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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.

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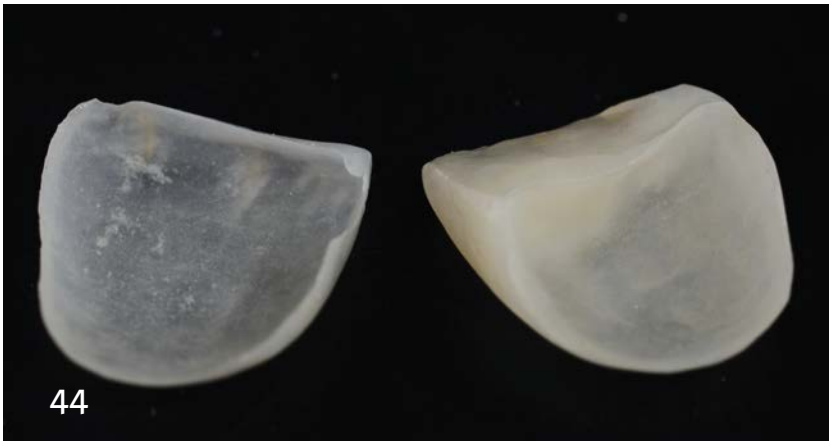

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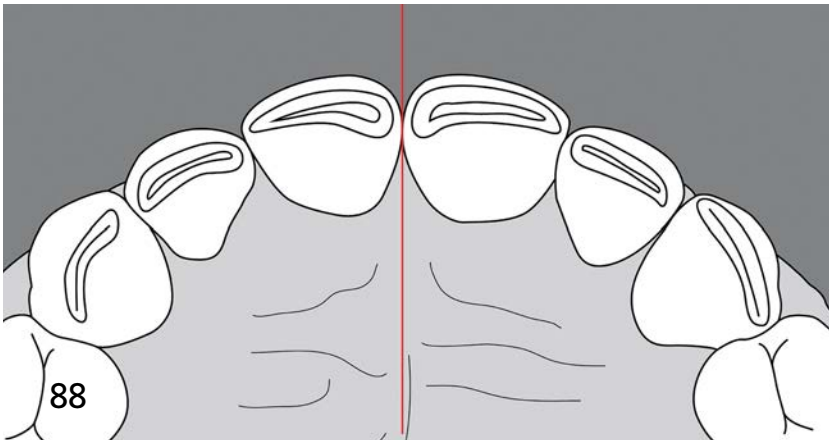

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What Exactly is a *Legend*?

> These educators have had an enormous impact on the growth and development of the AACD and cosmetic dentistry.

The Cambridge Dictionary defines a *legend* as "Someone very famous and admired, usually because of their ability in a particular field."
This certainly describes the following four "Legends" of comprehensive cosmetic dentistry who will be presenting at AACD's 33rd Annual Scientific Session. Drs. Larry Rosenthal, William Dickerson, David Hornbrook, and William Strupp will be sharing their wisdom, expertise, and techniques in Las Vegas in April. You owe it to yourself to hear them speak.

These educators have had an enormous impact on the growth and development of the AACD and cosmetic dentistry. I am one of the many clinicians who have been inspired by them throughout the years.

I first heard Dr. Larry Rosenthal lecture in 1995. I had been in practice less than 10 years and wanted to get more out of dentistry. Larry, already a renowned clinician and speaker, was very gracious and advised me to join the AACD. I did, and was awed by the talent and skill I encountered. Inspired, I then attended the Anterior and Advanced Aesthetics program taught by Drs. Bill Dickerson and David Hornbrook. Shortly afterward, I became a clinical instructor under the direction of Dr. Hornbrook. Helping colleagues with their esthetic cases made me a better dentist and mentor. Amending and refurbishing case after case of composite mock-ups, acrylic provisionals, and final restorations over the next four years gave me an education in esthetics that no amount of money could buy. Larry taught me how to create distinctive central incisors, David showed me ways to characterize laterals, and Bill taught me how to contour cuspids. Although I did not officially study under AACD founding member Dr. Bill Strupp, his lessons have added immeasurably to my dental repertoire and personal growth.

Years later, when I thanked Dr. Rosenthal for sparking my interest in cosmetic dentistry, he modestly replied, "I didn't do anything…I merely cracked open the door for you." Whereas others might have taken credit for my enlightenment, he played it down like it was no big deal. What a class act!

I have never forgotten what he said. Guiding others to discover their own potential continues to give me tremendous joy. I have encouraged many colleagues and students to join the AACD and learn from some of the greats; it is my way of paying forward what these "Legends" of cosmetic dentistry have instilled in me.

Edward Lowe, DMD, AAACD
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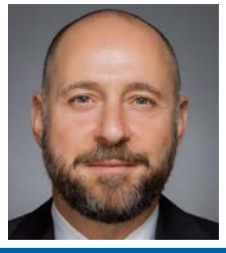

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BEHIND THE SMILE

Believing

When we tried-in the wax-up, our patient was ecstatic. She loved the shape, the alignment, and the entire smile design.

By Hilal Kuday, CDT, and Nihan Özlem Kuday, DDS, PhD

Our patient on the cover of this issue of the *jCD* is a university student studying psychology in Istanbul. She is also trying to become a model and takes acting lessons.

Although she felt good about herself in general, she was dissatisfied with her smile. She wanted a warm, natural-looking, and extremely attractive smile but, like many patients, she had a great deal of dental anxiety. She also was not sure that we would understand her needs and what she imagined her ideal smile to look like.

Challenges such as these are not uncommon, especially at the beginning of treatment. That is why using a wax-up is an important step before designing a smile. A wax-up aids in diagnosis and needs analysis, and provides information regarding the limits of the case; this, in turn, helps us to create the best esthetic result with noninvasive restorations while preserving maximum tooth structure. In addition, digital imaging and three-dimensional wax-ups can provide patients with clear visuals of the possibilities for their future smile.

When we tried-in the wax-up, our patient was ecstatic. She loved the shape, the alignment, and the entire smile design. From that moment on she completely believed in what we could do and became a true member of the team.

At the end of the cementation appointment she hugged us and said, "I can't believe what happened—I can finally smile without covering my mouth with my hands!" Those words, and her happiness, meant everything.

To learn more about this patient's treatment, turn to the Visual Cover Essay on page 26.

Cover and editorial images: Photographer, Fethi Karaduman; Make-up Artist, Burcu Taş; Hair Stylist, Isa Tore; Photography Assistant, Aydin Yukselmis (all from Istanbul, Turkey).

