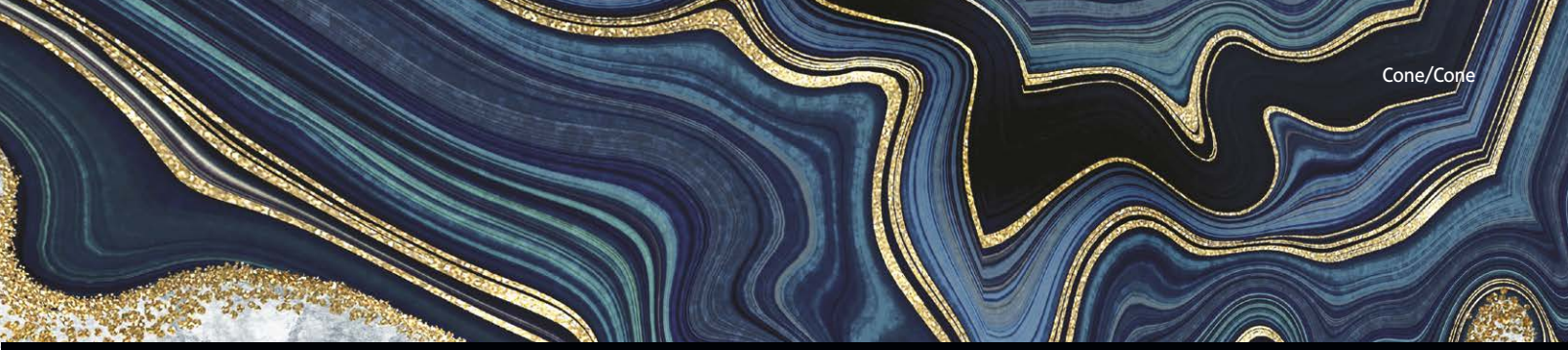
Depth of field: As already described, a minimalistic photographic composition often is preferred to pictures that have multiple subjects to distract the viewer's attention. As a final guideline, photographers may use a larger aperture setting and/or macro lenses to create a shallow depth of field. This technique further augments the streamlined aesthetic by holding a single point of focus near the center of the object, while the background blurs out of focus yet remains cohesive enough to provide context for the image as a whole **(Figs 19 & 20)**.

Figure 19: The use of a larger aperture creates a shallow depth of field with a specific focal point on the subject.

Figure 20: A blurred background creates a minimalistic aesthetic while providing enough context to remain cohesive.

Summary

Dental photography, like any profession-related skill, requires a particular set of techniques, aptitudes, and guidelines to produce emotionally driven photographs that leave a rich and strong memory with the viewer. While determining if an image has high or low emotional and esthetic value is important, it is perhaps more imperative to ascertain which attributes contribute to this value and why. Providing objective guidelines to the subjective human-centric proclivities surrounding these photographs is a challenging task, but, ultimately, the choices the clinician makes concerning composition, lighting, and subject matter say as much about the individual creating the photo as it does about the patients and products being photographed.



References

1. Freeman M. The complete guide to light and lighting in digital photography. New York: Lark Books; 2006.
2. Fernandez KV, Rosen, DL. The effectiveness of information and color in the Yellow Pages advertising. J Advertising. 2000 Summer;29(2):61-73.
3. Itten J. Design and form: the basic course and the Bauhaus and later. Revised ed. Hoboken (NJ) Wiley; 1975.
4. London B, Stone J, Upton, J. Photography. London: Pearson; 2017.
5. Deng Y, Loy CC, Tang, X. Image aesthetic assessment: an experimental survey. IEEE Signal Processing Magazine. 2017 Jul;34(4):80-106.
6. Krages B. Photography: the art of composition. New York: Allworth Press; 2005.
7. Datta R, Joshi D, Li J, Wang JZ. Studying aesthetics in photographic images using a computational approach. In: Leonardis A, Bischof H, Pinz A, editors. Computer Vision-ECCV 2006. Proceedings of the 9th European Conference on Computer Vision; 2006 May 7-13; Graz, Austria. Berlin Heidelberg: Springer-Verlag; 2006. p. 288-301.
8. Kühn S, Gallinat J. The neural correlates of subjective pleasantness. Neuroimage. 2012 May 15;61(1):289-94.
9. Chatterjee A. Prospects for a cognitive neuroscience of visual aesthetics. Bulletin of Psychology and the Arts. 2003;4(2):55-60.
10. Greenlee MW, Tse PU. Functional neuroanatomy of the human visual system: a review of functional MRI studies. In: Lorenz B, Borruat FX, editors. Pediatric ophthalmology, neuro-ophthalmology, genetics. Essentials in ophthalmology. Berlin Heidelberg: Springer-Verlag; 2008.
11. Cavanagh P. The artist as neuroscientist. Nature. 2005 Mar 16;434:301-7.
12. Marchesotti L, Murray N, Perronnin F. Discovering beautiful attributes for aesthetic image analysis. Int J Computer Vision. 2015 Jul;113(3):246-66.
13. Kaléine S, Cheam C, Izard V, Gentaz E. Adults and 5-year-old children draw rectangles and triangles around a prototype but not in the golden ratio. Br J Psychol. 2013 Aug;104(3):400-12.
14. Van Tonder GJ, Lyons MJ. Visual perception in Japanese rock garden design. Axiomathes. 2005;15(3):353-71.
15. Rentschler I, Jüttner M, Unzicker A, Landis T. Innate and learned components of human visual preference. Curr Biol. 1999 Jul;9(13):665-71.
16. Wynn T. Archaeology and cognitive evolution. Behav Brain Sci. 2002 Jun;25(3):389-402.
17. Galvane Q, Lino C. Christie M, Cozot R. Directing the photography: combining cinematic rules, indirect light controls and lighting-by-example. Pacific Graphics 2018. 2018 Oct 24;37(7):45-53.
18. Okeit H, Blochwitz D. Neuro-aesthetics and the iconography in photography. Psych J. 2020 Aug;9(4):444-57.
19. Block B. The visual story. Creating the visual structure of film, TV, and digital media. 2nd ed. Burlington (MA): Focal Press; Elsevier; 2008.
20. Babin BJ, Hardesty DM, Suter TA. Color and shopping intentions: the intervening effect of price fairness and perceived affect. J Bus Research. 2003 Jul;56(7):541-51.
21. Adams FM, Osgood CE. A cross-cultural study of the affective meaning of color. J Cross Cultural Psy. 1973 Jun 1;4(2):135-56.
22. Zettl H. Sight, sound, motion: applied media aesthetics. 7th ed. Boston: Wadsworth Pub.; 2013.
23. Greenleaf EA. Does everything look worse in black and white? The role of monochrome images in consumer behavior. In: Krishna A. Sensory marketing: research on the sensuality of products. New York: Routledge, 2009. p. 241-58.
24. Jutz G. Striking textures, sensuous surfaces in photography and film. Open Arts J. 2019 Summer;7:11-25. **jCD**

Dr. Cone owns a private practice clinic limited to prosthetic dentistry and is co-founder of Depth of Field Dental Photography in Portland, Maine.

Ms. Cone is vice president of Nuance Dental Specialists, co-founder of Depth of Field Dental Photography, and a strategic consultant and partner with Ascendancy Health, all in Portland, Maine.

The Missing Tooth

How the General Dentist and a Multidisciplinary Approach Can Achieve an Excellent Clinical Outcome

Danièle Larose, DMD, AAACD

Abstract

The successful replacement of a single anterior tooth involves a balance between esthetics, function, and anticipated longevity. In many cases, collaboration between the general dentist and one or more specialists is required to resolve the hard and soft tissue challenges that may arise in the process of achieving the desired outcome. This article describes how a collaborative approach between a cosmetic dentist and a specialist in replacing a single tooth produced the maximum benefit for the patient. Also discussed are how committing to a thorough examination and an educated patient improved the patient's overall dental health and self-esteem.

Key Words: ortho-restorative, single tooth replacement, tissue recontouring, gingival augmentation, Accreditation Case Type III

"Correcting proportions with conservative orthodontic movements can greatly help patients through the unfortunate situation of anterior tooth loss."

Introduction

There are many options available today for patients presenting with a missing or failing tooth. While it can be a challenge to create a lifelike restoration that blends into the natural dentition, recontouring or augmenting the soft tissue can be very helpful in achieving natural esthetics. In addition to soft tissue esthetic procedures, correcting proportions with conservative orthodontic movements can greatly help patients through the unfortunate situation of anterior tooth loss.

Case Report

Patient Complaint and History

A 30-year-old male presented with a chief complaint that several teeth were sensitive to cold. He also wanted information on how to correct the crowding of his lower teeth and whiten his smile. He had not been to a dentist for at least five years and thought he had never had a dental cleaning. The patient had experienced a traumatic dental injury many years earlier and had been treated with an endodontic post and crown on tooth #10 **(Figs 1-3)**.

Clinical Findings and Diagnosis

A thorough hard and soft tissue examination was performed, including radiographs and clinical photographs. Periodontally, the patient presented with Class III calculus, several areas of recession, and a thin area of attached gingiva associated with the mandibular bicuspids and canines. In addition, periodontal bone loss was observed radiographically on the distal of tooth #18. A 6-mm clinical probing depth was noted in this area, likely due to an unerupted wisdom tooth. A 4-mm pocket with bone loss associated with #10 also was observed. A root fracture linked to a defective post and crown restoration on that tooth was suspected, as the pocket was clearly observed in one specific area. Several posterior interproximal carious lesions, including one of considerable size on #18, were identified, and treatment with composite restorations was recommended to the patient. An anatomical defect was present on the distal aspect of tooth #7. The patient had Class I occlusion with lower anterior crowding with working interferences present on teeth #4 and #5. The temporomandibular joints appeared healthy and asymptomatic. Apart from the dental issues, the patient was in excellent general health.

Treatment Plan

The patient was advised that treatment of the existing carious lesions and periodontal issues should be completed prior to orthodontic correction of the anterior crowding. The extraction of #17 was critical to the restoration of #18; however, treatment of #18 was planned to be deferred until its periodontal condition improved. A deep cleaning was recommended to remove supragingival and subgingival calculus and ensure tissue health.

Orthodontics and implant placement: The risk of keeping the failing lateral incisor was discussed with the patient, as were options to replace it in the future. An endosseous implant, a Maryland bridge, and a removable partial denture were discussed as possibilities for the replacement of #10. Due to a size discrepancy resulting from the narrow widths of both lateral incisors, orthodontic treatment prior to the implant surgery would also create more ideal spacing for the implant in addition to correcting the crowding issues.[1-4] The patient preferred a long-term and fixed solution and seemed to be more inclined

Figure 1: Preoperative retracted maxillary anterior frontal view (1:1).

Figure 2: Preoperative frontal smile view (1:2).

Figure 3: Preoperative full-face smile view (1:10).

toward the implant option after his orthodontic treatment. Consultation with a periodontist was recommended regarding the possibility of utilizing an implant to replace #10 and to evaluate the bone loss associated with #18. Possible tissue changes after extraction were outlined, and it was suggested that a connective tissue augmentation graft, performed by the periodontist, might be preferable to achieve optimal esthetics regardless of whether the patient chose a bridge or implant.[5]

Home whitening and clear aligners: The treatment plan included the use of clear aligners with a pontic in the area of #10 in lieu of a temporary partial denture, until the implant was ready to be restored. It was suggested that the aligners could also be used to whiten the teeth with a home whitening kit. The patient was informed that following orthodontics, esthetic correction of the anatomical defect on #7 might be possible with the use of composite or a minimal-preparation porcelain veneer.

The patient received a written list of the estimated costs of the different treatment possibilities. He wanted to take some time to consider the options and to seek financial assistance before starting treatment.

Treatment

Treatment commenced with the administration of local anesthesia, caries removal, and the placement of composite restorations on #2, #4, and #5, which had been diagnosed at the comprehensive exam.

The patient returned six months later with the post on #10 decemented. A root fracture was visible both clinically and radiographically **(Fig 4)**. The prognosis was deemed poor and options for the replacement of this tooth were once again discussed.

The patient required more time to secure finances to proceed with the more permanent solution. He also wished to consult with the periodontist that we had recommended for implant placement. The post and crown were temporarily recemented and the patient was again given a written estimate of all treatment options. He was reminded that #18 required restoration due to caries, but declined treatment until after his periodontal consultation.

Orthodontics: The patient was scanned (iTero, Align Technology; San Jose, CA) and full photographic series (both orthodontic and AACD Accreditation) were obtained, followed by a thorough orthodontic examination. The latter revealed a Class I molar and canine occlusion, 20% overbite, and a 2-mm overjet. Lower anterior crowding was present, as were narrow arches and thinning attached gingiva in the areas of #22 and #27. The patient was informed that grafts might be necessary following orthodontic treatment, as well as the necessity of extracting #17 in order to restore #18 due to deep distal caries prior to starting orthodontic movements.

Three goals for orthodontic treatment were identified: correction of crowding, widening of both arches, and creation of equal spaces to enable #7 and #10 to be the same width. These orthodontic treatment objectives were planned using a 3D digital system that includes a Bolton analysis tool (ClinCheck, Align).

Treatment time was estimated to be 10 months. The patient was given a consent form to take home for further review, as well as a prescription for a cephalometric radiograph.

After several months, the patient returned and received a referral to a maxillofacial surgeon concerning the extraction of #17. The possibility of endodontic treatment on #18 was also discussed due to the progression of caries. The patient proceeded with extraction of the semi-impacted wisdom tooth and, being eager to start orthodontic treatment, accepted accelerated orthodontics with a chairside accelerator (Propel Excellerator, Propel Orthodontics; San Jose, CA). Due to the quicker

Figure 4: Preoperative radiograph showing failing #10.

timeline, the ClinCheck was reviewed and modified, resulting in a treatment plan that included clear aligners (Invisalign, Align) plus retention in passive aligners.

Aligners and home whitening: After approximately one month of healing post-extraction, #18 was restored. At the same appointment, clear aligner attachments were placed with clear composite (Evanesce Enamel Clear, Clinician's Choice; New Milford, CT). Soft tissue infiltration was performed employing four carpules of injectable anesthesia (3% Citanest Plain, Dentsply Sirona; York, PA) followed by micro osteoperforations from distal of first bicuspids to distal of first bicuspids, upper and lower. A new Propel tip (using an implant driver at 45 RPM) was inserted to a depth of approximately 2 mm into the cortical bone in all areas. At this point, the patient began the five-month, five-day aligner change orthodontic movements (this is in contrast to the 14-day wear of each set of clear aligners usually prescribed). The patient also began a whitening regimen with 10% carbide peroxide gel (Opalescence, Ultradent; South Jordan, UT) nightly for two weeks.

Implant placement: After consulting with the maxillofacial surgeon, the patient chose the implant option to replace #10. Extraction of #10 and immediate implant placement were planned during the final weeks of orthodontic treatment. This portion of treatment was timed to occur while the patient was in retention with aligner #23. Once the orthodontic movements were completed, limited occlusal equilibration was required as only the canines and one bicuspid needed an occlusal adjustment. A new scan was taken, and new custom trays were fabricated to be worn during orthodontic retention and the healing phase of the implant treatment.

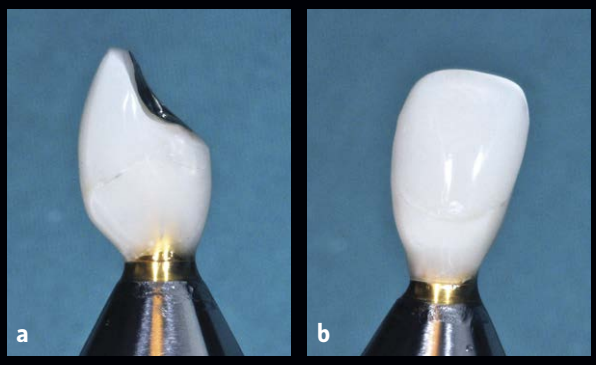
The periodontist extracted the failing #10, immediately placed a 4/3 x 15 mm endosseous implant (Biomet 3i; Palm Beach Gardens, FL), and performed a soft tissue augmentation procedure to achieve maximum gingival esthetics.[6] With the healing cap in place, the clear aligners were fitted with a custom pontic to replace the extracted #10 for three to four months. Once the periodontist confirmed implant integration, impressions were taken to create a temporary crown on the implant. The surgeon then refined the soft tissue augmentation and the temporary crown was modified to ensure optimal esthetics **(Figs 5-6b)**.[5,7] The healing time for the temporary crown was six months, during which time the patient was instructed to wear his aligners nightly. Once tissue healing was achieved **(Fig 7)**, the temporary crown was removed, and an implant transfer was placed and verified with a periapical radiograph **(Fig 8)**. A final impression was taken with polyvinyl siloxane impression material (Affinity, Clinicians Choice). The final shade selection, multiple photographs for the technician, and a bite registration were also obtained at this time **(Fig 9)**. The temporary crown was then recemented. An impression of the temporary crown was also sent to the laboratory to communicate the emergence profile to be replicated.

Final restoration: After consultation with the technician, the preferred definitive restoration was determined to be a custom zirconia implant abutment **(Fig 10)** with a cement crown (e.max, Ivoclar Vivadent; Amherst, NY). In consideration of the periodontist, it was decided to use temporary cement to ensure easier removal of the crown if it became necessary in the future. Within a few weeks, the new abutment and crown were ready for a try-in. Shape and shade modifications were required, so the case was returned to the lab along with specific instructions and photographs. The temporary crown was once again recemented. Once the prescribed modifications were completed, a second try-in resulted in much-improved esthetics, to the satisfaction of both patient and doctor.

It was decided to place the abutment permanently and torque to 20 Ncm. Polytetrafluoroethylene tape was placed in the access cavity and composite (B1 Evanesce) was used to close the opening in the abutment. The crown was cemented (Temp-Bond, Kerr Dental; Brea, CA). A radiograph was taken to ensure no subgingival cement was present **(Fig 11)**. (Note: in smile design, it is ideal that the two centrals be identical. On the other hand, it is normal and visually pleasing for the two laterals to be slightly different.) That said, the defect on #7 was now visually displeasing to the patient and he agreed to a slight shape modification using composite to better match #10 **(Fig 12)**. No preparation was made; however, the biofilm was removed with a blaster (Bioclear; Tacoma, WA). Tooth #12 was then etched and a single coat of adhesive (MPa Max, Clinician's Choice) was applied. The tooth was restored employing a combination of nano-enhanced universal restorative composite (Universal, Evanesce), white opaquer and grey tint (Creative Color, Cosmedent; Chicago, IL), and a thin layer of Evanesce Enamel Clear. After light curing, the restoration was shaped and polished with a medium disc (Sof-Lex, 3M; St. Paul, MN) and polishers (ASAP, Clinician's Choice) **(Fig 13)**.

The patient was scanned for his final retention trays (Vivera, Align). After two weeks he returned for the tray insertion. He was instructed to wear his retainers nightly for at least two years, then two to three times a week.

Figure 5: Initial temporary restoration on implant.



Figures 6a & 6b: Initial temporary restoration.

Figure 7: Tissue shaping with temporary restoration on implant.

Figure 8: Periapical view of temporary crown on implant.

Figure 9: Shade guide with many samples to help the technician evaluate the shading to be achieved.

Figure 10: Zirconia abutment on soft tissue model.

Figure 11: Final periapical x-ray of #10 after completion of treatment.

Figure 12: Close-up retracted right lateral view (1:1) showing a defect on the distal of #7.

Follow-Up

The patient returned at two months and six months for overall assessment. The periodontist also saw him for a follow-up and was very happy with the results. Most importantly, the patient was pain-free and very pleased with the restorative outcome and overall treatment experience **(Figs 14-16)**.

Summary

Employing a multidisciplinary approach combining orthodontics, periodontal, and restorative solutions to help ensure complete harmony of the smile instead of focusing on a single tooth can offer our patients an optimal esthetic outcome. This is true not only for the missing tooth challenge but in restorative cases as well. The use of clear aligners has improved the esthetics and longevity of the author's patients' restorations. Adding orthodontics in the general dental practice is an excellent asset to enhance patient outcomes.

Acknowledgment

The author thanks periodontist Dr. Alexandre Taché (Pointe-Clair, QC, Canada), for his clinical work with the case discussed in this article; and Mark Willes, CDT (Experience Dental Studio; Lindon, UT), for his assistance and skill with the case.

Figure 13: Postoperative close-up retracted right lateral view (1:1) of #5-#9, showing corrected defect on #7 with the use of composite resin.

Figure 14: Postoperative retracted close-up view (1:1) of #6-#11.

Figure 15: Postoperative frontal smile view (1:2).

Figure 16: Postoperative full-face portrait view.

References

1. Martegani P, Silvestri M, Mascarello F, Scipioni T, Ghezzi C, Rota C, Cattaneo V. Morphometric study of the inter proximal unit in the aesthetic region to correlate anatomic variables affecting the aspect of soft tissue embrasure space. J Periodontol. 2007 Dec;78(12):2260-5.

2. Carnio J, Carnio AT. Papilla reconstruction: interdisciplinary consideration for clinical success. J Esthet Restor Dent. 2018 Nov;30(6):484-91.

3. Bello A, Jarvis RH. A review of aesthetic alternatives for the restoration of anterior teeth. J Prosthet Dent. 1997 Nov;78(5):437-40.

4. Pini NP, de-Marchi LM, Gribel BF, Ubaldini ALM, Pascotto RC. Analysis of the golden proportion and width/height ratios of maxillary anterior dentition in patients with lateral incisor agenesis. J Esthet Restor Dent. 2012 Dec;24(6):402-14.

5. Pini NP, de-Marchi LM, Gribel BF, Pascotto RC. Digital analysis of anterior dental aesthetic parameters in patients with bilateral maxillary lateral incisor agenesis. J Esthet Restor Dent. 2013 Jun;25(3):189-200.

6. Yu SH, Tseng SC, Wang HL. Classification of soft tissue grafting materials based on biologic principles. Int J Periodontics Restorative Dent. 2018 Nov/Dec;38(6):849-54.

7. Eghbali A, Seyssens L, de Bruykere T, Younes F, Cleymaet R, Cosyn J. A 5-year prospective study on the clinical and aesthetic outcomes of alveolar ridge preservation and connective tissue graft at the buccal aspect of single implants. J Clin Periodontol. 2018 Dec;45(12):1475-84. **jCD**

Dr. Larose maintains a private practice in Saint-Laurent, QC, Canada.

Disclosure: The author is on the Teaching Faculty of Align Technology. She did not receive any financial remuneration for writing this article.

Examiners' Commentary

Case Type III: Planning for Success

William J. Rowe, Jr., DDS, AAACD

Accreditation Case Type III focuses on a dentist's ability to handle tissue in an edentulous space. A candidate may restore a missing tooth with a bridge or an implant; however, in both scenarios, proper development of the tissue in the edentulous area and integration of the restoration into the natural dentition are critical elements for case success. Given the requirements necessary to achieve a result that falls within the zone of excellence defined by Accreditation standards, appropriate case selection, interdisciplinary communication, and collaboration with a skilled laboratory technician are key factors, as well.[1]

Dr. Larose was able to exceed her patient's expectations and achieve Accreditation-level success with restoration of an endosseous implant in the #10 space. She employed orthodontic movement to improve positioning for the restoration of #7 and allow for proper placement and restoration of an endosseous implant in the #10 space.[2] A provisional implant crown at #10 helped to develop proper emergence profile and guide tissue support during the healing process. Accurate records to communicate soft tissue support and restorative contours were provided to the ceramist to guide fabrication of the definitive restorations.

Examiners appreciate the attention and dedication Accreditation candidates like Dr. Larose expend to achieve excellent results with a challenging case type. She carefully chose the right patient, focused on communicating effectively with the laboratory technician, periodontist, and oral surgeon to obtain an ideal result, and took the necessary steps to utilize proper clinical techniques.

Dr. Larose provided excellent treatment to her patient. However, no case is perfect, and examiners offered the following observations **(Figs 1 & 2)**:

- **Criterion #53:** *Is the color (hue, value, chroma) selection appropriate/natural, not monochromatic?* The value of #10 was found to be slightly lower than the adjacent dentition.
- **Criterion #56:** *Is incisal translucency and halo effect appropriate?* The restoration on #10 exhibited slightly excessive translucency and an overdone halo effect in the incisal third.

Figure 1: Preoperative retracted maxillary anterior frontal view (1:1).

Figure 2: Postoperative retracted maxillary anterior frontal view (1:1).

Dr. Rowe is an AACD Accredited Member and an AACD Accreditation Examiner since 2011. He practices in Jonesboro, Arkansas.

References

1. American Academy of Cosmetic Dentistry (AACD). A guide to Accreditation criteria: contemporary concepts in smile design. Madison (WI): AACD; 2014.

2. Bakeman E, Dompkowski DF, Kurtman GM. Deciding between immediate versus delayed implant placement. Compend Contin Educ Dent. 2014 May;35(5):310-1. **jCD**

AACD Proudly Presents Our Newest Accredited Members!

Ethan Harris,
DMD, AAACD

Brett Reeve,
DDS, AAACD

Diana Tadros,
DDS, AAACD

Petteri Viljakainen,
DDS, AAACD

Dawn Wehking,
DDS, AAACD

Camille Zelen,
DDS, AAACD

AACD
ORLANDO **2022**

See Them Honored Live and In-Person! April 27-30, 2022

Register today online at: **aacdconference.com**

"The art of composite bonding is an interdisciplinary modality that incorporates sculpture, design, engineering, architecture, and the dynamics of light to create highly esthetic, seamless, and functional outcomes."

Artistically Emulating Nature with Direct Composite Restorations

Four Clinical Cornerstones for Biomimetic Results

Brian P. LeSage, DDS, FAACD, FAGD, FAAED

Abstract

Composite artistry requires mastery of multiple skills to consistently create lifelike composite restorations. Other factors influencing the success of smile makeovers utilizing directly placed composite include the restorative material's ability to replicate the biological, functional, and esthetic properties of healthy tooth structure. However, also of paramount importance is the clinician's strict incorporation of four clinical cornerstones essential to achieving esthetic, functional, and durable direct composite restorations: starburst bevel, putty matrix, composite scaffolding and multilayering, and finishing and polishing. This article reviews these clinical cornerstones in detail, provides guidance for incorporating them into the clinical protocol for direct composite placement, and illustrates their utility with a clinical case presentation.

Key Words: composite restorations, starburst bevel, putty matrix, composite scaffolding, composite layering, composite finishing and polishing

Introduction

Three-dimensional (3D) composite artistry requires mastery of multiple skills to consistently create lifelike composite restorations. Patients present with smile deficiencies comprising infinite esthetic variables and clinical complexities, for which a comprehensive understanding of every aspect of the case and the selected restorative materials is critical to successfully restore the tooth to an ideal esthetic and functional outcome. The American Board of Cosmetic Dentistry—the credentialing authority of the American Academy of Cosmetic Dentistry—has endeavored to illuminate these variables in its Accreditation criteria sheet.[1] The approximately 40 criteria listed help in establishing an appropriate diagnosis, evaluating case progression, and achieving the eventual restorative outcome.

However, the cited criteria can also be broken down into numerous subcategories, and there is much crossover due to their interrelated nature. Therefore, the success of smile makeovers utilizing directly placed composite is predicated on a combination of factors. These include, but are not limited to, the composite restorative material's ability to replicate the biological, functional, and esthetic properties of healthy tooth structure (i.e., biomimetic dentistry),[2] and the clinician's strict incorporation of four clinical cornerstones essential to comprehensively mastering composite artistry: starburst bevel, putty matrix, composite scaffolding and multilayering, and finishing and polishing.

Material Characteristics, Selection, and Shade Matching

Interdisciplinary Modality

The art of composite bonding is an interdisciplinary modality that incorporates sculpture, design, engineering, architecture, and the dynamics of light to create highly esthetic, seamless, and functional outcomes. Fortunately, in response to the ever-increasing demand for esthetic dentistry, improvements to the physical and mechanical properties, esthetics, and durability of direct composite materials, as well as enamel and dentin bonding systems, have been introduced. Combined, these advances have encouraged and enabled more minimally invasive restorative techniques.[3,4]

Nanocomposites

For example, over the years, resin composites have evolved through generations of traditional macrofilled, microfilled, hybrid, microhybrid and, today, nanocomposites.[5] The latter, in particular, have been cited for their functionality in posterior Class I and Class II restorations, as well as their esthetic applications in anterior restorations.[6] Nanocomposites demonstrate improved mechanical properties (e.g., better compressive strength, diametrical tensile strength, fracture resistance, wear resistance, low polymerization shrinkage) and esthetic characteristics (e.g., high translucency, high polish retention, better esthetics) over their earlier counterparts **(Table 1)**.[7,8]

Table 1. Nanohybrid & Nanofilled Composites

Aelite Aesthetic Enamel	Bisco
Beautifil II	Shofu
Clearfil Majestic	Kuraray America
Empress Direct	Ivoclar Vivadent
Estelite Omega	Tokuyama Dental America
Evanesce	Clinician's Choice
Filtek Supreme Ultra	3M
G-Aenial Sculpt	GC America
GrandioSO	Voco
Harmonize	Kerr
Herculite XRV Ultra	Kerr
Mosaic	Ultradent
Omnichroma	Tokuyama Dental America
Paradigm	3M
Renamel NANO Plus	Cosmedent
Tetric EvoCeram	Ivoclar Vivadent
Venus Diamond	Kulzer
Venus Pearl	Kulzer

Strength, Hardness, and Stability

Interestingly, when choosing a material, compressive strength, diametral tensile strength, flexural strength, and hardness should all be considered. Additionally, a critical characteristic of esthetic restorative materials is their long-term color stability; the primary reason patients request replacement of a composite resin restoration in the esthetic zone is an unacceptable color match. Therefore, an esthetic criterion of the selected restorative material is its ability to mimic the appearance of natural tooth color by considering and assessing the initial color match, as well as color stability after prolonged exposure in the oral environment.[9] Note that a composite's color stability is dependent upon the material's resin matrix, filler particle dimensions, depth of polymerization, and coloring agents.[10-12]

Opacity, Translucency, and Light Reflection

However, a challenge to shade determination and color matching is establishing a balance between opacity and translucency during the smile restoration process. A highly opaque material will block all light and prevent dark dentin color from showing through underneath. Unfortunately, highly opaque materials will neither absorb nor reflect sufficient natural light for the restorations to appear pleasingly dynamic and lifelike.

Additionally, if the selected restorative materials differ in value, chroma, or hue compared to the natural tooth, an obvious esthetic mismatch at the tooth–restorative interface will result. Even if a perfect shade match is achieved, the margins likely will be visible because resin absorbs and reflects light differently than enamel over dentin.[13]

Clinical Guidance: To prevent dehydration during initial shade selection and shade reproduction:

1. *Take shade tab photographs prior to teeth dehydration.*
2. *Take photographs with a triangular, wedge-shaped increment of composite on the teeth/tooth.*
3. *Use a spectrophotometer for shade analysis of the teeth/tooth.*
4. *Color-map using the above information.*

Clinical Cornerstones for Emulating Nature

To comprehensively master 3D composite artistry and achieve an ideal overall esthetic outcome, it is essential that dentists incorporate four clinical cornerstones into their direct composite restorative protocol. These clinical cornerstones (demonstrated here on typodonts, in illustrations, and in clinical images), include a starburst bevel, putty matrix, composite scaffolding and multilayering, and finishing and polishing.

Starburst Bevel

A starburst bevel, described initially by the author in 2007,[14] creates a gradual transition between tooth structure and all resins.[15] This transition enables visual blending or imparting a chameleon effect between the esthetic characteristics of the two materials (e.g., tooth structure and restorative material), eliminating the visible margin.[16,17] Its proper use is crucial to producing a restoration that is invisible to the eye.

The starburst bevel is created with bevels that differ in depth, length, and volume. This undulated bevel facilitates blending resin and enamel so that when light transmits through the resin, it also interacts with the enamel, thereby camouflaging the fractured edge **(Figs 1 & 2)**.

Clinical Guidance: Create a starburst bevel on the facial aspect and a shoulder margin on the lingual.

Figure 1: View of a starburst bevel incorporating a conventional 30-degree bevel and additional bevels of varying depths, lengths, and volumes.

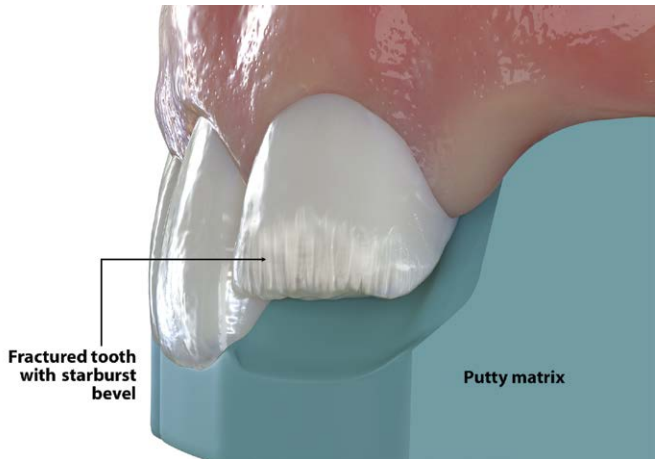


Figure 2: The completed starbust bevel and the putty matrix properly trimmed to the facial incisal line angle.

"...these advances have encouraged and enabled more minimally invasive restorative techniques."

Putty Matrix

A putty matrix, made directly or indirectly from a diagnostic mock-up using polyvinyl siloxane material, must be precisely trimmed to the facial incisal line angle. The putty matrix serves as a 3D blueprint for initiating the lingual scaffolding of the lingual enamel to subsequently apply the dentin, translucent, tints, and enamel composite layering increments **(Figs 3a & 3b)**.[18] Other anatomical features and characteristics (e.g., dentinal lobes, translucency, incisal halo, facial enamel) also can be developed from this initial lingual shelf or scaffolding **(Figs 4a & 4b)**.

Clinical Guidance: Fabricate the putty matrix off of a direct or indirect mock-up of the tooth/teeth to be restored. Trim the putty matrix to the facial-incisal line angle.

Composite Scaffolding and Multilayering

Composite layering is the third crucial clinical cornerstone of 3D composite artistry. Layering composite restorations for enhanced esthetic outcomes progressed from the development of light-curing technology and the introduction of comprehensive, multishaded enamel, dentin, and effect direct restorative materials. These optically structured composite systems offered a variety of opacity, translucency, hue, and chromatic shades **(Figs 5-7)**.

Today, successfully incorporating esthetic composite systems depends on a dentist's understanding of layered materials, combined with artistic and skillful application of architectural concepts, in order to emulate natural dental anatomy and optical properties. This can be achieved by following the author's 3D Characterized Layering Technique, which was first described in 2007.[14] Ranging from simple placement to more advanced layering concepts, this 3D technique begins by using the putty matrix to establish the lingual enamel, then progresses to building dentinal lobes as visualized from the natural dentition.

The shade for the dentin lobes is determined from the gingival third of the tooth, where the enamel is thinnest **(Fig 8)**. The dentin lobe topography, which is established in the incisal third of the tooth, leaves zones for translucent shaded composite to be placed **(Fig 9)** (note that the correct incisal translucency and halo effect must be established in this area). Tints can be applied sparingly to create maverick coloring **(Fig 10)**. The final outer layer of facial enamel composite, determined from the middle third of the tooth where the enamel is thickest, must be a homogenous layer that covers the entire facial surface of the tooth **(Fig 11)**.