Thoughts on Dental Artistry and More

An Interview with Dr. Larry Rosenthal

Educator Larry Rosenthal, DDS, AAACD, is internationally renowned for his expertise in esthetic dentistry. In this interview, Dr. Rosenthal, the owner of The Rosenthal Institute for Aesthetic Dentistry and the Rosenthal-Apa Group in New York, New York, answers questions from members of the *jCD* Editorial Review Board. The "legendary" Dr. Rosenthal will be presenting *The 'WOW' Factor: 1981 - Present*, at the 33rd AACD Annual Scientific Session in Las Vegas, Nevada, on Wednesday, April 19, 2017. Register today at www.aacdconference.com

> "Passion and dedication will initially guide the way to the necessary skills; the artistry will follow."

Q: Dr. Rosenthal, can you discuss for our readers the importance of mastering tooth shape and position, and the smile's harmonious balance with the face as a whole?

A: True dental artistry can be attained only through visualizing what a patient's teeth should look like, both individually and within the smile as a whole; as well as how the final smile should look in order to blend harmoniously with the rest of the face. It is essential to visualize the end result before beginning treatment. For me, the importance of provisionalization as part of the process became the focal point in achieving the final result. Initially I had difficulty both in visualizing and designing the proper tooth shape and arch form. Learning to design and shape provisionals and evaluating wax-ups enabled me to provide my ceramist with an accurate template of the esthetics I wanted to achieve for each patient.

Q: How can clinicians gain the skills to visualize the final outcome prior to treating the patient, thereby becoming a true artist?

A: Passion and dedication (and patience) will guide the way to the necessary skills; the artistry will follow. For me, the artistry is the most rewarding aspect of our profession, because patients will no longer see us as "just a dentist"; rather, they will think of and refer to us as "artists." That said, however, the actual clinical skills necessary to visualize the final outcome prior to treatment can be obtained in various ways:

- Detailed records including full-mouth and full-face digital photography, full-mouth radiographs and accurate diagnostic casts, and/or an intraoral composite mock-up/ diagnostic customized wax-up.
- Physical visualization of the final result via digital imaging and/or a trial smile that is placed directly over the unprepared teeth.
- Provisional restorations to comprehend and execute proper tooth, arch, and facial morphology (be sure to anticipate the final measurements of the length and width of the teeth).

The key is to have seamless integration of your treatment plan with excellent execution of the final result.

Q: The past 30 years have seen a tremendous improvement in public oral health and self-confidence as a result of advances in cosmetic dentistry. What do you see as the next potential breakthrough for the field?

A: The digital impression is a breakthrough in helping us to avoid potential negatives in our treatment. Also the advent of CAD/CAM dentistry, which creates restorations that are extremely predictable and reproducible (and, in turn, may ultimately reduce the restorations' overall cost to the patient). Another breakthrough would be immediate-load implants, a tremendous benefit in terms of provisionalization (and, therefore, immediate gratification for the patient).

Q: Increased public awareness of cosmetic dentistry has also improved understanding about the importance of dental health. What are your thoughts about responsibility and excitement in cosmetic dentistry?

A: Responsibility and excitement should respect a clear order of priorities, which is emphasized to patients. They need to be aware that the first priority is always health, followed by comfort, then function and, finally, appearance/esthetics. In addition, clinicians should strive for long-term sustainability of their cases that can be attained with minimally invasive dentistry.

The single most important thing is maintenance, maintenance, maintenance. This includes emphasis on digital technology, intraoral photography, radiograph review, and home care, as well as follow-up hygiene visits and clinician checkups every three to four months. Follow-up begins with the front desk staff or treatment coordinator. Your practice's proactive monitoring of patients' oral health will help to ensure long-term case success, patient happiness…and patient referrals.

Q: What is the most important thing you have learned to ensure long-term success of your cases and patient relationships?

A: That there is no single procedure that has as much impact on our patients as does comprehensive, high-quality dental care.

The Journal of Cosmetic Dentistry *thanks Dr. Rosenthal for participating in this interview.*

"Your practice's proactive monitoring of patients' oral health will help to ensure long-term case success, patient happiness…and patient referrals."

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- 10-12 views of the before and after images and 5-7 technique shots. All photos must be 300 dpi high-resolution.
- Two brief paragraphs explaining the clinical and laboratory work (if applicable) that was completed.
- Three to four sentences stating why the treatment plan was chosen to complete the case.

Send your cover case submissions via a large file transfer service such as Dropbox or Hightail to publications@aacd.com.

The *jCD* looks forward to receiving your submissions!

Triad of Excellence

A Commitment from the Dentist, Ceramist, and Patient

Dawn Wehking, DDS

> "...a crown was indicated due to the significant discoloration and the amount of preparation required."

Abstract

A single anterior restoration is one of the most challenging procedures in dentistry. The level of skill necessary calls for a "triad of excellence," requiring commitment from the dentist, the ceramist, and the patient. Matching a single anterior restoration to the surrounding dentition is rarely achieved on the first try. Managing patient expectations and laboratory communication is vital to success in a case of this detail.

Key Words: single crown, PFZ, AACD Accreditation Case Type II

Introduction

Responsible clinicians strive to perform the most conservative dentistry that will achieve the desired outcome.[1] In this case, a crown was indicated due to the significant discoloration **(Figs 1a-2b)** and the amount of preparation required.

Most dentists continue to use the shade guide they received in dental school throughout their career.[2] Becoming a master cosmetic dentist, however, requires more detail. The ability to communicate not only the tooth's hue, but also its value to the laboratory ceramist is vital in achieving a natural result.[3]

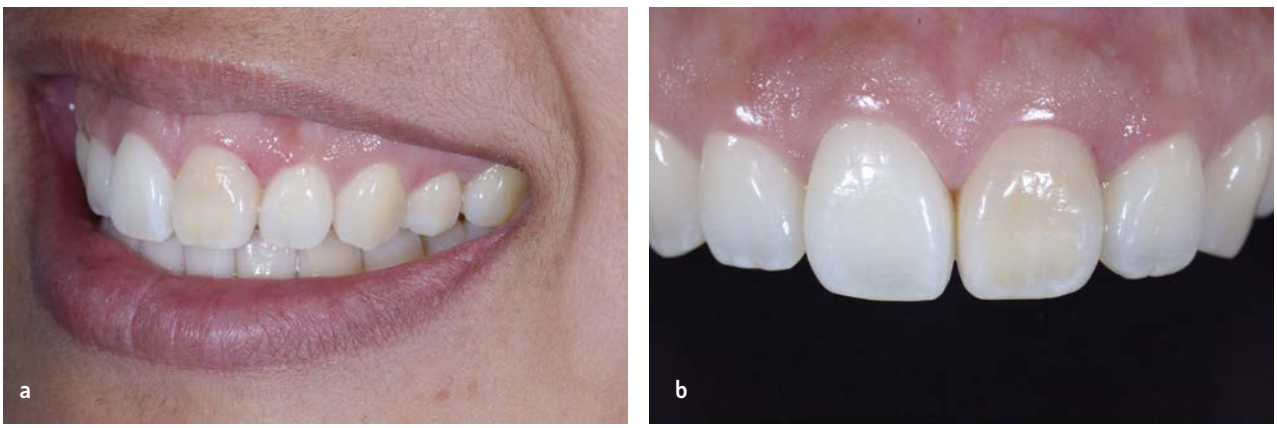
Case Presentation

Chief Complaint and Evaluation

The 34-year-old patient's chief complaint was her discolored tooth #9, which she had been self-conscious about since childhood.