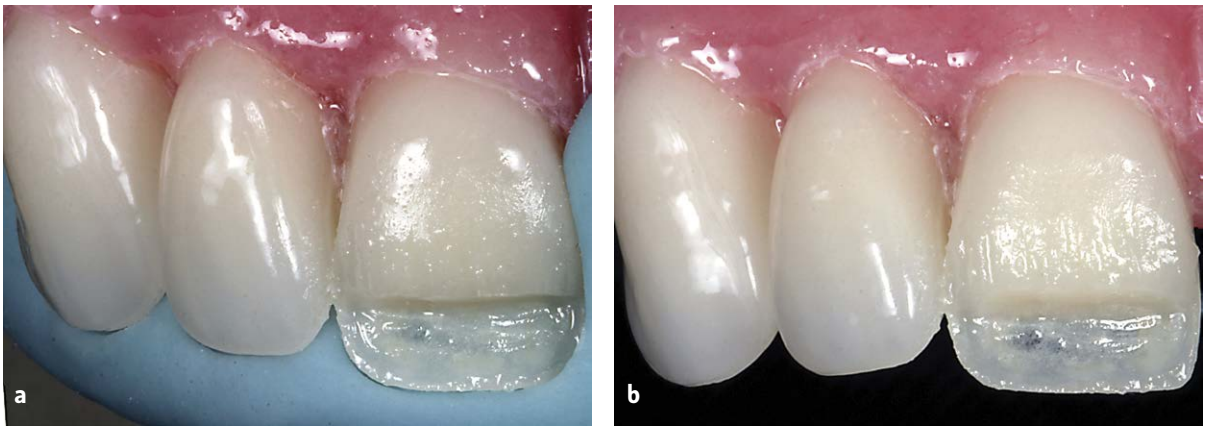
Clinical Guidance:

1. *Etch the enamel past the end of the starbusrt bevel, and the dentin, for 20 to 30 seconds, then rinse for 10 seconds.*
2. *Apply 2+ coats of universal adhesive for 30 seconds; air dry until nothing moves; then light cure.*
3. *Place a thin (e.g., 0.5 mm) increment of enamel shade composite into the putty matrix, being sure to include the entire incisal edge; place the putty matrix onto the tooth, ensuring that the composite contacts the lingual surface of the tooth to be restored, and light cure for 20 seconds.*
4. *Place a more opacious or chromatic shade of composite to mimic the dentin shade of the tooth. Build irregular dentinal lobes that blend apically into the starburst bevel—but do not fill them—and stretch to reach the incisal edge. Light cure.*
5. *Apply a translucent or enamel effect shade of composite to fill in between the lobes and also into the interproximal transition zones, then light cure.*
6. *Apply tints, always white, internally (e.g., below or on top of the translucent zone) to mirror the maverick coloring of the natural teeth.*
7. *Cover all prior layers of composite and 2 mm to 3 mm beyond the bevel with an enamel shade that will modulate the value of the restoration, then light cure for 2 to 3 cycles of 20 seconds from the buccal and lingual aspects.*

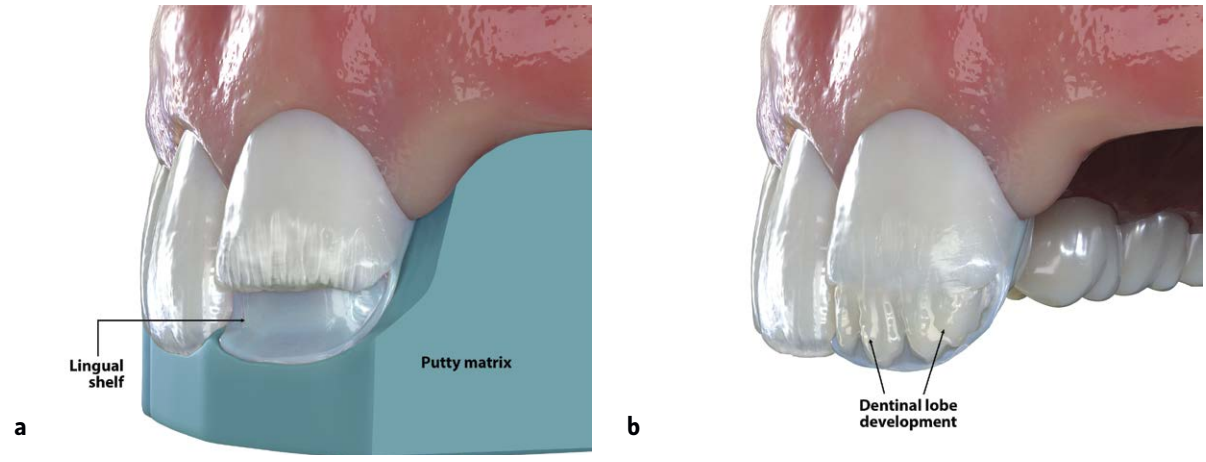
Finishing, and Polishing

Morphology and surface finish: Finishing and polishing, the fourth clinical cornerstone essential for successful direct composite restorations, are both material- and technique-sensitive. To achieve a highly esthetic and durable restoration, a topographically correct surface is clinically necessary. Morphology and surface finish that are clinically correct for an esthetic outcome help to prevent staining, plaque retention, gingival irritation, recurrent caries, abrasiveness, wear kinetics, and tactile perception by the patient.[19,20]

Primary, secondary, and tertiary anatomy: Each patient has their own unique and specific tooth luster and polish, and each tooth has its own primary (i.e., general shape or outline form), secondary (i.e., peaks and valleys), and tertiary (i.e., texture, dots, and lines) anatomy. *Contouring* is the artistic act of gross reduction to obtain the required restorative anatomy and outline form. Changes are made to areas that reflect or disperse light, thereby improving the smile's esthetics. Start with a coarse or medium disc to correct the incisal edge plane **(Fig 12)**. The goal is to mirror the adjacent tooth. A coarse disc moves the line angles toward the interproximal area **(Fig 13)**. A medium-grit disc can be used to begin the finishing and polishing by removing any remaining imperfections and scratches. Finally, a red flame-shaped finishing diamond is used to make minor adjustments by moving the line angles toward the center of the tooth, creating the appropriate curvature to the line angle **(Figs 14 & 15)**. Following this sequence will impart a high polish to the restoration.



Figures 3a & 3b: (a) The lingual enamel layer is established by placing a small, thin increment of composite into the putty matrix intimately against the tooth and light curing. (b) This lingual scaffolding is a precise starting point for the 3D composite layering technique.



Figures 4a & 4b: (a) To initiate 3D scaffolding of the composite restoration, a very thin increment of the selected enamel shade is placed in the putty matrix. (b) Dentinal lobe development.

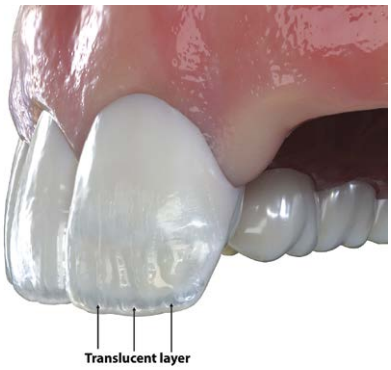


Figure 5: Translucency is established by placing the appropriate thickness of translucent or enamel composite.

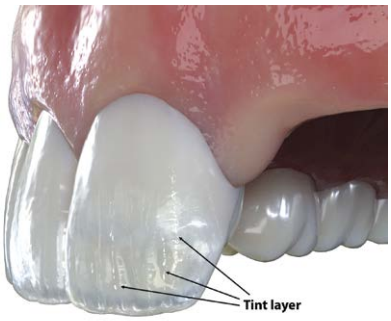


Figure 6: Natural characterization is achieved by applying white tints (and other colors) as maverick colorization to mirror adjacent dentition.

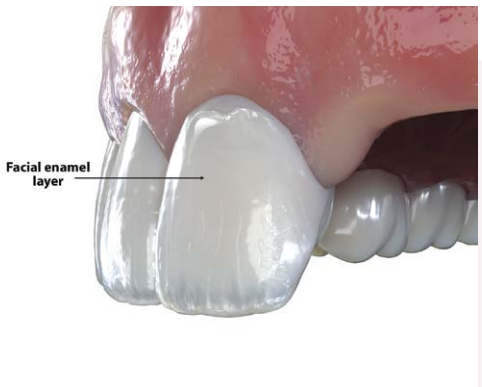


Figure 7: The selected enamel shade, when placed in the appropriate thickness, ideally modulates the value of the final restoration.

Tips

Beginner

- Select a composite kit with a full complement of shades (e.g., A, B, and D) that ideally includes multiple dentin shades.
- For anterior restorations, use a minimum of two composite shades (i.e., a dentin shade with more chroma for the first layer deep in the tooth, and a shade with less chroma or higher value for the outer enamel layer).

Intermediate

- Take before and after photographs of all your cases, and use these as a basis for improving your contouring and color-matching skills.
- Use rubber dam isolation, but be aware that the teeth will dehydrate.

Advanced

- Perform detailed color-mapping and photography prior to rubber dam placement and tooth dehydration.
- Incorporate more advanced 3D characterized layering techniques.
- Follow the contour, polish, and high finishing (sheen) sequence to create texture and luster appropriate for the specific patient's dentition.

Figure 8: A more opacious/chromatic shaded composite layer—which should be applied upward onto the starburst bevel to block out the fracture line—creates the dentinal lobes.

Figure 9: A translucent composite layer is placed to fill in between the dentinal lobes and interproximally in the transition zones, but does not fill the starburst bevel.

Figure 10: A tint or characterization layer creates maverick coloring, where needed, to replicate the patient's natural dentition.

Figure 11: The final layer of facial composite is applied to cover all prior composite layers and onto the natural tooth beyond the starburst bevel.

Figure 12: A coarse or medium disc creates the incisal edge plane.

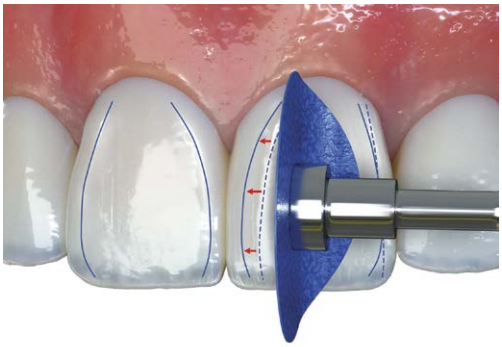


Figure 13: A coarse or medium disc moves the line angles from the center portion of the tooth to the mirror position on the contralateral tooth (the red marks indicate where the outer facial enamel layer establishes the line angle; the solid blue line indicates where it should be moved to mirror the contralateral tooth).

Figures 14 & 15: A red flame-shaped finishing diamond moves the line angles toward the center of the tooth.

Figure 16: Following appropriate finishing and polishing, the definitive restoration demonstrates the ideal sheen and luster, with natural-looking translucency, incisal halo effects, and lifelike characteristics.

"To achieve a highly esthetic and durable restoration, a topographically correct surface is clinically necessary."

Finishing is the process of refining the roughness or minimizing the micro scratches typically created during contouring.[21,22] *Polishing* imparts a high sheen and further eliminates micro scratches, creating a satin finish, lower luster, or high sheen, depending on the tooth being replicated.

Imparting realism: Various finishing and polishing techniques and systems are available for imparting realism in direct composite restorations, thereby enhancing a patient's smile **(Fig 16)**. Removal of excess material and recontouring is performed first, using any of a variety of coated abrasive discs, carbide burs and stones, fine finishing diamond burs, and resin- or silicone-impregnated burs.[23] Seamless and invisible margins are effectively achieved when fine, extra-fine, and ultra-fine finishing diamonds are used.[23] A polishing system that includes polishing discs, points, cups, wheels, silicone brushes, goat hair brush with a chamois in the middle, and polishing paste should be used to achieve the appropriate luster and polish, as well as patient-specific variations in surface roughness, topography, and sheen.[22,24]

Clinical Guidance:

1. *Begin contouring using a coarse disc to create the facial planes and incisal edge plane.*
2. *Use a red flame-shaped diamond to create line angle positions.*
3. *Use pencil lines and smudged articulator paper to reveal and confirm the topography and reflective surfaces on the facial anatomy.*
4. *Apply texture using a coarse diamond on a low speed.*
5. *Polish with medium and fine discs, and/or rubber points and wheels.*
6. *Reapply texture, then use a goat hair brush with composite polishing paste at low torque and firmness, followed by higher speed and less pressure.*

Clinical Case

A 32-year-old patient presented with an existing composite restoration on tooth #9 that he received when he was 12 to treat a Class IV fracture. The additive restoration comprising the incisal one-third of this anterior tooth did not blend with the natural tooth structure or the adjacent teeth **(Figs 17a & 17b)**. The patient requested a more esthetic and natural-looking restoration.

Shade Selection

To select the best shade, three triangle-shaped wedges in varying degrees of thickness with high chroma, translucency, and enamel shade were placed on the tooth and light cured **(Fig 18)**. Selecting the right hue, chroma, and related value based on the thickness of composite is critical, as thickness determines how light will reflect, absorb, and transmit off the composite to establish the correct shade.

After shade-taking and color-mapping, rubber dam isolation with ligation was established **(Fig 19)**. Conservative removal of the composite was initiated, and after removal of 1 mm to 1.5 mm, it was determined that the existing composite shade would work well as the dentin substrate and lingual scaffolding.

Layering

Due to the transition between the existing restoration and tooth structure, a minimal starburst bevel was placed **(Fig 20)**, which served as the starting point for the 3D composite artistry. (In most cases the entire composite would be removed, but that was not necessary in this case. However, the same protocol would be followed.) In the present case, routine etching (Etch-37 w/BAC, Bisco; Schaumburg, IL), universal adhesive application (All-Bond Universal, Bisco), and curing (Demi Plus, Kerr; Brea, CA) were performed to initiate bonding **(Fig 21)**, and white tint (Estelite Color, Tokuyama Dental America; Encinitas, CA) was added as maverick coloring to mirror the contralateral central incisor. The outer composite layer (i.e., facial enamel layer covering beyond the starburst bevel and all previously placed composite layers in their entirety) was placed and cured (Estelite Omega, Tokuyama) **(Fig 22)**.

Contouring, Finishing, and Polishing

Contouring was initiated by first establishing the appropriate outline form using a coarse disc, red flame-shaped finishing diamond, and blue points (Dialite, Brasseler USA; Savannah, GA) **(Figs 23a-23c)**. Finishing was then undertaken with a medium blue disc (FlexiDisc, Cosmedent; Chicago, IL) and pink diamond-impregnated points (Dialite), followed by a green striped diamond (6856L31.020, Brasseler) in an electric handpiece (NSK, Brasseler) on very slow speed to create tertiary anatomy or texture **(Figs 24a-24c)**. The final polishing phase was completed using a goat hair brush (Brasseler) with a chamois in the middle and composite polishing paste (Enamelize, Cosmedent) **(Figs 25 & 26)**.

The patient was dismissed and seen 5 business days later, at which time contouring and gradation of finishing and polishing was resumed (the author recommends that the patient be seen between 5 and 10 business days later so the tooth can rehydrate adequately). The definitive restoration demonstrates seamless integration and harmony with the surrounding dentition, as well as appropriate anatomy, texture, and sheen **(Figs 27a-30)**.

Figures 17a & 17b: (a) Preoperative smile view revealing the patient's unesthetic composite restoration on #9. (b) Retracted preoperative view with visible composite margin.

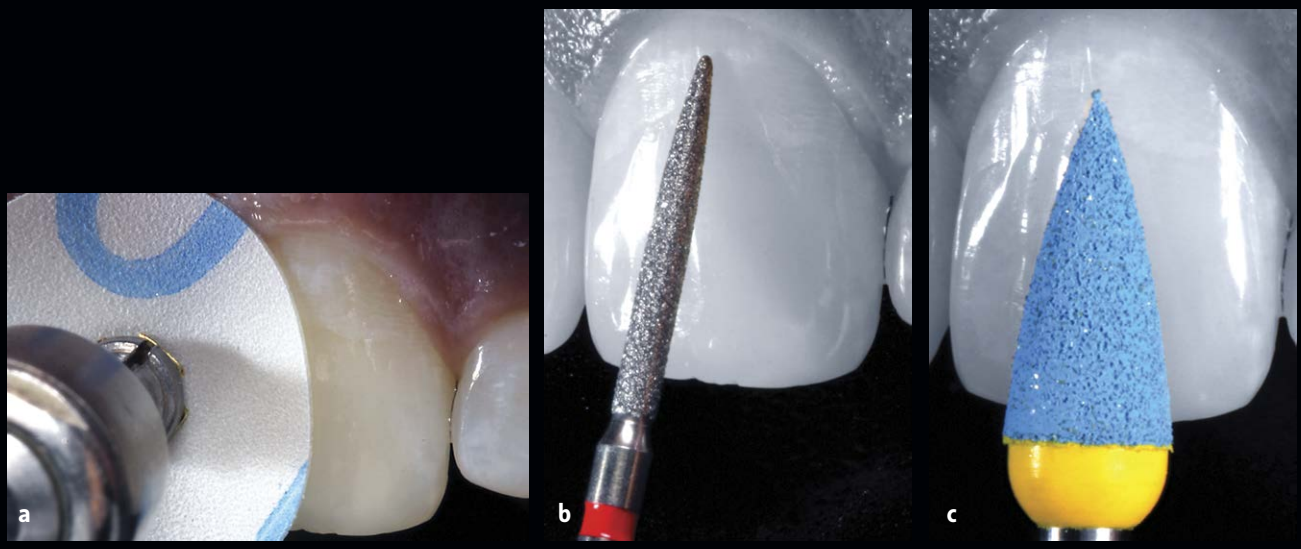
Figure 18: Using the selected shade of composite, place a higher chroma/dentin shade, translucency shade, and enamel shade in a "triangle" from thick to thin, and light cure.

Figure 19: A ligated rubber dam was placed for ideal composite bonding.

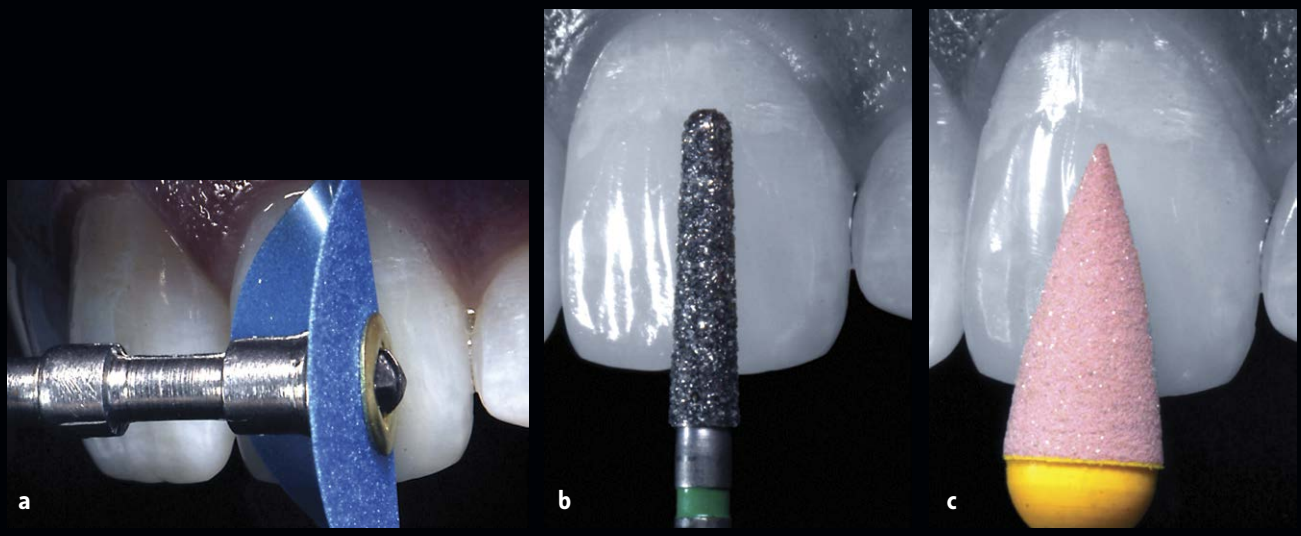
Figure 20: A cut-back facially and incisally, with minimal starburst bevel, was all that was necessary due to the existing composite-to-tooth transition.

Figure 21: Routine etching, rinsing, and universal adhesive bonding protocols were performed.

Figure 22: The final enamel layer was applied to cover the bevel and extend up onto the gingival enamel.



Figures 23a-23c: (a) A coarse disc was used to contour the incisal edge and facial surface, and to establish the outline form of the tooth. (b) A red flame-shaped finishing diamond was used to finish the margins and develop the line angles, while (c) a coarse blue diamond-impregnated point was used for initial contouring.



Figures 24a-24c: (a) A blue (medium) aluminum oxide disc aided polishing, while (b) a coarse (green striped) diamond imparted tertiary anatomy. (c) A pink (medium) diamond-impregnated point was used for prepolishing.

Figure 25: A goat hair brush with chamois in the middle, along with polishing paste, was used to achieve the appropriate sheen for this patient.

Figure 26: View of the initial contouring, finishing, and polishing.

Figures 27a-27c: Views with various light sources showcasing the tertiary anatomy.

Figures 28a & 28b: Postoperative images of the well-integrated definitive restoration on #9, which was achieved without any biological sacrifice. (a) Retracted view. (b) Smile view.

Figures 29a & 29b: Two-year postoperative images. (a) Retracted view. (b) Smile view.

Summary

The ultimate goal of composite bonding is to achieve predictable and long-lasting restorative results in a minimally invasive way, without recurrent issues that warrant further removal of healthy tooth structure, or the use of more invasive and aggressive restorative techniques. The systematic approach described in this article—which is predicated on the clinician's ability to incorporate four clinical cornerstones into their direct composite protocol—will enable the creation of seamless, undetectable, and ultra-conservative additive restorations. By broadening their knowledge of and skill in executing starburst bevels, putty matrices, composite scaffolding and multilayering, and finishing and polishing, clinicians will be able to achieve composite restorations that mimic the beauty of natural tooth structure while enhancing its integrity in a biomimetic way.

Figure 30: Portrait of the happy patient.

Acknowledgment

The author thanks Zach Turner (Pearl River, NY) for creating the illustrations shown in Figures 2, 4a-7, 12-15, and 18.

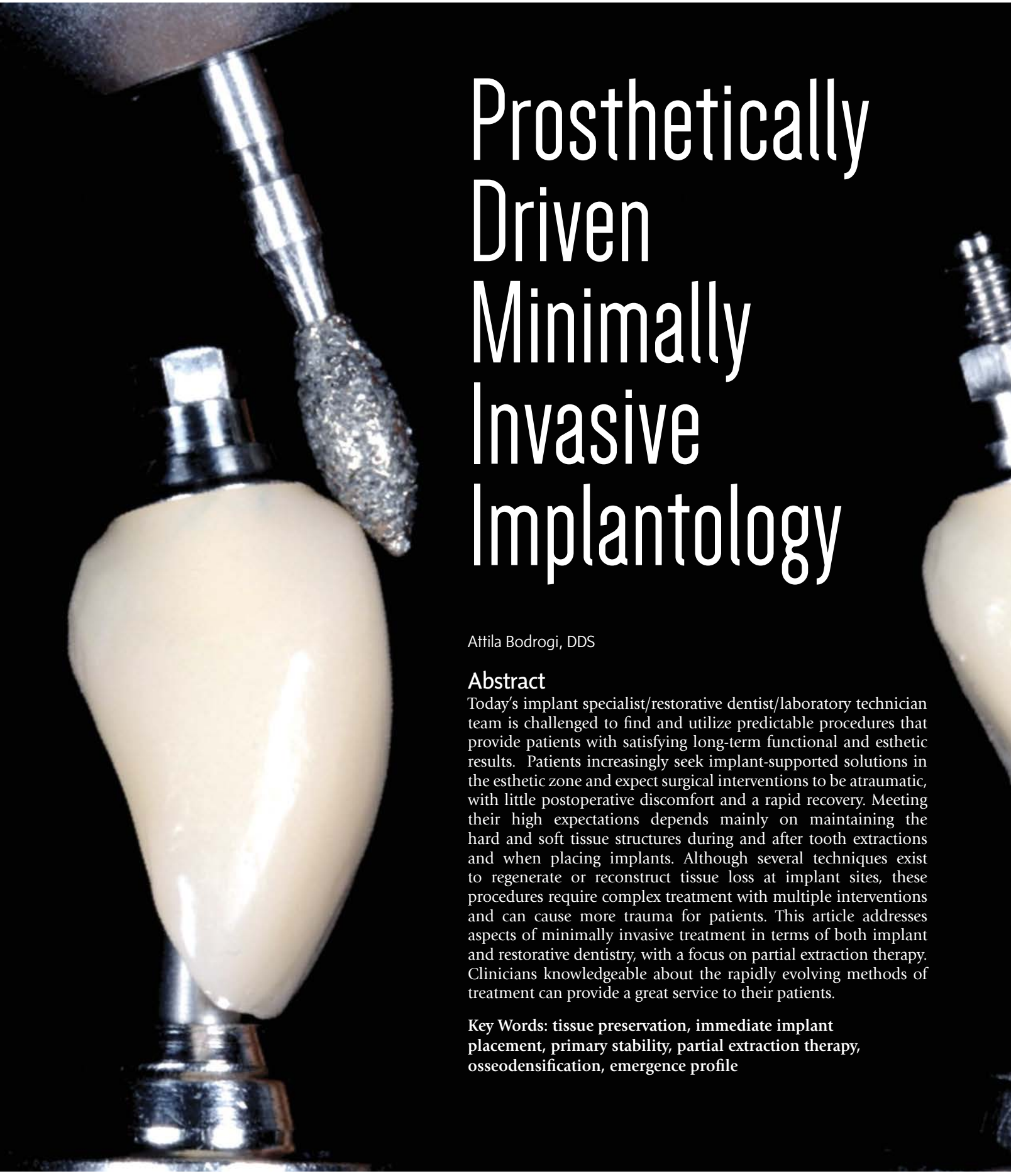
References

1. American Board of Cosmetic Dentistry. Accreditation examination criteria [Internet]. Available from: https://aacd.com/proxy/files/Credentialing/Criteria%20Sheet%20Jan%202020%20-%20Current.pdf
2. Zafar MS, Amin F, Fareed MA, Ghabbani H, Riaz S, Khurshid Z, Kumar N. Biomimetic aspects of restorative dentistry biomaterials. Biomimetics (Basel). 2020 Sep;5(3):34.
3. Mota EG, Oshima HM, Burnett LH Jr, Pires LA, Rosa RS. Evaluation of diametrical tensile strength and Knoop microhardness of five nanofilled composites in dentin and enamel shades. Stomatologija. 2006 Jan;8(3):67-9.
4. Ruddell DE, Maloney MM, Thompson JY. Effect of novel filler particles on the mechanical properties of dental composites. Dent Mater. 2002 Jan;18(1):72-80.
5. Lu H, Lee YK, Oguri M, Powers JM. Properties of a dental resin composite with a spherical inorganic filler. Oper Dent. 2006 Nov-Dec;31(6):734-40.
6. Mitra SB, Dong WU, Holmes BN. An application of nanotechnology in advanced dental materials. J Am Dent Assoc. 2003 Oct;134(10):1382-90.
7. Moszner N, Klapdohr S. Nanotechnology for dental composites. Int J Nanotechnol. 2004;1:130-41.
8. Swift EJ. Nanocomposites. J Esthet Restor Dent. 2006;17(1):3-4.
9. Sarac D, Sarac YS, Kulunk S, Ural C, Kulunk T. The effect of polishing techniques on the surface roughness and color change of composite resins. J Prosthet Dent. 2006 Jul;96(1):33-40.
10. Inokoshi S, Burrow MF, Kataumi M, Yamada T, Takatsu T. Opacity and color changes of tooth-colored restorative materials. Oper Dent. 1996 Mar-Apr;21(2):73-80.
11. Yannikakis SA, Zissis AJ, Polyzois GL, Caroni C. Color stability of provisional resin restorative materials. J Prosthet Dent.1998 Nov;80(5):533-9.
12. Ergücü Z, Türkün LS, Aladag A. Color stability of nanocomposites polished with one-step systems. Oper Dent. 2008 Jul-Aug;33(4):413-20.
13. Terry DA. Restoring the incisal edge. NY State Dent J. 2005 Aug-Sep;71(5):30-5.
14. LeSage BP. Aesthetic anterior composite restorations: a guide to direct placement. Dent Clin North Am. 2007 Apr;51(2):359-78.
15. Wehking D. Layering materials to achieve an undetectable transition between natural tooth and composite. J Cosmetic Dent. 2018 Winter;2018;33(4):18-22.
16. Kenyon BJ, Louie KG, Surti B. Direct composite restorative techniques. In: Geissberger M, editor. Esthetic dentistry in clinical practice. Chichester, West Sussex (UK): Wiley-Blackwell; 2010. p. 175.
17. Seo D, Yi Y, Roh B. The effect of preparation designs on the marginal and internal gaps in Cerec3 partial ceramic crowns. J Dent. 2009 May;37(5):374-82.
18. Fahl N. Step-by-step approaches for anterior direct restorative challenges. J Cosmetic Dent. 2011 Winter;26(4):42-55.
19. LeSage B. Finishing and polishing criteria for minimally invasive composite restorations. Gen Dent. 2011 Nov-Dec;59(6):422-8.
20. Giacomelli L, Derchi G, Frustaci A, Bruno O, Covani U, Barone A, De Santis D, Chiapelli F. Surface roughness of commercial composites after different polishing protocols: an analysis with atomic force microscopy. Open Dent J. 2010 Sep;15(4):191-4.
21. Bashetty K, Joshi S. The effect of one-step and multi-step polishing systems on surface texture of two different resin composites. J Conserv Dent. 2010 Jan-Mar;13(1):34-8.
22. Senawongse P, Pongprueksa P. Surface roughness of nanofill and nanohybrid resin composites after polishing and brushing. J Esthet Restor Dent. 2007;19(5):265-73.
23. Berger SB, Palialol ARM, Cavalli V, Giannini M. Surface roughness and staining susceptibility of composite resins after finishing and polishing. J Esthet Restor Dent. 2011 Feb;23(1):34-43.
24. Maresca C, Pimenta LAF, Heymann HO, Ziemiecki TL, Ritter AV. Effect of finishing instrumentation on the marginal integrity of resin-based composite restorations. J Esthet Restor Dent. 2010 Apr;22(2):104-12. **jCD**

Dr. LeSage is an Accredited Fellow Member of the AACD and a Fellow member of AAED and AGD. The founder and director of the University of California, Los Angeles, (UCLA) Esthetic Continuum Levels I and II, he has maintained a private practice in Beverly Hills, California, for 31 years.

Disclosure: The author did not report any disclosures.


The Best Conference on
Comprehensive Cosmetic Dentistry
is Back!
Welcome Back #AACDfam
AACD
April 27-30
ORLANDO 2022
EDUCATE
INSPIRE
CONNECT
Live & In-Person!
April 27-30, 2022
Register today online at:
aacdconference.com



Prosthetically Driven Minimally Invasive Implantology

Attila Bodrogi, DDS

Abstract

Today's implant specialist/restorative dentist/laboratory technician team is challenged to find and utilize predictable procedures that provide patients with satisfying long-term functional and esthetic results. Patients increasingly seek implant-supported solutions in the esthetic zone and expect surgical interventions to be atraumatic, with little postoperative discomfort and a rapid recovery. Meeting their high expectations depends mainly on maintaining the hard and soft tissue structures during and after tooth extractions and when placing implants. Although several techniques exist to regenerate or reconstruct tissue loss at implant sites, these procedures require complex treatment with multiple interventions and can cause more trauma for patients. This article addresses aspects of minimally invasive treatment in terms of both implant and restorative dentistry, with a focus on partial extraction therapy. Clinicians knowledgeable about the rapidly evolving methods of treatment can provide a great service to their patients.

Key Words: tissue preservation, immediate implant placement, primary stability, partial extraction therapy, osseodensification, emergence profile

> “Patients increasingly seek implant-supported solutions in the esthetic zone and expect surgical interventions to be atraumatic, with little postoperative discomfort and a rapid recovery.”

Introduction

The practice of responsible dentistry means approaching treatment based on an understanding of science and biology, evidence-based minimally invasive treatment, serving the patient's best interests, and impacting the patient's life in a meaningful way. Due to greater awareness of health-conscious lifestyles and the pervasive influence of social media over the last decade, cosmetic dental patients have come to expect maximum esthetic results and the highest level of function. These patients rightfully expect a thoroughly planned and comprehensive approach, especially in cases where the goal is not only an esthetic makeover but also functional improvement. Because long-term esthetic results can exist only when supported by the correct function, the clinician must be particularly knowledgeable about smile design and techniques concerning occlusion.

Partial Extraction Therapy

The situation becomes further complicated when one seeks to replace missing teeth with implants. Implant site preservation is the concept of maintaining the volume and architecture of both the soft and hard tissues during and after extraction. The collapse of the buccal cortical plate in a post-extraction ridge, especially in the anterior dentition,[1-3] is a challenging situation in restorative and implant dentistry.[4] Implant surgeons should strive to preserve as much tissue as possible, but in the case of a delayed approach, they must reconstruct the surrounding tissues to achieve long-term functional and esthetic success. A variety of ridge preservation techniques have been described in the literature. Besides immediate implant placement,[5] there is one approach that uses the root itself (or at least a fragment of the root) to maintain the cortical plate. This approach is called *partial extraction therapy* (PET),[6] which is an umbrella term comprising the socket shield, the pontic shield, and the root submergence techniques.[7]

The biology behind PET involves the maintenance of periodontal ligaments attached to the intentionally left root (or fragment), which provide the blood supply to the cortical plate from inside the socket. The key factor when placing an implant immediately, either in the case of total or partial extraction, is primary stability, which is determined by the design and surface structure of the implant, as well as the bone's quality and quantity. Osseodensification is a novel technique that allows for an increase in bone density,[8,9] and in certain areas (i.e., the posterior maxilla and sinus) can allow for an auto-grafting procedure to be performed without opening the lateral window.

In addition to these biologic considerations, excellent esthetics can be achieved through proper planning. The primary guiding principle of planning is "facially driven smile design." Utilizing this principle, one can determine the shape and size of the final restorations, as well as the position of the prosthetics made for the implants.[10] It is critical that the implants be placed in the correct position with a prosthetic plan in mind; a digitally designed 3D-printed surgical guide is an essential tool to accomplish this **(Fig 1)**.[11]

Figure 1: Digitally designed complex, prosthetically driven full-mouth reconstruction with minimally invasive flapless guided implant placements.

Case Report

Patient Complaint and Initial Situation

A 45-year-old male sought treatment when his maxillary right central incisor (#8), which had undergone root canal treatment, fractured near the gum due to trauma. The patient's general dentist recognized the possibility for immediate implantation and referred him to the author's clinic after temporarily splinting the broken tooth to the adjacent teeth with composite filling material **(Fig 2)**. A cone-beam computed tomography (CBCT) image clearly showed the fracture line, so the position of the implant could be accurately planned. According to the latest CBCT classification for immediate implant placement based on the radial plane tooth position and bone wall dimensions,[12] this situation was a Class IIb; therefore, an immediate implant placement could be performed with relative ease **(Fig 3)**.

Maintaining Tissue Volume

It is important to note that in these situations, practitioners are not able to place an implant immediately into the extraction socket because, even when employing the least traumatic extraction procedure, only the buccal and palatal cortical plates remain and the apical bone is also missing. When performing implant placement in the smile zone, maintaining volume is critical, as loss of volume creates extremely displeasing esthetics.[13-17] The pink esthetic score (PES) assesses the esthetic success of single implants. It examines seven different parameters, evaluating each with a score between 0 and 2, with a maximum total score of 14 **(Fig 4)**.[18]

With these considerations and keeping the biology of the healing process following tooth extraction in mind, immediate implantation was an obvious solution. It is of the utmost importance to know that the buccal cortical plate is usually very thin (less than 1 mm)[19] and that long-term tissue volume maintenance depends on the blood supply to the bone. From the periosteum side, the flapless approach provides safety; however, preserving blood vessels from the periodontal ligament side is another scientifically proven method for predictable implant placement. Several studies, as well as daily chairside observation, have shown significantly less bone resorption when employing a flapless approach. This is why PET, namely the socket-shield technique, was the author's first consideration in this case.[20,21]

Other Techniques

Of course, in Type 1 socket situations such as the present case, there are other possible treatments. When considering the time from extraction to implant placement and deciding between immediate, early, or delayed placement, practitioners can choose from among the following techniques:

Figure 2: Initial situation, showing #8 splinted to the adjacent teeth with composite.

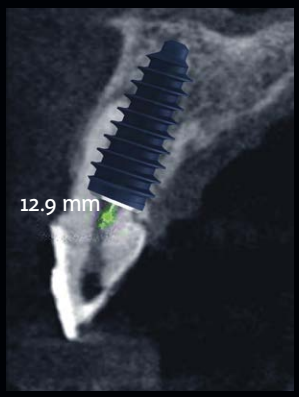


Figure 3: The patient's CBCT image with the correctly determined implant position.

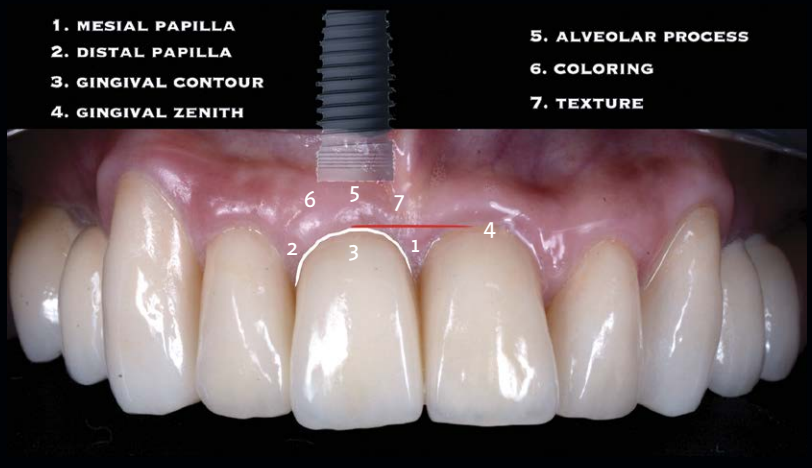


Figure 4: Pink esthetic score and its parameters, shown in a single implant in the anterior maxilla at the 18-month follow-up in a previous case.