A comprehensive examination was completed at the new patient visit, assessing temporomandibular joint health, masticatory muscle function, periodontal health, tooth condition, and esthetics. An oral cancer screening was also completed and a full mouth series of radiographs was taken with no pathology noted. Once the patient decided to proceed with treatment, the required AACD photographs were taken. While the patient had a 1-mm slide from centric relation to maximum intercuspation (MIP), the decision was made to treat her in MIP since her occlusion was functional and symptom-free.

Figures 1a & 1b: Preoperative full-face smile (1:10) and frontal natural smile (1:2) showing #9's low value.



Figures 2a & 2b: Preoperative left lateral natural smile (1:2) and retracted maxillary anterior frontal view (1:1) showing discolored #9.

Treatment Plan

The patient's only concern with the appearance of her smile was the severe discolored tooth #9 **(Fig 2a)**. Following endodontic treatment of the nonvital tooth, the patient decided to proceed with esthetic treatment to correct the discoloration. Options discussed included internal bleaching, and a crown. She chose treatment with a crown.

Treatment

Shade

Before preparing the tooth, shade selection was performed using Vita Masters Linear shade guide[4] (Vita North America; Yorba Linda, CA) and a Nikon D7000 digital camera (Nikon USA; Melville, NY). The shade was communicated to the laboratory by first selecting a value and then selecting the hue.

Material

After discussing the case with the ceramist, we chose to proceed with a porcelain-fused-to-zirconia crown. The high-opacity zirconia base was selected, then porcelain was layered to control and manage the dark #9 stump shade while producing a durable and esthetic restoration. Zirconia demonstrates a unique ability to inhibit crack propagation, which accounts for its low susceptibility to stress fatigue, its superior fracture toughness, and its high flexural strength compared with traditional ceramics.[5]

Tooth Preparation

Because #9 was so badly discolored **(Fig 2b)**, an extensive reduction protocol was necessary to achieve the desired outcome. An extensive reduction diamond was used (RW Ext, Brasseler USA; Savannah, GA) to remove enough tooth structure to block out the discoloration, while being careful not to over prepare. Labial, palatal, window, and vertical preparation reduction guides were used to ensure adequate reduction. The tooth was reduced 2.0 mm incisally, 1 mm lingually, and 1.5 mm labially.[6] The extent of facial reduction was determined by the restorative material selection and the degree of masking required to achieve an acceptable esthetic outcome.[7]

The preparation shade was recorded and verified with photographs. Retraction cords (Ultradent Products; South Jordan, UT) were used with Aquasil (Dentsply Caulk; York, PA) impression material and sent to the laboratory with an opposer and bite registration (Regisil, Dentsply). The temporary was fabricated using Luxatemp (DMG America; Englewood, NJ), cut back, and custom-shaded with Estelite Omega Composite and tints (Tokuyama Dental America; Encinitas, CA). The temporary was cemented with Cling (Clinician's Choice; New Milford, CT). During the patient's temporization phase, she was instructed to use antioxidant products (AO ProToothpaste, ProRinse, and ProVantage gel, PerioSciences; Dallas, TX) to reduce inflammation of the tissue around #9.

Laboratory Instructions

Digital photographs of the preoperative and prepared teeth were taken with a Nikon D7000, using the Vita Master shade guide to communicate value and shade.[8] The crown was made with a white zirconia core and layering porcelain (Ivoclar Vivadent; Amherst, NY). The crown was tried in at the laboratory with the ceramist present so that custom tints could be added chairside, paying special attention to the characterization of the patient's natural dentition. Surface texture was achieved with carbide burs and diamonds (Brasseler and Kerr Axis; Orange, CA) and hand polished with pumice (Kuraray Noritake Dental; Tokyo, Japan) and diamond paste (Cosmedent; Chicago, IL) in some areas. During this process, photography was very helpful in allowing us to magnify the image to see the patient's unique characterization and mimic her natural tooth structure.

Delivery and Cementation

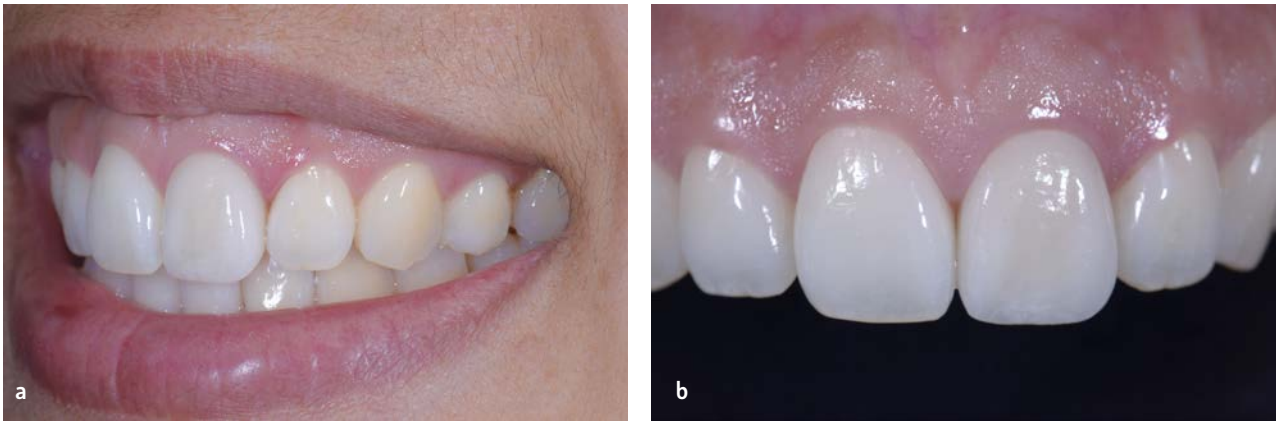
The zirconia intaglio was pretreated by sandblasting with 50-µ aluminum oxide, air dried, and coated with a thin layer of Scotchbond Universal Adhesive (3M ESPE; St. Paul, MN). Occlusion was checked in MIP and excursive movement using 90-µ articulating ribbon (Madame Butterfly, Almore Int.; Beaverton, OR). The preparation was cleaned with isopropyl alcohol, lightly pumiced, and scrubbed with Microprime-G (Danville Materials; San Ramon, CA). The enamel was treated with 35% phosphoric acid (Ultradent) for 15 seconds, rinsed, and the entire preparation coated with a thin layer of Scotchbond Universal Adhesive. The crown was cemented with RelyX Ultimate Adhesive Resin Cement (3M ESPE)[9] and adjustments were made with Brasseler's porcelain adjustment kit.