Figure 5: Removal of the coronal part of the hopeless tooth.

Figure 6: Mesiodistal dissection of the root.

Figure 7: Removal of palatal fragment.

Figure 8: Occlusal view, showing the root membrane buccally and the dimensions of the palatal extraction socket.

Figure 9: Shield preparation.

Figure 10: Implant insertion.

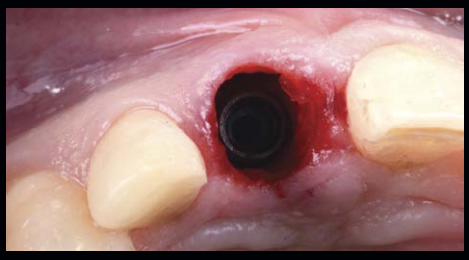


Figure 11: Final 3D position of palatally placed implant, occlusal view.

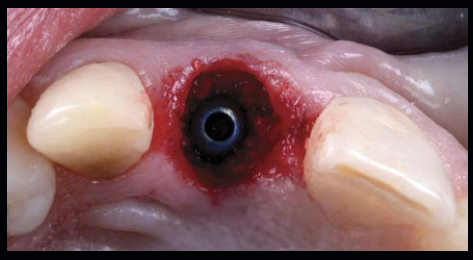


Figure 12: Grafting the gap between the root membrane and implant with allograft material.

Figure 13: Immediate screw-retained provisional six days postoperative, showing excellent healing and tissue stability.

- immediate implant placement with gap grafting
- early implant placement with contour grafting
- socket grafting with delayed implant placement
- delayed placement with connective tissue grafting
- modified interpositional vascularized augmentation neogenesis.

Early and delayed techniques require multiple visits and surgical procedures, take more treatment and healing time, and cause greater patient discomfort. The immediate approach, however, is based on the "one surgery—one time" concept: it is minimally invasive and results in significantly less bone loss over time. Consequently, it must be concluded that the main advantage of PET over the classic Tarnow approach involving immediate implant placement with gap grafting[17] is the importance of maintaining the internal blood supply by keeping the root membrane and preserving periodontal ligaments.

It should be noted that PET also has limitations and possible complications. The main contraindication is a periodontally compromised tooth with loose attachment to the bone. However, periapical inflammation is not a reason to avoid using this approach, as an apicoectomy can be performed simultaneously. In terms of complications, shield exposure should be mentioned, as the reason behind it generally is the improper preparation of the root fragment. However, this can be solved relatively easily by submerging the shield back to the crest level and letting the soft tissue close again, or by carrying out connective tissue grafting on the site.

While performing the socket shield technique, a 1- to 1.5-mm buccal fragment of the root must be kept intentionally by removing the coronal part of the tooth first **(Fig 5)**. After that, the root should be dissected mesiodistally up to the apex **(Fig 6)**, and then only the palatal portion should be

removed **(Fig 7)** to provide room for the implant to be placed behind the shield immediately **(Fig 8)**. Shield preparation is an important part of this procedure. The shield should be cut back to the crest level, which must be thin enough and shaped chamfer-like to leave sufficient room between the root membrane and the implant-to-restoration interface **(Fig 9)**.[22-24] Root membrane kits are available (e.g., PET Kit, MegaGen America; Englewood Cliffs, NJ) to help practitioners with precise and predictable shield preparation.

An implant system with a platform-switching solution, a thread design appropriate for high initial stability, and an internal connection for easy screw-retained restorability should be selected **(Fig 10)**. When temporizing implants, the main criterion is to have high primary stability. This parameter should always be measured with an implant stability quotient (ISQ) device, as temporization can be done only if the ISQ is 70 or above. Seating torque is sometimes used to determine the stability of an implant; however, torque does not necessarily correlate with implant stability.[25-28]

In an extraction socket, it follows that there will be insufficient bone quantity. There are two options to increase primary stability. The first is to conventionally position the osteotomy and the implant mostly into the palatally and apically located bone **(Fig 11)**.[29] The second option is to use a bur kit (e.g., Densah, Versah; Jackson, MI) in a counterclockwise direction to prepare the implant bed, resulting in a denser and better-quality bone to support the newly placed implant. Osseodensification in combination with the socket-shield technique is a safe choice for anterior cases as well, with the understanding that neither the burs nor the condensed bone are in contact with the shield itself, and they therefore cannot dislodge the buccal root fragment, as they are far more palatal. In general, Densah burs can replace conventional osteotomy burs whenever an implant site provides a sufficient amount of bone to be condensed, the only exception being a Class V situation.

The increased primary stability is essential, as it allows the fabrication of an immediate implant-supported provisional. Studies have shown the best tissue healing pattern around immediately placed implants can be achieved by utilizing the dual-zone approach.[30] This concept consists of grafting the gap between the implant and the extraction socket—in this case, the buccal shield **(Fig 12)**—and providing an immediate provisional on the implant **(Fig 13)**. Because of the differences between immediate temporization and immediate loading, occlusal considerations and proper restoration design were essential in this case.[31]

Special care must be taken when dealing with the emergence profile of implant-supported restorations **(Fig 14)**.[32] The reason for this is that only proper critical and subcritical contours provide sufficient space for the soft tissue and their blood vessels. The shield must not be in contact with the restoration. The enormous advantage of this immediate approach is that it minimizes trauma and the number of interventions (one operation one time), and it offers an opportunity to mold the soft tissues around the implant from the beginning.

TIPS

- Start treatment planning with the prosthetic solution in mind.
- Always have a CBCT.
- First, consider the possibility of an immediate approach.
- Use an implant system that is appropriate for high initial stability.
- Develop the skills that enable you to utilize the dual-zone concept, such as chairside immediate temporary or individual healing abutment.
- Educate yourself about prosthetic considerations of implant dentistry.
- Surround yourself with a team with the same vision (implantologist, prosthodontist, digital technician, etc.).
- Open your mind to new, out-of-the-box techniques.
- Use the advantages of digital technology such as printed surgical guides and restorations.
- Attend hands-on courses.

Figure 14: Critical and subcritical contouring of the provisional can be modified chairside.

Healing and Follow-Up

After a healing period of four months, this case was ready to be finalized **(Fig 15)**. All the esthetic parameters on the extra- and intraoral images were checked (i.e., PES) and, as the esthetics were deemed pleasing **(Figs 16 & 17)**, the screw-retained provisional was copied for the final one-piece titanium-based porcelain-fused-to-zirconia restoration. In this phase, there is an opportunity to make some modifications in shape, size, and emergence profile **(Figs 18 & 19)**. If the patient is open to enhancing their dentition through objective smile design parameters, the clinician must act accordingly; however, in some situations, as in this case, the clinician was permitted only to reconstruct the extraction site. The final images taken at the 15-month follow-up show no dimensional changes at the site and demonstrate excellent esthetics and tissue health **(Figs 20-24)**.

Summary

The concept of minimally invasive treatment has come to the fore in the last decade. The primary and most important measure of success is long-term durability, which refers to both the preservation of the volume of tissues surrounding the implants and the longevity of the prostheses supported by them. Patients want esthetically outstanding and lasting restorations as quickly and with as little trauma as possible, even in cases that require implant placement. Partial extraction therapy can be employed with predictable and reproducible success not only in the esthetic zone but also in the posterior areas, even in cases of adjacent implants **(Fig 25)**. In conclusion, in most cases, it is easier and more predictable to preserve an implant site than to reconstruct it.

Figure 15: Provisional at the four-month follow-up, showing outstanding tissue maturation and stability.

Figure 16: Frontal view of the tissue control, showing excellent papillae positions, gingival zenith, and contour.

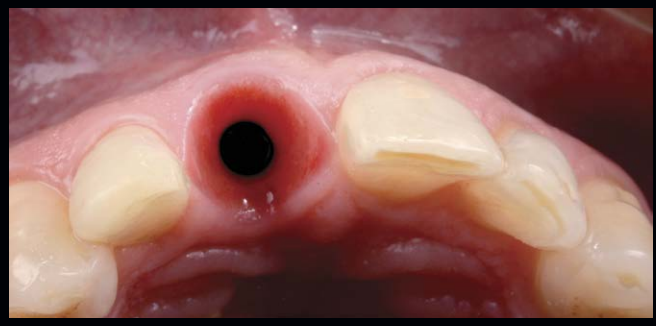


Figure 17: Occlusal view of the tissue control, showing identical volume compared to the adjacent natural teeth.

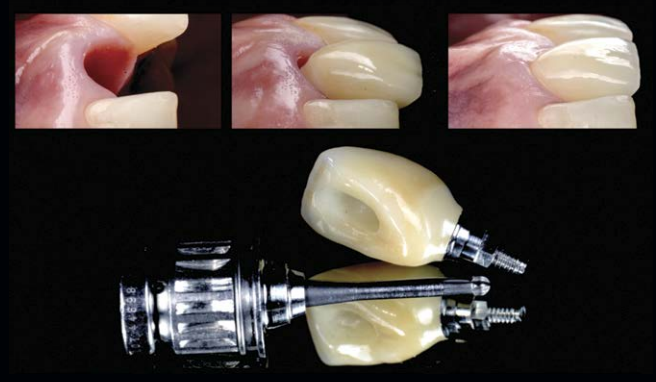


Figure 18: Final screw-retained restoration with proper emergence profile.

Figure 19: Final implant-supported restoration in situ on day of placement.

Figure 20: Follow-up at 15 months, showing no dimension changes and good tissue health.

Figure 21: Follow-up at 15 months, occlusal view.

Figure 22: Follow-up at 15 months, right lateral view.

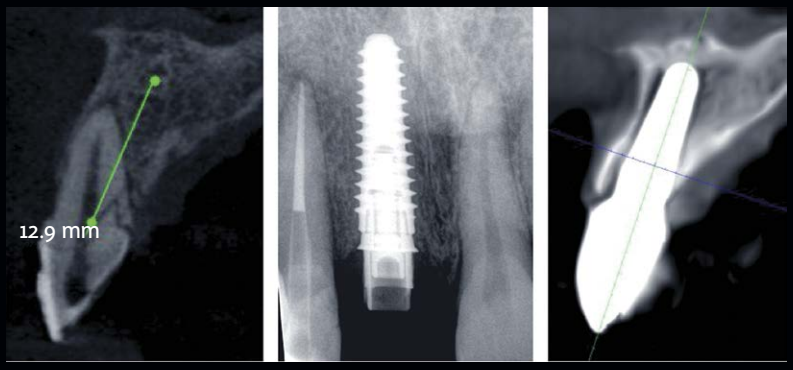


Figure 23: Intraoral radiograph of the provisional and CBCT control at 15 months. The shield is clearly visible, maintaining the cortical plate and tissue volume.

Figure 24: Portrait of the happy patient at the 15-month follow-up.

Acknowledgment

The author thanks András Váradi, CDT (Budapest, Hungary), for fabricating the ceramic restorations discussed in this article.

References

1. Hansson S, Halldin A. Alveolar ridge resorption after tooth extraction: a consequence of a fundamental principle of bone physiology. J Dent Biomech. 2012;3:1758736012456543.

2. Spray JR, Black CG, Morris HF, Ochi S. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. Ann Periodontol. 2000 Dec;5(1):119-28.

3. Chappuis V, Engel O, Reyes M, Shahim K, Nolte LP, Buser D. Ridge alterations post-extraction in the esthetic zone: a 3D analysis with CBCT. J Dent Res. 2013 Dec;92(12 Suppl):195S-201S.

4. Schropp L, Isidor F. Papilla dimension and soft tissue level after early vs. delayed placement of single-tooth implants: 10-year results from a randomized controlled clinical trial. Clin Oral Implants Res. 2015 Mar;26(3):278-86.

5. Lazzara RJ. Immediate implant placement into extraction sites: surgical and restorative advantages. Int J Periodontics Restorative Dent. 1989;9(5):332-43.

6. Hürzeler MB, Zuhr O, Schupbach P, Rebele SF, Emmanouilidis N, Fickl S. The socket-shield technique: a proof-of-principle report. J Clin Periodontol. 2010 Sep;37(9):855-62.

7. Gluckman H. Past, present, and future of partial extraction therapies [thesis]. [Szeged (Hungary)]: University of Szeged; 2019.

8. Huwais S, Meyer EG. A novel osseous densification approach in implant osteotomy preparation to increase biomechanical primary stability, bone mineral density, and bone-to-implant contact. Int J Oral Maxillofac Implants. 2017 Jan-Feb;32(1):27-36.

9. Machado RCM, Da Gama CS, Batista SH, Rizzo D, Valiense H, Moreira RF. Tomographic and clinical findings, pre-, trans-, and post-operative, of osseodensification in immediate loading. Int J Growth Factors Stem Cells Dent. 2018 Sep-Dec;1(3):101-5.

10. Coachman C. Complete digital workflow for facially driven restorative dentistry. Clin Oral Implants Res. 2017;28(Suppl 14):7.

11. Coachman C, Calamita MA, Coachman RG, Sesma N. Facially generated and cephalometric guided 3D digital design for complete mouth implant rehabilitation: a clinical report. J Prosthet Dent. 2017 May;117(5):577-86.

12. Gluckman H, Pontes CC, Du Toit J. Radial plane tooth position and bone wall dimensions in the anterior maxilla: a CBCT classification for immediate implant placement. J Prosthet Dent. 2018 Jul;120(1):50-6.

13. Sclar AG. Preserving alveolar ridge anatomy following tooth removal in conjunction with immediate implant placement. The Bio-Col technique. Atlas Oral Maxillofac Surg Clin North Am. 1999 Sep;7(2):39-59.

14. Esposito M, Grusovin MG, Polyzos IP, Felice P, Worthington HV. Interventions for replacing missing teeth: dental implants in fresh extraction sockets (immediate, immediate-delayed and delayed implants). Cochrane Database Syst Rev. 2010 Sep 8;(9):CD005968.

15. Cardaropoli D, Gaveglio L, Gherlone E, Cardaropali G. Soft tissue contour changes at immediate implants: a randomized controlled clinical study. Int J Periodontics Restorative Dent. 2014 Sep-Oct;34(5):631-7.

16. Chen ST, Buser D. Esthetic outcomes following immediate and early implant placement in the anterior maxilla: a systematic review. Int J Oral Maxillofac Implants. 2014;29 Suppl:186-215.

17. Tarnow DP, Chu SJ. Human histologic verification of osseointegration of an immediate implant placed in fresh extraction socket with excessive gap distance without primary flap closure, graft, or membrane: a case report. Int. J Periodontics Restorative Dent. 2011 Sep-Oct;31(5):515-21.

18. 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.

19. Wang HM, Shen JW, Yu MF, Chen XY, Jiang QH, He FM. Analysis of facial bony wall dimensions and sagittal root position in the maxillary esthetic zone: a retrospective study using cone beam computed tomography. Int J Oral Maxillofac Implants. 2014 Sep-Oct;29(5):1123-9.

20. Gluckman H, Salama M, Du Toit J. A retrospective evaluation of 128 socket-shield cases in the esthetic zone and posterior sites: partial extraction therapy with up to 4 years follow-up. Clin Implant Dental Relat Res. 2018 Apr;20(2):122-9.

21. Bäumer D, Zuhr O, Rebele S, Schneider D, Schupbach P, Hürzeler M. The socket-shield technique: first histological, clinical, and volumetrical observations after separation of the buccal tooth segment – a pilot study. Clin Implant Dent Relat Res. 2015 Feb;17(1):71-82.

22. Gluckman H, Salama M, Du Toit J. Partial extraction therapies (PET) part 1: maintaining alveolar ridge contour at pontic and immediate implant sites. Int J Periodontics Restorative Dent. 2016 Sep-Oct;36(5):681-7.

23. Gluckman H, Salama M, Du Toit J. Partial extraction therapies (PET) part 2: procedures and technical aspects. Int J Periodontics Restorative Dent. 2017 May-Jun;37(3):377-85.

24. Siormpas KD, Mitsias ME, Kontsiotou-Siormpa E, Garber D, Kotsakis GA. Immediate implant placement in the esthetic zone utilizing the "root-membrane" technique: clinical results up to 5 years postloading. Int J Oral Maxillofac Implants. 2014 Nov-Dec;29(6):1397-405.

25. Degidi M, Daprile G, Piattelli A. Determination of primary stability: a comparison of the surgeon's perception and objective measurements. Int J Oral Maxillofac Implants. 2010 May-Jun;25(3):558-61.

26. Trisi P, Carlesi T, Colagiovanni M, Perfetti G. Implant stability quotient (ISQ) vs direct in vitro measurement of primary stability (micromotion): effect of bone density and insertion torque. J Osteol Biomat. 2010;1(3):141-51.

27. Pagliani L, Sennerby L, Petersson A, Verrocchi D, Volpe S, Andersson P. The relationship between resonance frequency analysis (RFA) and lateral displacement of dental implants: an in vitro study. J Oral Rehabil. 2013 Mar;40(3):221-7.

28. Park IP, Kim SK, Lee SJ, Lee JH. The relationship between initial implant stability quotient values and bone-to-implant contact ratio in the rabbit tibia. J Adv Prosthodont. 2011 Jun;3(2):76-80.

29. Esposito M, Gonzáles-García A, Peñarrocha Diago M, Fernández Encinas R, Trullenque-Eriksson A, Xhanari E, Peñarrocha Oltra D. Natural or palatal positioning of immediate post-extractive implants in the aesthetic zone? 1-year result of a multicentre randomised control trial. Eur J Oral Implantol. 2018;11(2):189-200.

30. Chu S, Salama MA, Salama H, Garber DA, Saito H, Sarnachiaro GO, Tarnow DP The dual-zone therapeutic concept of managing immediate implant placement and provisional restoration in anterior extraction sockets. Compend Contin Educ Dent. 2012 Jul-Aug;33(7):524-32, 534.

31. Palatella P, Torsello F, Cordaro L. Two-year prospective clinical comparison of immediate placement vs. immediate restoration of single tooth in the esthetic zone. Clin Oral Implants Res. 2008 Nov;19(11):1148-53.

32. González-Martín O, Lee E, Weisgold A, Veltri M, Su H. Contour management of implant restorations for optimal emergence profiles: guidelines for immediate and delayed provisional restorations. Int J Periodontics Restorative Dent. 2020 Jan-Feb;40(1):61-70. **jCD**

Dr. Bodrogi is the founder of the Bodrogi Institute for Advanced Dentistry in Budapest, Hungary. He has been performing partial extraction therapy since 2015.

Disclosure: The author did not report any disclosures.

> "The main contraindication [to PET] is a periodontally compromised tooth with loose attachment to the bone. However, periapical inflammation is not a reason to avoid using this approach, as an apicoectomy can be performed simultaneously."

Make it e.max® Prime

For a difference you can see.

Place with ZirCAD® Cement

IPS e.max® Prime.

Dr Peter Auster, DMD, FACD Pomona, NY
"e.max Prime has become my number one choice for strength and beauty. We finally have an esthetic zirconia that is strong enough for splints and bridges and translucent enough to be comfortably used in anterior cases. It's gradient technology creates Y3 strength where it is needed as well as Y5 translucency, to create a functional, beautiful restorative. It is truly worthy of the name e.max!"

For optimal strength, esthetics and multiple indications. – Make it e.max!

Learn more about IPS e.max® Prime

ivoclarvivadent.com
Making People Smile

ivoclar vivadent®

With over 500 IPS e.max® Prime dental laboratories in North America, it's never been easier to Make it e.max!

- NuCraft Dental Arts
- Oral Ceramics Studio
- Yankee Dental Arts
- Drake Precision Dental Laboratory
- King Dental Arts
- Precision Craft Dental Lab
- Harrison Dental Studio
- Jerry's Dental Lab
- Kootenai Dental Lab
- Sherard Dental Lab
- Centre City Dental Laboratory
- DSG Clearwater Dental Lab
- Trinident Dental Lab
- Corr Dental Lab
- Ottawa Dental Lab
- Custom Dental LLC
- Elegant Dental Laboratories LLC
- Ohio Dental Lab
- Nu Art Dental Lab Inc
- Crawford Dental Lab
- Precision Dental Design
- Georgia Dental Lab Inc
- Thompson Dental Studio
- Brlit Dental Lab Inc
- Jade Dental Lab Group
- Napa Valley Dental Lab
- Singler Dental Ceramics Inc
- Distinctive Dental Design
- Precision Ceramics
- Smile Designs by Rego
- Gordon Dental Lab
- Frontier Dental Laboratories, Inc
- Professional Dental Arts
- Custom Dental Ceramics
- Crown Me Dental Lab Inc
- Friendship Dental Lab
- Shaunns Dental Lab
- Triad Dental Studio
- Gibson Dental Designs Inc
- Killian Dental Ceramics Inc
- MicroDental Northwest Featuring
- Phoenix Dental Arts Inc
- New Image Dental Lab Inc
- The Master's Hand Dental Lab
- Centric Dental Lab
- Findlay Dental Lab Inc
- Thompson Suburban Dent Lab
- Natural Esthetics Inc
- Infinity DigiLab LLC
- Exclusive Dental Arts Inc
- Mizrachi Dental Lab Inc
- Aesthetic Reconstructions
- Precision Dental Arts
- CMR Dental Lab
- Noel Lab
- Masters Touch
- Utah Valley Dental Lab Inc
- Gardali Crown & Bridge
- Matrix Laboratories
- Micro Dental Laboratories
- FR Dental Lab
- Precision Esthetic Dental Lab
- Harmony Dental Lab
- Harrison-Neal Dental Lab
- Dental Masters Lab
- Pacific Dental Inc
- Alpha Dental Ceramics LLC
- Superior Dental Lab Inc
- Rochester Technical Group Inc
- Alexander Lande Dental Lab
- Kaylor Dental Lab
- Langer Dental Arts
- Williams Dental Lab
- Burbank Dental Lab
- Sheen Dental Laboratory
- Cerum Dental Supplies Ltd
- Progenic Dental Laboratory
- Classic Dental Lab Ltd
- Wiand Dental Lab
- California Dental Arts
- Image Dental Laboratory Ltd
- The Lab
- Complete Dental Ceramics Inc.
- Gordana Dental Art Studio
- Robertshaw Dental Lab
- Ontario Ceramics Dtl Lab
- Allstar Dental Lab Ltd
- Artistic Dental Ceramic Ltd
- Hallmark Dental Lab Ltd
- Quantum Dental Laboratory
- Laboratoire Dentaire Gati Inc
- Filipancic Dental Lab
- Burlington Dental Studio
- McCulley Dental Lab
- Perfect Impressions
- Westech Dtl Laboratories Ltd
- Powers Dental Lab Inc
- Carlton Dental Laboratories
- Centennial Dental Lab
- Fayette Dental Aesthetics
- Crown Dental Studio
- Teamwork Dental Ceramic Lab
- DW Dental Lab
- Smith Haist Dental Lab
- Anvarda Dental Services
- Harmony Ceramic Dental Lab,Ltd
- Lab Dentaire Daniel Morin
- Innovative Dental Lab Ltd
- Talisman Dental Lab
- ADL Dental Lab
- Mitech Dental Lab Inc
- Ocean Ceramics Ltd
- Schell Dental Ceramic Inc
- Hamilton Dental Lab
- Essex Dental Laboratory
- Lab Dentaire Roger Picard
- C & H Dental
- Silex Dental
- Nash Dental Lab
- Nilsson Dental Studio
- Apache Dental Lab
- Miller Dental Lab Inc
- D & R Dental Ceramic (2007) Ltd
- Ernesto's Dental Lab Inc
- Rocky Mountain Dental Lab
- Identity Laboratories Inc
- Suncoast Ceramic Studio
- Cosmetic Dental Arts
- Integra Dental Ceramic Studio
- Treasure Dental Studio Inc
- Lab Esthetik - Art Inc.
- Faustini Dental Arts
- Grasers Dental Ceramics
- Premier Dental Lab Inc
- B G Denture Clinic Ltd
- Stevenson Dental Technologies
- Professional Dental Studio Inc
- Impressions Dental Laboratory
- Cutting Edge Dental Lab Inc
- Southwest Florida Dental Arts
- Matrix Dental Lab
- Town & Country Dent (Dentaco
- Image Dental Arts
- Costa Cad Creations LLC
- M.Y. Dental Lab
- Patrick J ODonnell Dental
- Natural Aesthetics
- R and R Restorations Inc
- Alternative Dental Lab
- Becker Dental Lab
- R and R Dental Lab
- Certified Dental Ceramics Inc
- Dental Ceramics Inc
- Allied Dental Lab
- Gator Ceramics
- Midwest Dental Arts
- Wolf Dental Studio
- Utica Dental Laboratories
- LSK 121 Oral Prosthetics
- Khzam Dental Ceramics
- CRN Dental Technology
- One Dental Ceramics
- Synergy Dental Ceramics
- Premiere Dental Studio
- Trosvig Dental Lab
- Pro Tech Dental Lab
- Advance Implants Dental Lab Inc.
- Dental Harmony Dental Lab
- Ianto Dental Studio
- ArtiSmile Dental Laboratory
- Mark Dental Lab
- Oral Arts & Design
- Hunter Dental Lab
- Ace Dental Studio
- Vital Tec Dental Lab Inc
- Art & Technology Dental Studio
- Larry Brewer Dental Lab
- Toothmaker
- Advanced Dental Lab
- H O T Creative Dental Designs
- Master Tech Dental Studio
- Helm Dental Laboratory
- Precision Aesthetics
- Image Dental Lab
- Lakeland Dental Laboratory
- Image Dental Laboratory
- AMR Dental Ceramics
- Vision Dental Arts
- Unlimited Dental Laboratory
- Genesis Cosmetic Dental Ceramics
- Creative Dental
- Artdent Esthetic Design Lab
- Platinum Dental Lab
- Prolab Esthetics Inc
- The Dental Workshop
- Nu Smile Ceramics
- Can Dental Studio
- D and L Dental Studio LLC
- Martin Dental Studio
- Progressive Dental Lab
- Elite Dental Restorations
- Finishing Touch Dental Lab
- Creative Smiles
- Elite Dental Arts
- Takehiro Akiyoshi
- Sage Dental Design
- Shama Ceramics Dental Lab
- Finesse Dental Lab
- Eclipse Dental Inc
- Americare Dental Lab
- Newell Ceramic Art Inc
- Kappel Dental Arts
- Hi Tech Prosthetics
- Damerau Dental Creations
- Agnini Family Dental
- Robert Faulkner DDS
- World Class Dentistry
- Dental Care Of Scarsdale PLLC
- Hybridge Dental Laboratory, LLC
- Stewart Dental Laboratory
- Dresch Tolson Dental Labs
- Gray Dental Lab Inc
- Kass Dental Lab
- Crown Dental Studio
- Gnathodontics Ltd
- Ragle Dental Lab Inc
- Walker Dental Lab Inc
- Gemini Dental
- Peebles Prosthetics
- Associated Dentists
- Barksdale Dental Lab
- Sunbelt Crown and Bridge
- M.M.S Freytag Inc
- Jacksons Porcelain Lab
- Identical Dental Lab
- Star Dental Laboratory
- Weber Family Dentistry
- Alamo Prosthodontics
- CB Dental Lab LLC
- Dental Aesthetic Studio PC
- Smoke Bomb Hill Dental Clinic
- Marotta Dental Studio Inc
- Walter Reed National
- Naval Area Dental Center
- Bay View Dental Lab
- Knight Dental Group Inc
- Pittman Dental Laboratory
- Arrowhead Dental Lab Inc
- Tri County Dental Lab
- Changing Smiles
- Neimar Laboratories
- Ultra Tech Dental Lab
- Lebon Dental Services
- ArtTech Dental Lab
- Stevens Dental Prosthetics
- Epic Dental Studios
- Hyde Dental
- Anderson Dental Studio
- Cutshaw Dental Lab
- Na'pier Cosmetic Ltd Inc
- Picasso Dental Studios Inc.
- A Dent Restorations
- Creative Design
- Hiros Dental Studio LLC
- Esthetic Dental Laboratory
- Bryce Canyon Dental Studio
- Valenzuela Dental Lab
- Laboratoire Dentaire Summum Inc
- Edgar Jimenez Dental
- YM Lab Technologies
- Diablo Dental Arts Inc
- Oral Reconstruction & Cosmetic
- Unice Dental Art Ltd
- Laboratoire Dentaire Manningham Inc
- Unistar Dental
- Indent Studio
- DDS Lab LLC
- Pamela DiTomasso Dental Corporation
- Maroney Dental Lab
- Anderson Dental Studio
- Experience Dental Studio
- Leavitt and Scher Dental Group
- Lintec Dental Labs
- QSDL
- Larry Randy Buntyn DMD
- Prosthodontics & Implant Dentistry
- Yagi Designs
- Oak View Dental Lab
- Golden Dental Laboratory
- Matrix Full Service Dental Lab
- Christopher Williams DMD
- Midtex Dental Lab
- Cosmetic Dental Associates
- Misc Sales - House Account
- XL Dent Laboratories LLC
- Chic Dental Studio
- Arizona Esthetics
- Astro Dental Art Ltd
- Harrisons Dental Lab
- Doca Group
- Frontier Dental Lab
- Distinctive Dental Studio Inc
- H & R Dental Studio
- Aesthetic Dental Art Studio
- Obdulla Rondon DDS
- Gemini Ceramics
- US Dental
- Exceptional Dental Arts
- Legacy Dental Arts
- Joseph Mulloy Dental Lab
- 3D Dental Lab
- Renaissance Dental Lab
- KH Dental Lab
- Rite Bite Denture Clinic
- Patriot Dental Laboratory Inc
- Roberta's Crown & Bridge
- Valley Dental Arts
- Bio Aesthetics
- M&D Dental Arts
- Innovative Dental Technologies
- Cosmetic Advantage Inc
- Innovative Dental Laboratory
- Evolution Studio Dental Ceramics
- Summit Dental Lab
- Capture Dental Arts
- Sowle Ceramics
- Apex Dental Lab Inc
- Uni Dental Studio
- Mascola Esthetics Dental Lab
- South Park Dental Group
- Qualident Dental Lab LLC
- Synergy Ceramics
- Dentissimo Lab Dent
- Apex Dental Milling
- Y M Dental Lab
- Esthetic Dental Designs
- Bon Dental Laboratory Ltd
- Spodak Dental Group
- Triangle Dental Lab
- Evolution Dental Science LLC
- Today's Dental Lab LLC
- Barclay Dental Lab
- Cosmetic Dental Artistry
- Alberta Denture Clinic Inc
- Laboratoire Dentaire Champlain
- SouthDown Dental
- Apa Rosenthal Group
- Innovative Aesthetics Dental Lab
- Cypress Dental Lab
- Louisiana Dental Implant Lab
- Precious Art Dental Lab
- RJ Dental Creations
- McDonald ACH Pmt 22
- Grandpas Dental Care
- Bobby Clark CDT
- IK Dental Studio
- Atlantic Aesthetics
- Premier Dental Arts Studio
- Digital Dental Leaders
- ARM Dental Lab
- Tru Crown
- Biggs AFLD Dental Clinic #2
- Deane Hill Dental Lab
- FDL Dental Lab
- Cypress Dental Studio
- Whitley Dental Laboratory
- E-V Dental Lab Inc
- Whitecap Institute
- All Dental Inc
- Diamond Head Dental Lab LLC
- Power Dental Studio
- West Coast Dental Milling Centre
- Fort Jackson Dental Activity
- Precision Dental Lab
- D Baird Dental Lab
- Macomb Dental Ceramics
- Toothking Dental Studio Ltd.
- Monz Dental Lab Inc
- Gono Dental Lab
- Simpatico Dental Studio
- James B Dental Studio
- Advantage Dental Design Lab
- Summit Dental Lab
- Tuxedo Park Dental Services
- Abby Dental Studio Inc
- Dental Story Lab
- Dentaklix
- JDM Dental Studio
- Rocky Mountain Dental Ceramics Inc
- JR Dental Lab
- Goddard Dental Lab
- Master Dental Solution Ltd.
- Express Dental Lab LLC
- Precision Dental Lab
- Picasso Dental Ceramics LLC
- Chattanooga Dental Technologies
- Digital Dent Prost
- 3D Dental Laboratories
- BioDental Sciences LLC
- JDL Dental
- Q-Precision Dental Lab Ltd
- Midwest Dental Arts - Melbourne
- SK Dental Ceramic Studio Inc
- Parkway Dental Lab LLC
- Modern Dental Lab USA
- New Century Dental Services
- Clifton L Harris DDS
- New Smile Prosthodontics
- Arch Works Dental Lab Corp
- Vivid Smiles Dental Lab
- Eric M Donaty DMD
- Camp Pendleton
- Ceramic Artisan Dental Lab
- Montana Dental Lab
- Qualtek Ceramic Dental Lab Ltd
- Precision Dental Innovations
- SDL Swiss Dental Lab
- OSMAR Trading
- Naisbitt Family Dentistry
- Allegra Dental
- Albanese Dental Lab
- 123 Dentist o/a BC Digital Dental
- Esthetics by Design LLC
- 3Dent Laboratory
- Saki Lab Dental Esthetics LLC
- Identity Dental Studio
- Laney Dental Arts
- Garden State Dental Design
- Spokane Dental Art
- Camcube Inc.
- Sea Island Dentistry PC
- Peninsula Cosmetic Implant Dtl Lab
- Crystal Crown Dental Milling Corp
- Laboratoire Dentaire Ozak
- Shine Smile Dental Lab
- Innovation Dental Studio Ltd
- CAD Ceramics
- Inter-Pro Dental Lab Ltd
- Kinetic Dental Aesthetics
- USA Dental Lab & Milling
- Digital Milling LLC
- Pacific Northwest Prosthodontic Lab
- CreoDental Prosthetics
- Mid Cape Dental Laboratory II Inc.
- Mint Dentistry
- Z Dental Studio
- High Ridge Dental
- Prestige Dental Arts
- Haus Milling Center
- Cerall Dental Laboratory
- Natural Design Dental Lab
- CDS Dental Studio
- Trans Blue Dental Lab
- Archibald Esthetics LLC
- Craftmill Dental Laboratory
- Engage Dental Studio
- Global Ceramics Dental Lab Ltd.
- Whiteford Dental Laboratory
- Core 3D Centres LP
- Azar Cana Holdings Inc
- Great Crowns & Smiles Dental Lab
- XirCon Dental Designers
- Harshit Aggarwal DDS
- Lucent Design Digital
- Urban Dental Design
- Dentcorp
- Downtown Dental Lab
- Americana Dental Inc
- Vista Dental Lab Studio
- Jewel Dental Lab
- 38 Smiles Dental Laboratory
- CUSP Ceramics
- Three Peaks Dental Milling Centre
- Hanna Dental Implant Center
- Hollywood Perfect Smiles
- Aesthetic Milling Systems
- Lab Angeles
- Advanced Oral Surgery & Dental
- STL Digital Dental Lab
- MicroDental Laboratory
- KB Dental Laboratory Ltd
- Lakeshore Dental Prosthetics LLC
- K&K Dental Studio
- Ata Dental Kissimmee
- Dentination Lab
- Barron Dental Laboratories
- Crown Dental Lab of
- Success Dental Laboratory Ltd
- Integrity Dental Services
- Compass Dental Arts
- Dental Designs & Solutions LLC
- 360 Digilab LLC
- Pacific Dental Arts, Inc
- Peak Dental Technologies
- 818 Dental Lab
- Design Dental Studios LLC
- The Dental Laboratory Inc
- Innovare Dental
- A.D Dental Lab
- Smile Now
- Hancock Dental Arts
- Pan Am Dental LLC
- Magellan Dental Arts
- H & A Ceramic Arts Ltd
- Spectrum-Killian
- Esthetic Digital Dental Lab
- Propel Digital Dental Lab
- Nova Denture and Implant Centre Inc
- Full Arch Dental Laboratory
- A Shade Above Dental Lab LLC
- Air Capital Dental Lab
- Middletown Dental Associates
- Watts Dental - St Pete
- Attention 2 Detail Dental Lab

Effects of Material Selection, Light Curing, and Polishing on the Color Stability of Direct Composite Resins

A Photographic Study

Taiseer Sulaiman, DDS, PhD

Abstract

A photographic series was undertaken to illustrate the effects of material selection, light curing, and finishing and polishing on the color stability and translucency of composite resin veneers. To prepare the samples, typodont teeth were veneered with composite resin and then finished and polished in four groups using progressively sophisticated polishing procedures. After immersion in hot coffee (131°F) for 7 days, all samples were photographed for comparison. In addition, samples that underwent the full finishing procedure were compared as follows: cured versus under cured restorations, nanofilled composite versus microhybrid restorations, and composite resin versus natural tooth samples.