Summary

Excellent communication with the patient and laboratory technician allowed us to achieve a natural result, mimicking the unique characteristics, translucency, and morphology of the patient's natural dentition **(Figs 3a & 3b)**. Capturing these details of nature and replicating them in ceramic required a superb ceramist and a time commitment from our patient, who was thrilled with her result **(Figs 4a-5)**.

Acknowledgment

The author thanks ceramist Carmen Nicholas, MDT (New Age Dental Laboratory; Lakewood, CO), for her mentorship, patience, artistry, and expertise.



Figures 3a & 3b: Postoperative left lateral natural smile (1:2) and retracted maxillary anterior frontal view (1:1) showing a lifelike restoration with beautiful characterization, surface texture, and healthy tissue response to the restoration.

Figures 4a & 4b: Postoperative full-face smile (1:10) and frontal natural smile (1:2) in which the dentistry cannot be detected.

Figure 5: The happy patient.

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> "Excellent communication with the patient and laboratory technician allowed us to achieve a natural result, mimicking the unique characteristics, translucency, and morphology of the patient's natural dentition."

Dr. Wehking maintains a practice in Lafayette, Colorado.

Disclosure: The author did not report any disclosures.

Congratulations to AACD's Newly Accredited Fellows!

The American Academy of Cosmetic Dentistry is proud to announce that Dr. Craig Goldin, Dr. Trinh Lee, Mr. Juan Rego, and Dr. Jack Ringer, have become AACD Accredited Fellows!

AACD Fellowship is the highest level of achievement recognized by the Academy. It requires commitment and determination, and its status connotes education and excellence. It is necessary to first become AACD Accredited before one can attain the Fellow designation.

Well done, Dr. Goldin, Dr. Lee, Mr. Rego, and Dr. Ringer! Your dedication, enthusiasm, and insight are inspiring and we wish you many more years of great success!

Craig P. Goldin, DDS, FAACD
Troy, MI

Trinh N. Lee, DDS, FAACD
Mountain View, CA

Juan J. Rego, CDT, FAACD
Santa Fe Springs, CA

Jack Ringer, DDS, FAACD
Anaheim Hills, CA

The Ultimate Test of Clinician-Ceramist Communication

Brian J. Gilbert, DDS, AAACD

> "...the ultimate test of Case Type II is whether the candidate can utilize indirect restorations on one or two anterior teeth in such a way that the result is virtually undetectable amidst the surrounding dentition."

Replacing a dramatically discolored tooth in the anterior region with an indirect restoration that blends imperceptibly into the surrounding dentition is always a challenge. Many factors play a role in the success of the final outcome, including choice of restorative material, preparation design, and, most importantly, precise communication with the laboratory technician.[1]

Achieving accurate shade selection communication is one of the main problems that technicians encounter.[2] Ocular fatigue as well as the clinician's individual color perception can contribute to an inaccurate shade evaluation, and the use of digital colorimeters has been shown to be only slightly more accurate.[3,4] In addition to accurate shade selection, the clinician must communicate various other tooth characteristics, including surface texture and translucency.

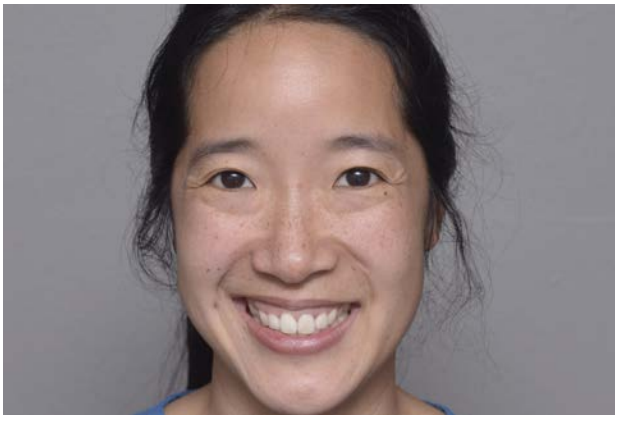

Figure 1: Postoperative full-face smile (1:10).

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

In many cases, this communication is best accomplished with the use of digital photography.[5]

Dr. Wehking demonstrated clearly that excellent results do not occur by accident. She carefully analyzed the shade, contour, translucency, and subtleties of the adjacent teeth. Through digital photography and the use of diagnostic models, she was able to provide the detailed information necessary to effectively communicate her desired esthetic end result to the ceramist.

According to the AACD's *A Guide to Accreditation Criteria*, the ultimate test of Case Type II is whether the candidate can utilize indirect restorations on one or two anterior teeth in such a way that the result is virtually undetectable amidst the surrounding dentition.[6] Duplicating nature is a complex task that requires clear communication and cooperation between the clinician and the ceramist. With the understanding that aspects of smile design *are* involved in Case Type II, the main criteria are focused on characteristics of the adjacent and contralateral teeth that influence the details of the final restoration.

This case is a good example of what success in the Accreditation process comprises: carefully selecting the right patient for the case type, taking the necessary time and steps to utilize proper clinical technique, and communicating effectively with the laboratory technician to obtain an ideal result. Congratulations go to Dr. Wehking on a very positive outcome for her patient.

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Dr. Wehking's excellent case passed, with the main comments focused on the following criteria :

- **Criterion 53:** *Is the color (hue, value, chroma) selection appropriate/natural, not monochromatic?* The examiners noted a lower value for #9 as compared to #8 and the adjacent teeth; the chroma in the midfacial of #9 was higher as compared to #8 **(Fig 1)**.
- **Criterion 87:** *Are contralateral teeth in harmony in terms of size, shape, and position?* The examiners expressed a minor concern regarding #9 being slightly shorter than #8 **(Fig 2)**.

Dr. Gilbert is an AACD Accredited Member and an Accreditation Examiner since 1998.
He practices in Las Cruces, New Mexico.

Disclosure: The author did not report any disclosures.

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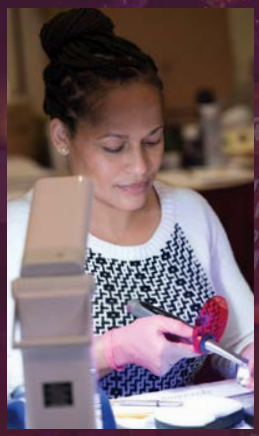

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Micro-Layering Prepless Veneers

Combining Digital Tools with Artistic Application Techniques

Hilal Kuday, CDT
Nihan Özlem Kuday, DDS, PhD

Abstract

This article presents a case illustrating the manner in which very thin yet highly esthetic and characterized prepless veneers can be planned by first designing a digital mock-up, then a three-dimensional wax-up, and finally by testing the design intraorally. Using photography, digital tools, and new high-value ceramic materials, the authors demonstrate how a beautiful smile transformation can be achieved in the most conservative way possible with micro-layered veneers.

Key Words: digital mock-up, 3D wax-up, prepless, micro-layered veneers

Introduction

The first thing we generally notice when meeting someone new is the person's smile. A healthy, attractive smile enhances self-confidence and affects one's personal life, sociability, and professional success. An esthetically pleasing smile is particularly important for individuals working in the visual and performing arts. Therefore, it is not uncommon for such patients to present requesting smile design enhancements to satisfy their specific esthetic expectations, which may include correcting color differences among teeth, asymmetric alignment, caries, and smile line discrepancies **(Figs 1 & 2)**.

Planning for Preservation

The ideal smile design is one that can be achieved with the least amount of tooth preparation possible, or without any removal of tooth structure. Determining the feasibility of prepless veneers, however, is predicated on a thorough analysis of the patient's smile, tooth structure, alignment, and ultimate esthetic goals.[1] For example, an examination of this patient's natural teeth revealed weak surface texture[2-4] and malpositioned teeth.[5] In addition, the lower lip position was not in harmony with the smile line and support was needed for the buccal corridors.[5] In such instances, to preserve the maximum amount of tooth structure possible, a systematic approach that begins with a digital mock-up, proceeds to a wax-up, and then continues with a clinical mock-up should be undertaken.[6,7] Planning treatment and designing the smile in this manner enables dentists and their ceramists to deliver beautiful results, usually without significant preparation.[8-10]

Figure 1: Preoperative close-up intraoral view of a 22-year-old aspiring actress who was referred to address her concerns regarding the esthetics and morphology of her smile.

Figure 2: Preoperative full-facial view of the patient during the consultation, at which time she expressed a desire to correct differences, alignment issues, and smile line discrepancies.

> "Determining the feasibility of prepless veneers…is predicated on a thorough analysis of the patient's smile, tooth structure, alignment, and ultimate esthetic goals."

Kuday/Kuday

Redesigning a Smile with a Digital Mock-Up

It Starts with Photography

To simulate the anticipated results of proposed changes, a digital mock-up can be made. The basis for a digital mock-up that realistically represents potential smile transformations is an accurate digital photograph taken at the proper angle and distance, and with consistent reference points.

The face should remain symmetrical to the camera lens to ensure equal overall angles. To verify symmetry within the lens, observe the patient's ears; they should appear the same within the frame.

Repeatable and reproducible reference points—which will ensure photographic consistency over time—also help to address angulation. These could include the bottom line of the nose and bottom line of the ears, or the bipupillar line and top line of the ears. When these lines overlap, more or less the same angulation is achieved, which facilitates capture of approximately the same photographic angle during follow-up appointments.

For ease of viewing and digital manipulation, it is also important to capture a black background behind the incisal edges of the teeth. Ask the patient to make the "AAAAA" sound while smiling, without closing his or her mouth, to facilitate photographing the teeth from this perspective.

Using Presentation and Photo Manipulation Tools

A variety of commercially available presentation and photographic software (e.g., Keynote [Apple; Cupertino, CA], PowerPoint [Microsoft; Redmond, WA], and Photoshop [Adobe; San Jose, CA]) can be used to digitally mock up a smile; determine appropriate changes to tooth shape, size, and other smile measurements; and then present the treatment plan to patients in an easy way. The process begins by importing selected photographs into the software's presentation slides, then checking the symmetrical view with cross lines that are positioned at 90-degree angles to each other. Then, another parallel line can be placed along the incisal edge to examine the presence of asymmetrical positions on the photograph **(Fig 3)**.

With the guidelines in place, the photograph can be manipulated within the software by touching and/or clicking on certain areas to achieve more symmetrical, wider, and/or longer tooth shapes and contours **(Figs 4 & 5)**. If working in Photoshop, the dramatic effect of the proposed transformation can be highlighted by selecting the Filter option from the menu bar and then applying the Liquify option **(Fig 6)**.

> "Planning treatment and designing the smile in this manner enables dentists and their ceramists to deliver beautiful results, usually without significant preparation."

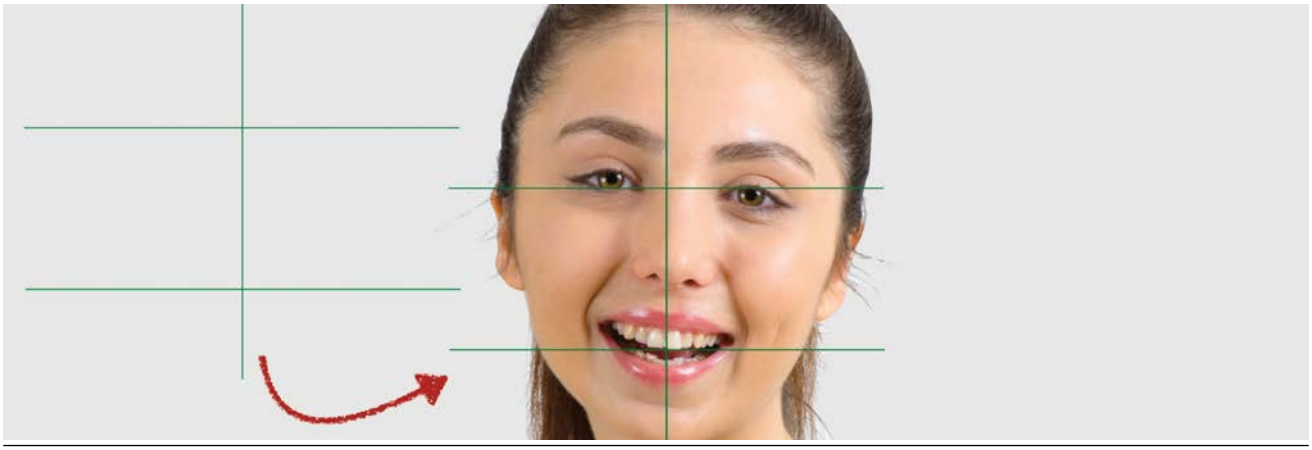

Figure 3: Horizontal and vertical guide frames are applied to verify the symmetrical view.