Key Words: nanofilled, composite resin, color stability, aging, finishing and polishing

"Coffee is known to cause significant staining of composite resins, and its temperature may act to accelerate the degree and severity of both the… extrinsic and intrinsic staining."

Introduction

Today more than ever, patients expect highly esthetic restorative dentistry. Although recent advances in technology have improved the reliability of restorative materials, some clinicians still have concerns about the color stability of composite resin restorations, especially since composite resin tends to become less translucent if it becomes stained, which degrades the esthetics of the restoration even further.[1,2]

Studies show that red wine, coffee, tea, juice, cola, and deionized water can cause staining of resin-based materials.[3-6] In previous research, the most severe discoloration was seen in study groups immersed in coffee for 14 days at 131°F. Coffee is known to cause significant staining of composite resins, and its temperature may act to accelerate the degree and severity of both the extrinsic and intrinsic staining because of the effect it has on the resin/photoinitiator systems.[7]

Study

Materials and Methods

For this photographic series, typodont teeth were veneered with composite resin and compared after artificial aging to demonstrate that color stability is influenced by several factors, including material selection, light-curing technique, and finishing and polishing protocols. A common method of evaluating color stability was employed whereby samples were immersed in an aging solution (in this case, coffee at 131°F).[8]

The composite resin samples varied by material type, light-curing technique, and finishing and polishing methodology. A nanofilled composite (Filtek Supreme Ultra Universal Restorative, shade A2, 3M; St. Paul, MN) and a microhybrid composite resin (Gradia Direct, shade A2, GC America; Alsip, IL) were used to veneer the facial surface of each tooth. Light curing was accomplished using a 1470 mW/cm2 visible light-curing unit with a 10-mm light guide (Elipar DeepCure-S LED Curing Light, 3M).

The typodont teeth veneered with composite resin were immersed in hot coffee (131°F) for 7 days. This staining protocol was selected because of its ability to yield fast and dramatic results to demonstrate that material selection, light curing, and finishing and polishing techniques have the potential to dramatically increase or decrease the color stability of composite resins. This photographic series compared a nanofilled composite resin versus a microhybrid composite resin, a fully cured versus under cured nanofilled composite resin, and a nanofilled composite resin versus a natural tooth. Removal of extrinsic stains with polishing points (Jiffy Points, Ultradent, South Jordan, UT) and a diamond polishing paste and brush was also attempted. The groups were as follows:

- Group 1: carbide finishing bur only
- Group 2: carbide bur and coarse and medium discs
- Group 3: carbide bur, coarse and medium discs, and polishing points
- Group 4: carbide bur, coarse and medium discs, polishing points, and polishing with a diamond paste and brush.

Specimens in Group 4 also underwent the following comparisons:

- 4a: cured versus under cured nanofilled composite resin
- 4b: nanofilled composite versus microhybrid composite resin
- 4c: before versus after stain removal
- 4d: nanofilled composite resin versus natural tooth.

Figure 1: Nanofilled composite resin versus microhybrid composite resin before (left images) and after (right images) a 7-day immersion in hot coffee.

Results

Effect of composite resin type: Figure 1 shows the nanofilled composite resin before and after 7 days of coffee immersion and the microhybrid composite resin subjected to the same conditions. After immersion, the microhybrid composite resin was darker in color and exhibited dots and streaks that seemed to correlate with the larger filler size within the composite resin. The nanofilled composite resin was less stained, was more uniform in color, and exhibited stable translucency.

Effect of optimum curing on color stability: Figure 2 shows the difference between a fully finished and properly cured nanofilled composite resin, achieved by curing the facial surface for 30 seconds and with close approximation, after 7 days of coffee immersion, and a fully finished but under cured nanofilled composite. Under curing was achieved by curing the facial surface for 10 seconds at 3 to 5 mm from the surface, a common clinical practice when proper light curing is not taken into the highest consideration during the composite resin curing process. It is clear from the photographic results that under cured composite resin takes on more stain than the same material that has been properly cured. Ensuring a proper curing technique and regularly testing the curing light for adequate output are both critical for ensuring long-lasting, color-stable composite resin restorations.

Effect of optimal finishing and polishing on color stability: Every dentist has a preferred finishing and polishing technique and related instruments. A sequential and thorough finishing and polishing protocol is critical to the color stability of composite resins.

Clinical Tips

Beginner

- Before using composite resin, be aware of its type and properties.
- The smaller the filler size, the better the composite resin's color stability and polishability.
- Check the efficiency of the curing light and ensure that the composite is sufficiently cured.

Intermediate

- Skipping steps in the finishing and polishing procedure can affect the appearance and color stability of the composite resin.
- The heat element in dark-colored beverages is detrimental to the color stability of composite resins.

Advanced

- Given efficient and sufficient light curing, as well as a thorough finishing and polishing procedure, nanofilled composite resins are the most color-stable composite resins.
- Extrinsically stained composite resin may be successfully refinished and repolished, removing most of the extrinsic stain and discoloration.

Figure 2: Properly cured composite resin (left) versus under cured composite resin (right) after a 7-day immersion in hot coffee.

Figure 3: Composite resin finished with carbide finishing bur. Before (left) and after (right) a 7-day immersion in hot coffee.

Figure 4: Composite resin finished with a carbide finishing bur and coarse and medium finishing discs. Before (left) and after (right) a 7-day immersion in hot coffee.

Figure 5: Composite resin finished with a carbide finishing bur, coarse and medium discs, and polishing points. Before (left) and after (right) a 7-day immersion in hot coffee.

Figure 6: Fully finished and polished composite resin (carbide finishing bur, coarse and medium finishing discs, polishing points, and diamond polishing paste and brush). Before (left) and after (right) a 7-day coffee immersion.

For this series, a four-step finishing and polishing sequence was completed, and the composite resin veneers were soaked in hot coffee for 7 days after each step. The images in this article present the results after using the following:

- a carbide bur
- finishing discs
- polishing points
- diamond polishing paste and brush.

Figure 3 shows a composite resin veneer after finishing with only a carbide bur and the same composite veneer after 7 days of immersion in hot coffee. The rough bur marks acquired significant amounts of stain.

Figure 4 shows a composite resin veneer after being finished with a carbide finishing bur and coarse and medium finishing discs. Following a 7-day coffee immersion, significant staining still occurred, especially where the surface was not yet completely smooth.

Figure 5 shows a composite resin veneer after being finished with a carbide bur, coarse and medium finishing discs, and polishing points, as well as the restoration after 7-day coffee immersion. The results were better, but there was still significant staining, especially in areas that were inadequately polished.

Figure 6 presents a composite resin veneer after undergoing the complete finishing and polishing sequence (carbide bur, medium and coarse finishing discs, polishing points, and diamond polishing paste and brush). The composite resin veneer is also shown after a 7-day coffee immersion. The immense improvement that the full, sequential finishing and polishing protocol makes on long-term color stability is very clear.

Repolishing of a surface to remove stains: The question is: Can the surface of a restoration or natural tooth be polished to remove stains? **Figure 7** shows the entire sequence of composite resin veneers after 7 days of immersion in hot coffee, and the same groups refinished and polished with polishing points and a diamond polishing paste.

In a fully cured and finished composite resin veneer that has been immersed in coffee for 7 days, some stain can be removed when polishing the tooth. Even more dramatic is the difference in a natural tooth that has been immersed in coffee for 7 days and then polished. It is striking how similar the staining characteristics of the nanofilled composite resin are when compared to the natural tooth **(Fig 8)**.

Summary

When exposed to staining media such as grape juice or coffee, composite resin restorations may stain, which can influence the amount of light penetrating through the restoration and decrease the translucency of the final restoration. The nanofilled composite resin in this study was the most resistant to color change and had stable translucency after aging. Under cured composite resins not only are less durable than fully cured composite resins, but they also acquire significantly more stain. The importance of a thorough, multi-step finishing and polishing protocol was illustrated photographically, since the smoother the composite surface, the less it stained. Finally, it is possible to remove some extrinsic staining on both composite resins and natural teeth.

Figure 7: (top): Four composite resin veneers with increasingly finished and polished surfaces, achieved with (left to right): a carbide bur alone; carbide bur and medium and coarse finishing discs; carbide bur, finishing discs, and polishing points; carbide bur, finishing discs, polishing points, and a diamond polishing paste and brush) after 7 days of immersion in hot coffee; and an under cured composite resin veneer after 7 days of immersion in hot coffee. (bottom, left to right): These veneers were photographed after refinishing and polishing of each group with polishing points and diamond polishing paste and brush following coffee immersion.

Figure 8: The effect of repolishing a nanofilled composite resin veneer (top) and a natural tooth (bottom) after a 7-day immersion in hot coffee.

References

1. Sulaiman TA, Rodgers B, Suliman AA, Johnston WM. Color and translucency stability of contemporary resin-based restorative materials. J Esthet Restor Dent. 2021 Sep;33(6):899-905. Epub 2020 Aug 14.

2. Salas M, Lucena C, Herera LJ, Yebra A, Della Bona A, Pérez MM. Translucency thresholds for dental materials. Dent Mater. 2018 Aug;34(8):1168-74.

3. Ren YF, Feng L, Serban D, Malmstrom HS. Effects of common beverage colorants on color stability of dental composite resins: the utility of a thermocycling stain challenge model in vitro. J Dent. 2012 Jul;40 Suppl 1:e48-56.

4. Dos Santos Domingos PA, Garcia PP, de Oliveira AL, Palma-Dibb RG. Composite resin color stability: influence of light sources and immersion media. J Appl Oral Sci. 2011 May-Jun;19(3):204-11.

5. Ertaş E, Güler AU, Yücel AC, Köprülü H, Güler E. Color stability of resin composites after immersion in different drinks. Dent Mater J. 2006 Jun;25(2):371-6.

6. Dos Santos PA, Garcia PP, De Oliveira AL, Chinelatti MA, Palma-Dibb RG. Chemical and morphological features of dental composite resin: influence of light curing units and immersion media. Microsc Res Tech. 2010 Mar;73(3):176-81.

7. Souza ROA, Ozcan M, Michida SMA, de Melo RM, Pavanelli CA, Bottino MA, Soares LES, Martin AA. Conversion degree of indirect resin composites and effect of thermocycling on their physical properties. J Prosthodont. 2010 Apr;19(3):218-25.

8. Prodan DA, Gasparik C, Mada DC, Miclăuş V, Băciut M, Dudea D. Influence of opacity on the color stability of a nanocomposite. Clin Oral Investig. 2015 May;19(4):867-75. **jCD**

Dr. Sulaiman is an assistant professor, Division of Comprehensive Oral Health, The University of North Carolina Adams School of Dentistry, in Chapel Hill, North Carolina.

Disclosure: The author creates educational content for and has received research grants from 3M. He did not receive any financial remuneration for writing this article.

Gingiva-Colored Restorative Material *as a Substitute for Onlay-Inlay Grafting Following Trauma*

Phelan R. Thomas, DDS, AAACD

Abstract

There are a limited number of options for restoring a diminished partially edentulous ridge, especially when the treatment site has sustained severe trauma. This article will demonstrate that when traditional hard/soft tissue treatment possibilities are not viable, alternative restorative choices utilizing high-strength gingiva-colored crystalline ceramics can result in a highly esthetic and durable fixed partial denture.

Key Words: onlay-inlay grafting, Class III ridge defect, hybrid implant bridge, gingival color guide, graftless

Learning Objectives

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

1. Choose the proper ceramic materials and shades for each individual patient's teeth and tissues.
2. Understand options for restoring a partially edentulous ridge that has excessive bone and tissue loss.
3. Develop a treatment plan for the compromised edentulous ridge using gingival- and tooth-colored restorative materials.

Disclosure: The author did not report any disclosures.

CE CREDIT

Introduction

This patient experienced a traumatic dental injury in 1999, in which teeth #8, #9, and #11 were avulsed **(Fig 1)**. In 2002, multiple bone and soft tissue grafts were performed prior to the placement of dental implants to replace these three teeth. Because the presence of adequate bone is critical to enable the placement of implants, clinicians planning the rehabilitation of an edentulous patient must understand the challenges of progressive bone resorption.[1] The patient had a three-implant-supported hybrid bridge with pink porcelain placed during that time **(Fig 2)**. She presented for treatment desiring a more esthetic implant bridge with a more pleasing adjacent crown and veneers.

Discussion

Classification of Ridge Defects

Periapical and periodontal pathology, trauma, and healing potentialities of the body are important factors in determining the future design of the pontic recipient site.[2] Many surgical techniques have been devised for restoring the contour of edentulous ridges that have been compromised. Allen has classified edentulous ridge defects as A, B, or C, with type C being the most difficult to augment adequately.[3] The ridge deformity may further be described by assessing the depth of the defect relative to the adjacent ridge, with a severe deformity being greater than 6 mm.[3] Partially edentulous patients seeking fixed restoration of missing teeth often present with an insufficiency of the hard and soft tissues required to fulfill their desire for an implant-supported prosthesis. Three-dimensional ridge reconstruction can correct this insufficiency and facilitate implant-based restorative dentistry. This case consisted of a type C combined loss ridge contour in both apicocoronal and buccolingual dimensions.

Treatment Limitations and Challenges

The patient was subsequently referred to a local periodontist who felt that the additional ridge augmentation would not be a viable option due to the significant loss of hard and soft tissue. Often, bone and soft tissue surgical procedures fall short of achieving a natural-looking esthetic result. In some cases, even after surgical procedures, the results are unpredictable and unsatisfactory in terms of esthetics and function. These limitations may necessitate the use of gingiva-colored "pink" restorative materials to achieve the desired esthetic outcome.[4] In some situations, a gingiva-colored prosthesis can be one of the treatment options to restore the hard and soft tissue defect.[5] The artificial gingival restoration planned for this case aimed to provide a good integration between natural and artificial tissues.

In addition to papillae, a sufficient volume of supporting hard and soft tissues is required to achieve an ideal esthetic outcome. Surgical procedures may not always restore these lost tissues and offer prosthetic solutions. In diagnosis and treatment planning, a prosthesis with artificial gingiva may be considered, as it potentially can provide a more favorable result while requiring minimal or no surgical intervention.[6]

The ultimate physical and anatomic form of the pontic's recipient site results directly from the periodontal and dental state prior to the extraction—or accidental loss—of teeth.[7] Graftless solutions for the defective maxillary alveolar ridge are a significant challenge, to say the least. The elimination of air escape and phonetic problems arising from the earlier designs of implant-supported fixed prostheses with denture teeth and pink acrylic, as well as the visibility of the residual ridge crest, have been noted.[8]

If only tooth-colored ceramics are employed, the teeth can look very long and narrow when they fill the full length from the reabsorbed ridge to the proper incisal position. To avoid

Figure 1: Teeth #8, #9, and #11 were avulsed.

Figure 2: Full-face preoperative image of hybrid implant bridge.

Figure 3: Improved ceramic materials in concert with an accurate shading system will render a more esthetic result.

these problems, gingiva-colored porcelain may be used to refill the space formerly occupied by the patient's natural gingiva.[9]

Advances in Ceramics

Challenged by the patient's desire for a "better-looking bridge" and the difficulties of meeting her expectations, treatment planning was paramount. In the 16 years since her previous hybrid implant bridge was placed, there have been tremendous advances in ceramic dental materials. In this case, high-strength CL-IIIb crystalline ceramics were utilized (In-Ceram, VITA; Yorba Linda, CA). Crystalline ceramics are classified from Class 1 (CL-I) to Class IV (CL-IV). CL-IIIb ceramics were initially alumina-based materials, but now are zirconia-based. Zirconia can be used when significant tooth structure is missing, when there is a high risk for flexure and stress, and in cases that require posterior full crowns or fixed partial dentures.[10]

The utilization of these newer ceramic materials in combination with the use of a specialized shade guide (Oral Prosthetics Chairside Shade Guide, LSK121; Naperville, IL) **(Fig 3)** combine to make gingival architecture and color results visually and clinically undetectable from the patient's natural gingival tissue. Also, an adjunct such as the Munsell Color Order System is recommended as the system of choice for dentists who wish to gain a working knowledge of color.[11] The planned "artificial" gingival restoration would provide an optimum integration between natural and synthetic soft tissue.

Case Description

The initial exam revealed an existing hybrid implant bridge with negative tooth morphology, unsatisfactory proportions, and low-value teeth. The gingiva-colored acrylic was an unsatisfactory match with the surrounding gingival tissue and clinically unacceptable **(Fig 4)**.

The patient desired an overall improvement in the esthetics of her bridge. She especially did not like the gray "show-through" associated with the existing pink porcelain, nor the shapes and color of her teeth **(Fig 5)**. Three implants (two 3.75 × 13 mm and one 3.75 × 15 mm, EsthetiCone, Nobel Biocare; Yorba Linda, CA) had been placed in 2002 to replace the traumatically avulsed teeth #8, #9, and #11 respectively **(Fig 6)**.

Treatment Planning

After recording height and width measurements of preoperative natural and prosthetic teeth #6-#11, a graphic smile design **(Fig 7)** was created to plan for the precise development and enhancement of the patient's new implant bridge.

Tips for Clinicians

Beginner

- Realize that listening is the most underrated component of a comprehensive smile design/plan. Adherence to the patient's initial desires will help to ensure a more mutually favorable esthetic result.
- Know that the shape of a patient's face is a reliable place to begin when trying to establish the correct tooth morphology for the case.

Intermediate

- Recognize that the rules of golden proportion, the golden mean, and other smile evaluation techniques are imperative for formulating a blueprint for correcting challenging smiles.
- Know that a broad understanding of dental materials, soft tissue, tooth and ancillary hard tissue and support surfaces, and sound procedural techniques all help to produce an appealing and long-lasting clinical outcome.
- Understand the traditional treatment options available to restore large tissue defects, as well as nontraditional methods and dental materials that can be employed when soft and hard tissue assessments challenge the clinical norms.