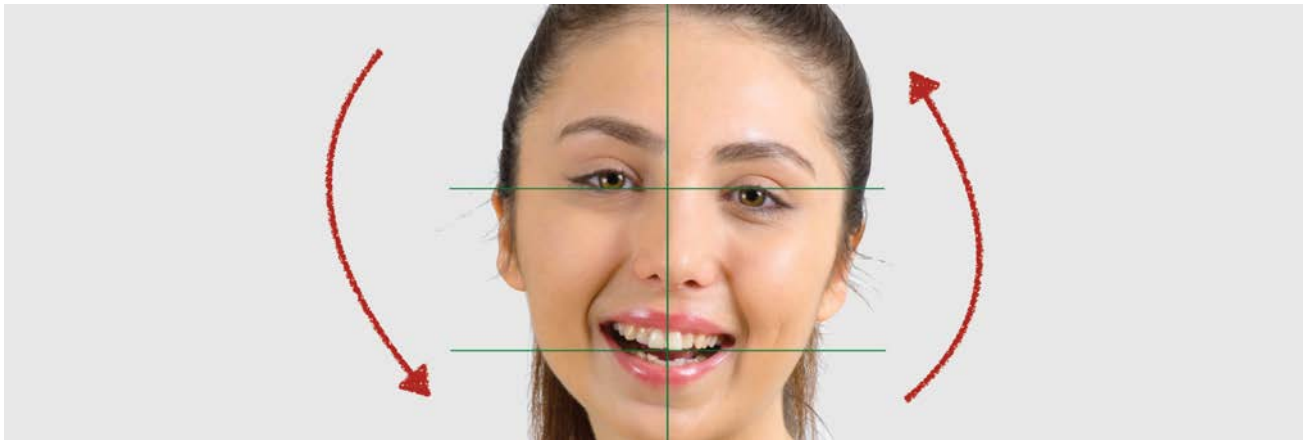

Figure 4: Aspects of the photograph, and in particular the smile, are manipulated and corrected using the software to create more desirable proportions.

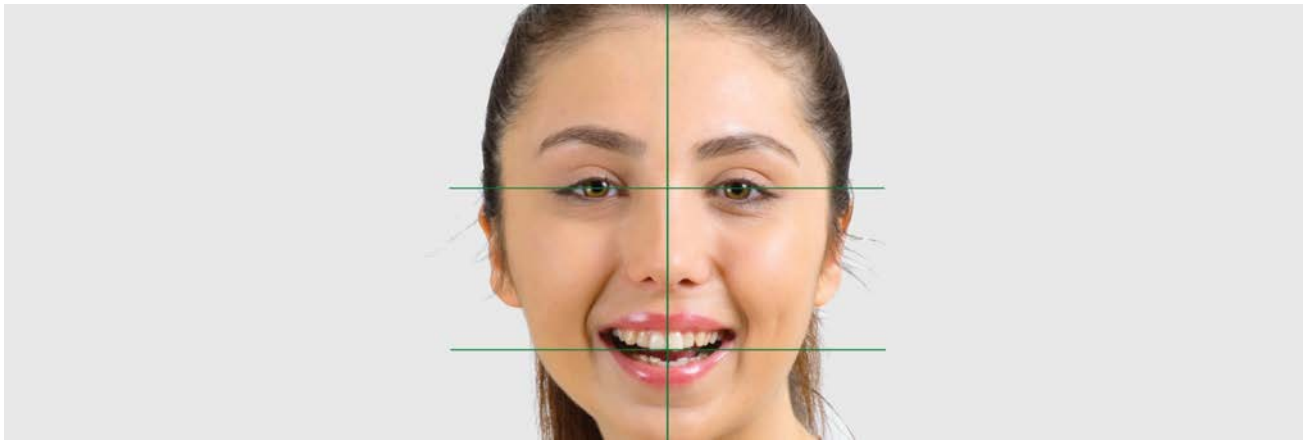

Figure 5: The corrected image in Keynote.

Figure 6: The digitally manipulated photographs are highlighted using Photoshop's Liquify effect.

Measuring Differences

To transfer the digital mock-up reliably to a wax-up and then, ultimately, to an intraoral mock-up, it is necessary to calculate the differences between the patient's preoperative condition (i.e., preoperative model) and the proposed treatment. Using one ruler that is correctly scaled is essential for this task (such rulers can be downloaded from the Internet).

To measure and calculate differences, first import the image of your selected ruler into the presentation slide(s) with the digital wax-up photograph. Then, using an actual ruler and the patient's preoperative model, measure the distance from, for example, the distal aspect of tooth #8 to the distal aspect of tooth #9 **(Fig 7)**. The same approach can be applied virtually by taking similar measurements—from side to side—using the virtual ruler and manipulating it from different angles. The virtual ruler is calibrated according to the enhanced digital mock-up photograph, and it can be rolled over the image without the need to change its scale two-dimensionally **(Fig 8)**.

Creating the Wax-Up

Digital laboratory technologies such as computer-aided design/computer-assisted manufacturing (CAD/CAM) three-dimensional (3D) printers enable ceramists to achieve greater precision in wax-up models while simultaneously encouraging hands-on artistry. When incorporating these tools in the wax-up process, it is important to select materials that will facilitate CAD/CAM digital scanning, as well as demonstrate necessary optical and physical properties required for a given case (e.g., greater opacity for easy visualization). This includes cases for which prepless veneer options are being considered.

Sculpting materials with more opacity and sufficient surface hardness (e.g., CX5, Adam Beane Industries; Vernon, CA) enhance visualization of tooth morphology, facilitate carving, and enable shaping of shallow surface texture.

To be as conservative as possible, the key to creating a prepless veneer wax-up is thinking additively. This requires consideration of how much natural tooth structure can be preserved while allowing creation of a beautiful smile. Conserving natural tooth structure makes controlling the underlying color of the preparation much easier and also simplifies adhesive bonding procedures. However, because restoration thickness inherently alters the color value of restorations, it is important to take into account the available space between the prepared tooth surface and the target restoration morphology. Analyzing the preoperative model can assist in this evaluation **(Fig 9)**.

The wax-up can be developed with gray wax, and white plaster exposed where necessary on the model **(Fig 10)**. Although the application of a lighter fluid to the wax-up surface promotes easier digital scanning by CAD/CAM units, it is advisable to wait 15 minutes to avoid softening the wax surface **(Figs 11 & 12)**.

Trying in the Wax-Up

The ideal method for transferring the completed wax-up form to the mouth is via an index fabricated from soft, detailed silicone surrounded completely by a rigid solution shell **(Figs 13-15)**, rather than using flexible or semi-flexible silicone. Custom-designed 3D printed trays allow the doctor to control the force in the posterior region equally and also demonstrate a precise insertion as a result of digitally analyzed angulation **(Figs 16 & 17)**.[11]

Following this procedure provides dentists and ceramists with an opportunity to test the form and function of their proposed restorations (i.e., phonetics, occlusion, shape, contours) with provisional material. We can determine if the wax-up represents our and the patient's esthetic and functional expectations, with achieving a "wow" effect being our ultimate goal after wax-up placement **(Fig 18)**.