Advanced

- Recognize that dental laboratories are not the same; each has a particular strength.
  - Some are better with fluorescence, some excel with thin laminate production, and some may be superior in terms of colorimetry and metamerism (the latter specialty was key when it came to producing the gingival effects and color for this case).
  - It is important to maintain a comprehensive list of laboratories along with details regarding their areas of expertise - no laboratory should be a "one stop" option for all dental restorations.
  - Skilled and experienced clinicians should have the knowledge and training to enable them to choose the best dental laboratory for each particular clinical situation.
- Multidisciplinary dentistry involves the utilization and convergence of the skills of the primary clinician, the specialist, and the laboratory technician. When a specialist is not part of the equation, it is imperative that the primary clinician have the experience and most current knowledge to still be able to establish a platform for success.

Figure 4: Hybrid implant bridge showing undesirable gingival color and tooth morphology.

Figure 5: Previous bridge displaying unsatisfactory esthetics.

Figure 6: Previously placed implant abutments for #8, #9, and #11.

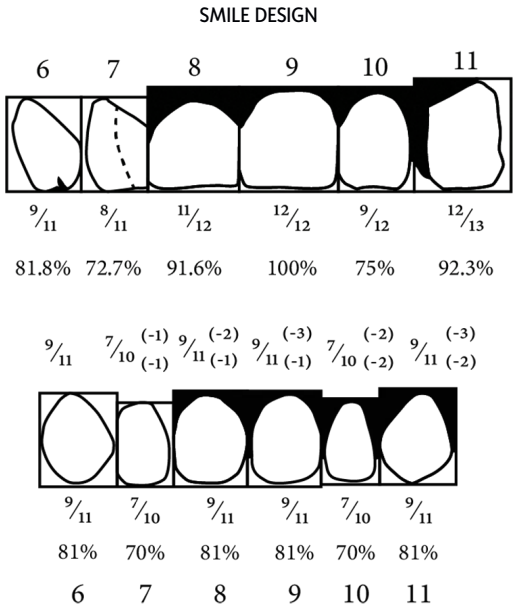


Figure 7: Graphic smile design created by the clinician.

The catastrophic loss of #8, #9, and #11 and the unesthetic soft tissue complex made the creation of an esthetic restoration with gingival architecture that harmonizes with the adjacent dentition a formidable challenge. The health and appearance of gingival tissues are of paramount importance to a smile's overall esthetics. An esthetic smile includes a harmonious combination of pink and white (i.e., pink gingiva and white tooth structure), wherein each component complements the other in terms of color, texture, and shape.[12] In the normal extraction of a failing tooth or teeth, five diagnostic keys are generally considered to more accurately predict the peri-implant esthetic outcome: relative tooth position, form of the periodontium, biotype of the periodontium, tooth shape, and position of the osseous crest.

In this case, the predictable unfavorable result due to the loss of the diagnostic keys acting dependently can have a definite influence on resorption, loss of biological width, loss of proximal gingival architecture, and the possible formation of black triangles. It also caused unfavorable new positions of interdental papillae, which were all due to the unintentional loss of teeth.[13]

Treatment

Smile design: A freehand smile design was implemented to plan for the precise replacement and enhancement of the patient's new implant prosthesis. Ordinarily, smile designs should involve the evaluation of certain elements in a specific sequence, beginning with the observation of the facial elements. Tooth size and position, lip length, and lip mobility significantly affect maxillary tooth display both statically and

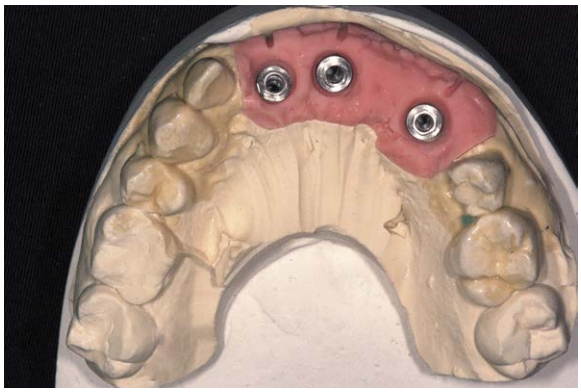


Figure 8: Soft tissue model and implant housings.

dynamically.[14] A study at the UCLA Center for Esthetic Dentistry determined that the optimal width-to-length ratio for the maxillary central zone was a width that was 75% to 85% of the length. Smiles with these values were most often deemed "esthetic to highly esthetic." The most esthetically pleasing ratio was 80%.[15] Most clinicians and technicians would agree that the ideal restorative option for dental implants is an esthetic, screw-retained solution directly restored onto the implants.

Impression and try-in: An implant-level physical impression utilizing polyvinyl siloxane was used to record the impression copings associated with #8, #9, and #11, the soft tissue platform, veneer preparations for #6 and #7, as well as the full-coverage crown for #12. The laboratory team then fabricated a soft tissue model **(Fig 8)** and a wax-supported try-in tooth on an acrylic base. The clinician utilized this to determine patient expectations and establish the buccolingual corridors and incisal edge position. The ceramist also would use the try-in as a study cast for tooth position, shape, and shade. In some patients, pink porcelain that will mimic the soft tissue must be applied to create natural emergence and to control the coronal length of the teeth. Pink tissue was added by the laboratory team to compensate for tissue deficiencies.[16] Matching the pink porcelain of the hybrid implant bridge to the patient's attached gingiva was vital.[17] The shade chosen (STC-4 Brownish Pink, LSK121) was ideal for achieving the most accurate gingival–porcelain color interface.

Seating: Note the contrast between the patient's original hybrid bridge and her new hybrid bridge **(Fig 9)**. Before seating the new implant bridge, the three previously placed abutment screws were replaced with new ones torqued to 35 Ncm, and the access channels were sealed with composite resin **(Fig 10)**. The anterior veneers (#6 and #7) and the full-coverage crown (#12) were cleaned with an antibacterial slurry (Concepsis Scrub, Ultradent; South Jordan, UT), acid-etched (Etch-37 Bisco; Schaumburg, IL), bonded with a single-component adhesive

Tips for Laboratory Technicians

Beginner

- Have an open, reciprocal dialog such that both parties, clinician and laboratory technician, can feel free to "agree to disagree" about issues (e.g., dental material choices, whether strength/longevity might be a future problem, even whether the cervical chroma value for a particular restoration is too low). Mutually agreed-upon objectivity facilitates treatment success.

Intermediate

- Selecting the proper glass-ceramics for this case to simulate and mimic the natural dentition, as well as choosing a gingiva-colored element to mask a sizable alveolar defect and seamlessly blend that tissue substitute with the patient's natural gingival hue, required a significant and skilled effort from the dental laboratory technician.

Advanced

- The congruence of tooth and tissue color and form, when the restoration of a large tissue defect warrants such a combination, is like yin and yang. A highly skilled laboratory technician can create such complementary components so that a clinically excellent outcome is not only esthetically apparent but long-lasting as well.

"If only tooth-colored ceramics are employed, the teeth can look very long and narrow when they fill the full length from the reabsorbed ridge to the proper incisal position."

Figure 9: Preoperative hybrid bridge versus postoperative hybrid bridge.

Figure 10: Palatal access of hybrid implant bridge.

Figure 11: Much-improved tooth morphology, gingival architecture, and color blend.

Figure 12: Thanks to advances in dental technology and collaboration between the clinician and laboratory technician, the patient's outdated dentistry was replaced by a more functional and esthetically pleasing outcome.

(Opti-Bond Solo Plus, Kerr Dental; Brea, CA), and then luted with clear resin cement (Insure Lite Clear, Cosmedent; Chicago, IL). The patient's occlusion and function were within normal limits **(Fig 11)**.

Material options: It was immensely satisfying to replace the patient's outdated dentistry with more modern dental materials and employ current treatment modalities. Short of traditional hard and soft tissue grafts, the two predominant options for the hybrid bridge were alumina or zirconia. Metal-ceramics (e.g., gold) was another option, but the esthetics after layering with a suitable ceramic would not approach the desirable outcome of the aforementioned options.

Digital workflow: The traditional digital workflow modalities available today are myriad. Computer-aided design/computer-aided manufacturing technology for the supportive "prosthetic" scaffolding, as well as the individual tooth structures (crown and veneers), was but a small component of this digital workflow plan. While the "new tooth forms" were a significant improvement over the patient's original prosthesis, the use of intraoral scanners, cone beam imaging, and digital printing, for example, was not warranted for the outcome of this case.

At-home hygiene: Because of its proximity to the prosthesis, the tissue or intaglio surface required careful consideration during the treatment-planning phase. The patient was instructed to use oral irrigators as opposed to string floss to keep her bridge clean. The prosthesis' nearness to the tissue surface would require sustained deftness to avoid tissue trauma. Normal toothbrushing methods were suggested for both the immediate labial and lingual surfaces.

Summary

Traditionally, a fixed bridge—commonly known as a *fixed partial denture*—replaces a missing tooth or teeth.[18] When hard and soft tissues deviate from the norm, a more prudent diagnosis and treatment plan are warranted. When a surgical option involving a traditional onlay-inlay graft is not a viable alternative, a close collaboration between the laboratory technician and the dentist is paramount for helping to ensure a better treatment outcome **(Fig 12)**. Restoration of the defective environment in an esthetic zone is always a challenge. Guided bone regeneration to establish bony contours and restore bony defects for an effective bone reconstruction is usually the most traditional and prudent methodology for the ideal treatment of complex vertical and buccolingual bony defects.[19] Where bone loss and gingival recession are severe, a gingiva-colored prosthesis can be one of the best treatment options to restore the hard and soft tissue defects.[20]

Acknowledgments

The author thanks Michael Henrichsen (LSK121; Naperville, IL) for fabricating the all-ceramic restorations and implant prosthesis used in this case. Thanks also go to sales consultant Joey Jones (Nobel Biocare; Ankeny, IA). Additional thanks are extended to Ben Easter (Ben Easter Photography; Des Moines, IA) for his help with the images in this article.

References

1. Geminiani A. Treatment planning guidelines and prosthetic options for the edentulous patient. Dental Economics. 2016 Aug 25;106(8):81-6.
2. Rufenacht CR. Fundamentals of Esthetics. Hanover Park (IL): Quintessence Pub.; 1990. p. 263.
3. Chiche, G. Esthetics of anterior fixed prosthodontics. Hanover Park (IL): Quintessence Pub.; 1994. p. 188-93.
4. Coachman C, Salama M, Garber D, Calamita M, Salama H, Cabral G. Prosthetic gingival reconstruction. Part 1: introduction to artificial gingiva as an alternative therapy. Int J Periodontics Restorative Dent. 2009 Oct;29(5):471-7.
5. Sonune SJ, Kumar S, Jadhav MS, Martande S. Gingival-colored porcelain: a clinical report of an esthetic-prosthetic paradigm. Int J Appl Basic Med Res. 2017 Oct-Dec;7(4):275-7.
6. Kolakarnprasert N, Trushkowsky R, Oquendo Parilli AC, Alharty F, Pizzi P. Effective utilization of pink and white esthetics in smile design: case report. Compend Contin Educ Dent. 2020 Jan;41(1):34-41.
7. Morr T. Achieving optimal esthetic outcome with previously placed, compromised implants. Compend Contin Educ Dent. 2019 Jul/Aug;40(7):454-65.
8. Babbush C, Hahn J, Krauser J, Rosenlicht J. Dental implants: the art and science. Second ed. Philadelphia: Saunders/Elsevier; 2011. p. 251-9.
9. Roberts M. Accreditation review: anterior bridge replacement. J Cosmetic Dent. 1997 Spring;13(1):14-8.
10. McLaren EA, Figueira J. Updating classifications of ceramic dental materials: a guide to material selection. Compend Contin Educ Dent. 2015 Jun;36(6):400-5.
11. Sproull RC. Color matching in dentistry. Part 1. The three-dimensional nature of color. J Prosthet Dent. 2001 Nov;86(5):453-7.
12. Milnar F. Clinical tips for placing direct pink prosthetics using gingiva-colored composites. J Cosmetic Dent. 2018 Winter;33(4):52-7.
13. Kois JC. Predictable single-tooth peri-implant esthetics. Five diagnostic keys. Compend Contin Educ Dent. 2004 Nov;25(11):985-6.
14. Ward DH. Proportional smile design using the recurring esthetic dental (red) proportion. Dent Clin North Am. 2001 Jan;45(1):143-54.
15. McLaren EA, Cao PT. Smile analysis and esthetic design in the smile zone. Inside Dent. 2009 Jul/Aug;5(7):46-8.
16. Rensburg CJ. Screw retained: the future of implant dentistry. Dent. Today. 2018 Aug.;37(8):44-52.
17. Rosenberg S, Da Silva J, Ishikawa-Nagai S. A comprehensive approach to color matching in the esthetic zone. J Cosmetic Dent. 2019 Summer;35(2):50-7.
18. Shillingburg HT Jr., Hobo S, Whitsett LD. Fundamentals of fixed prosthodontics. Hanover Park (IL): Quintessence Pub.; 1978. p. 30-45.
19. Sonune SJ, Kumar S, Jadhav MS, Martande S. Gingiva-colored porcelain: a clinical report of an esthetic prosthetic paradigm. Int J Appl BSIC Med Res. 2017 Oct-Dec; 7(4):275-7.
20. Resnik RR. Guided bone regeneration: 8 steps to successful ridge augmentation. Chairside Magazine. 2020:15(2);31-9. **jCD**

Dr. Thomas is an Accredited Member of the AACD and maintains a private practice in West Des Moines, Iowa. He can be reached at thomas.phelan@mchsi.com

jCD Self-Instruction

Fixed Prosthodontics (CE) Exercise No. jCD47 AGD Subject Code: 610

3 Hours Credit

This Continuing Education (CE) self-instruction examination is based on the article *Gingiva-Colored Restorative Material as a Substitute for Onlay-Inlay Grafting Following Trauma* by Phelan R. Thomas, DDS, AAACD. This article appears on pages 58-65.

The exam is free of charge and available to AACD members only. AACD members must log onto www.aacd.com/jcdce to take the exam. Note that only Questions 1 through 5 appear in the printed and digital versions of the *jCD*; they are for readers' information only. This exercise was developed by members of the AACD's Written Examination Committee and *jCD*'s Contributing Editors.

1. What does the Allen classification of edentulous ridge defects measure?

a. size of teeth
b. number of teeth missing
c. buccolingual dimensions of ridge contour
d. design of the pontic recipient site

2. Edentulous ridge defects can be classified based on the severity of the defect which, in this case, was a type C. This equates to which of the following?

a. minimal vertical bone loss of the ridge contour
b. moderate vertical bone loss of the ridge contour
c. bone loss in the buccolingual dimension
d. bone loss in both apicocoronal and buccolingual dimensions

3. Which of the following is an esthetic solution to restoring the tissue portion of a severe three-dimensional ridge defect with extensive bone and tissue loss?

a. soft tissue grafting of the ridge defect
b. ridge augmentation with artificial bone
c. using tooth-colored pontics to press into the remaining gum tissue
d. severe defect is best restored with both tooth colored and tissue colored ceramics

4. What is the most important factor to consider for placement of dental implants after a traumatic incident?

a. periapical issues with surrounding teeth
b. periodontal pathology
c. healing potential of the body
d. presence of adequate bone

5. What did the chairside shade guide used in this case help determine?

a. air escape phonetics
b. tooth size
c. tooth length
d. gingival color

AACD Self-Instruction Continuing Education Information

Exams will be available for 3 years from publication date for dentists, and 1 year from publication date for laboratory technicians.

Original release date: November 30, 2021. Expiration for dentists: November 30, 2024. Expiration for laboratory technicians: November 30, 2022.

To receive course credit, AACD members must answer at least 70% of the questions correctly.

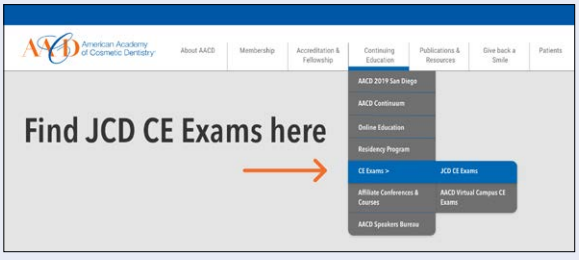
Participants will receive test results immediately and can only take each exam once. A current web browser is necessary to complete the exam.

Verification of participation will be sent to AACD members via their MyAACD account. All participants are responsible for sending proof of earned CE credits to their state dental board or agency for licensure purposes.

For more information log onto www.aacd.com/jcdce.

Contact the AACD at email: info@aacd.com or phone: 800.543.9220 or 608.222.8583.

To take the complete exam, log onto www.aacd.com/jcdce



ADA CERP® | Continuing Education Recognition Program

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 these activities for 1-3 credit hours to continuing education credits. Concerns or complaints about a CE provider may be directed to the provider or to ADA CERP.

CONTINUING EDUCATION APPROVED

NBC Approved Qualified Continuing Education Provider.

PACE ACADEMY of GENERAL DENTISTRY PROGRAM APPROVAL FOR CONTINUING EDUCATION

American Academy of Cosmetic Dentistry® Nationally Approved PACE Program Provider for FAGD/MAGD credit. Approval does not imply acceptance by any regulatory authority or AGD endorsement. 1/1/2019 to 12/31/2022.
Provider ID# 216647

EXPAND

your vision powerfully,
seamlessly, immediately

Innovation where you need it most

The iTero Element® 5D Plus imaging system in mobile configuration. It's an all-in-one, medical grade, dental imaging system in a sleek, compact package. With it comes:

- Reimagined practice integration and transportation
- 3D models, intraoral images, and aids in caries detection
- Wand and powerful, compact computing

Now you can deliver the same excellence of care and patient experience wherever you go.

New

Schedule a demo today and learn more at iTero.com

it starts with iTero®

DETAILS MATTER

MICRODENTAL E.MAX VENEERS

{ LIFELIKE CONTOURS · LIGHT TRANSMISSION · SHADE GRADATION · CHARACTERIZATION }

MicroDental's commitment to our customers' success includes executing on the highest level of technical expertise, while delivering personalized service throughout the process. From our advanced case planning to the final artistic touch, we fully commit to your patients' satisfaction. Our focus is to consistently deliver life-like restorations that enhance function and support oral health.

Contact us at 1.800.229.0936 to schedule your next case and find out how you can win a FREE Medit i700 IOS Scanner!

MICRODENTAL
LABORATORIES

800.229.0936
MicroDental.com

ACCESS
GALLERY