Then, we can evaluate the emergence profile relative to the tooth dimensions, zenith points, occlusion, lip support, and phonetics. Once the definitive tooth form is determined, we can verify the temporary/mock-up restoration's thickness.

In the case illustrated here, once the final veneer form was agreed upon, the patient's gingival architecture was enhanced according to the wax-up using a soft tissue laser. All teeth were bleached and, two weeks later, the definitive tooth shade was taken and the appropriate ceramic ingot was selected to create the desired value without any uncontrolled preparation surface color showing through.

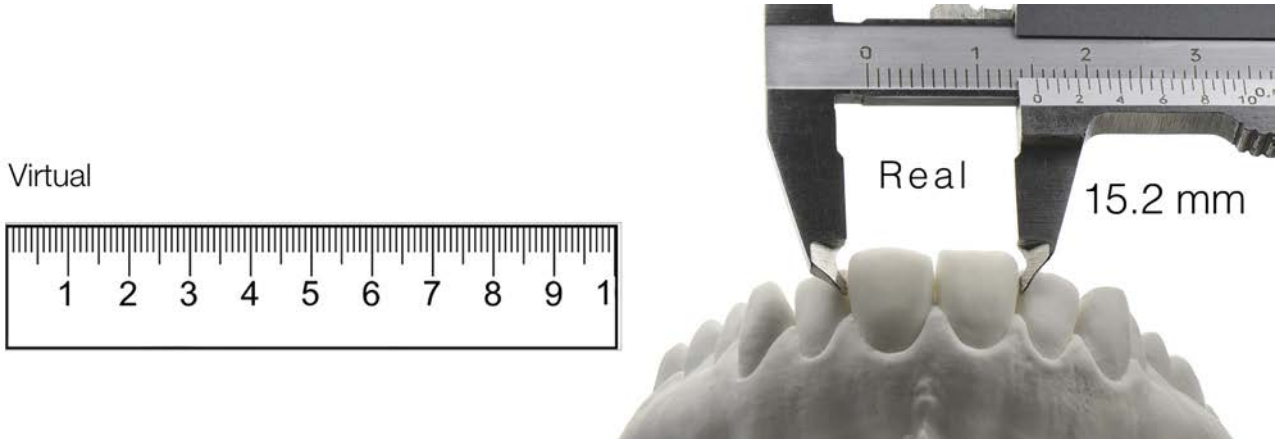

Figure 7: To convert the virtual ruler to a realistic device, use an actual ruler and the patient's preoperative model to measure the distance from the distal aspect of #8 to the distal aspect of #9.

Figure 8: The virtual ruler is rolled over the digitally enhanced mock-up photograph in Keynote to measure and calculate differences.

Figure 9: The preoperative model.

Figure 10: The CX5 wax-up can be developed with gray wax, and white plaster exposed where necessary on the model.

Figure 11: It is advisable to wait 15 minutes to avoid softening the wax surface.

> "A delicate balance among value, translucency, and material thickness is required to ensure esthetic results with thin veneers and minimally prepared tooth surfaces."

Figure 12: The completed CX5 wax-up.

Figure 13: The 3D-printed custom mock-up tray.

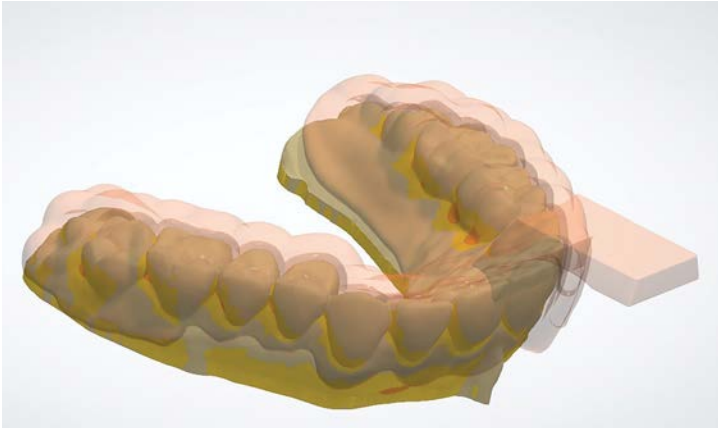

Figure 14: The custom mock-up tray is designed digitally for 3D printing.

Figure 15: The printed 3D mock-up tray is tried on the 3D printed model.

Figure 16: Placing temporary material into the custom 3D mock-up tray.

Figure 17: Cleaning temporary extensions after placement.

Figure 18: Frontal view after placement of mock-up.

Simplicity of Micro-Layering

To finalize the veneer form prior to fabricating the definitive restorations, the volume on the distal aspect of the canine required reduction to accommodate a very thin veneer. This reduction was guided by the digital design and wax-up **(Fig 19)**. The cervical lines were marked with a pencil on the working model, which should not contain any debris during the press procedure, at a 0.3-mm distance **(Fig 20)**.

In this case, an acrylic-based material that burns out without any residue (Ceramill Gel, Amann Girrbach North America; Charlotte, NC) was used according to the technique described by Crescenzo and Crescenzo.[12] The combination of material and technique provided better control of the thin layers with the curing light, as well as pressing to a 0.3-mm thickness without distortion **(Figs 21-25)**.

After pressing, simple shaping on the incisal edge of the framework (IPS e.max Press MT, Ivoclar Vivadent; Schaan, Liechtenstein) created the correct angulation for a natural shade degradation effect **(Figs 26 & 27)**. Then, the micro-layering began with the application of a new high-value power enamel material to shape the incisal translucency, with space left by the brush for subsequent mamelon effects **(Fig 28)**.

To create the mamelon effect, A1 Power Dentin (IPS e.max Ceram) was placed, and care was taken to alter the thickness of the mamelons to be irregular, naturally shaped, and opaque. A well-conditioned brush was used for effective material manipulation **(Fig 29)**.

For the second bake, a mixture of 50% Power Dentin and 50% Transparent Neutral was applied to the incisal border with a halo effect. Characterization of the incisal third was controlled using pure A1 Power Dentin **(Fig 30)**. To ensure a natural-looking luster during mechanical polishing procedures, the last layer to complete the labial surface consisted of Transparent Neutral powder **(Fig 31)**.

Figure 19: The distal aspect of the canine was corrected with a diamond bur, as guided by the wax-up.

Figure 20: The cervical lines were marked with a pencil on the working model to a distance of 0.3 mm.

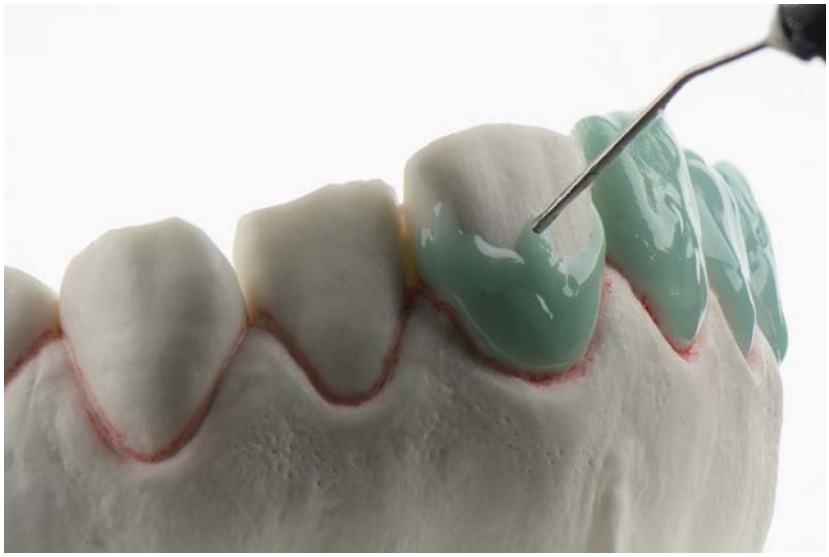

Figure 21: Ceramill gel was used to create the thin, pressable framework.

Figure 22: A backlight was used for visual effect to determine the thickness of the material.

Figure 23: The Ceramill modelation was connected to the press muffle.

Figure 24: The veneers after pressing.

Figure 25: Backlit view of the thin veneers on the working model.

Figure 26: The original surface condition immediately after pressing.

Figure 27: The corrected surface condition of the MT framework in preparation for micro-layering.

Figure 28: The first layer of micro-layering was accomplished using Power Incisal 1.

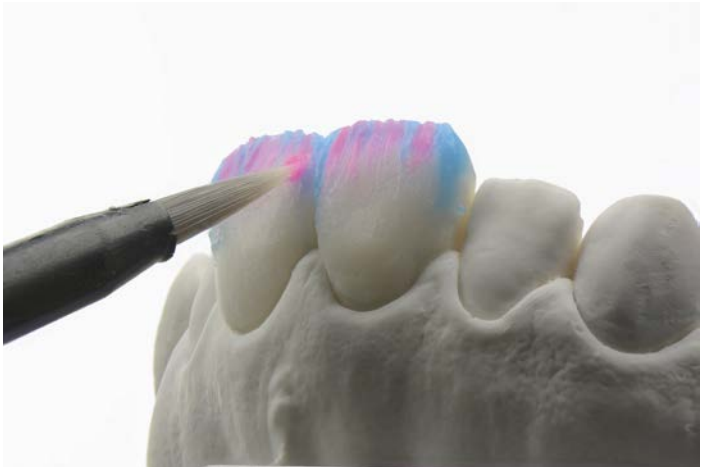

Figure 29: A1 Power Dentin was placed as the second micro-layer.

Figure 30: The first layer following the first bake was a Power Dentin to create a halo effect.

Figure 31: To ensure a natural-looking luster during mechanical polishing procedures, the last layer to complete the labial surface consisted of Transparent Neutral powder.

Caveats to Ensure Predictable Micro-Layered Shades

A delicate balance among value, translucency, and material thickness is required to ensure esthetic results with thin veneers and minimally prepared tooth surfaces. Care also must be taken regarding which tones are applied, and where, on the restorations to prevent a gray and unnatural appearance.

1. When working on a minimally prepared tooth surface, the ingot's thickness should be kept to the maximum level, and the incisal third used for characterizations with micro-layering.
2. However, because stains can appear so artificial, only very small amounts should be used, and then only very close to the restoration surface.
3. The color selected for the enamel layer must demonstrate opalescence with a white color emphasized, otherwise the transitional effects on strong white colors will produce too much contrast and contribute to an artificial appearance.
4. Note, however, that white color displays low-value effects in significant contrast, so grayish tones should not be used as a veneering material.
5. To ensure the transition from natural tooth color to white is seamless, gentle, and natural looking, consider the cervical tooth color and avoid sudden color changes in this area.
6. Finally, remember that the beauty of a prepless restoration's emergence profile comes from the minimal thickness of ceramic at the cervical part. The thickness difference between ceramic and natural tooth surface must be reduced carefully after cementation.

Cementation

During the cementation appointment for this case, the tooth surfaces were cleaned with a polishing brush and non-fluoride, oil-free paste. Because proper resin cement shade selection is of paramount importance when seating thin, prepless laminate veneers, a cementation kit with a broad range of shades and try-in pastes (e.g., Variolink Veneer Kit, Ivoclar Vivadent; Amherst, NY) was used. This enabled the dentist to determine the ideal cement shade value (e.g., high value, brighter white; lower value, warmer), which in this case was high value +1 **(Fig 32)**.

After proper isolation was achieved, the restorations and teeth surfaces were pretreated according to the manufacturer's instructions.[13-16] A liquid strip was also applied to prevent the oxygen inhibition layer **(Fig 33)**. Because the restorations were very thin, the transitions between the veneers and teeth were carefully finished intraorally after cementation. Silicone carbide burs were used to attain the final surface gloss.[17]

> "…the beauty of a prepless restoration's emergence profile comes from the minimal thickness of ceramic at the cervical part."

Figure 32: The thin ceramic veneers after cementation.

Figure 33: An oxygen barrier was applied for the last light-curing procedure.

Summary

Creating very thin yet highly esthetic and characterized prepless veneers is readily possible using a micro-layering process with a digitally developed 3D wax-up as the basis. In particular, new high-value contrast materials, white colors, and internally customized effects can be micro-layered into very thin veneers. As this article has demonstrated, planning a smile design case for micro-layered veneers using photography, digital tools, a 3D wax-up, and a mock-up allows ceramists and dentists to achieve a beautiful smile transformation in the most conservative way possible **(Figs 34 & 35)**.

Figure 34: Close-up final "wow" view of the patient's smile design.

Figure 35: Final postoperative portrait of the patient with her new smile design and prepless, micro-layered veneers.

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> "…new high-value contrast materials, white colors, and internally customized effects can be micro-layered into very thin veneers."

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Disclosures: The authors did not report any disclosures.

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Six Steps to Ceramic Veneers

A Practical, Predictable, and Minimally Invasive Approach

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Goran I. Benic, Dr.med.dent
Hong-Chang Lai, PhD
Niccolò Cea, DDS
Riccardo Guazzo, DDS, PhD
Edoardo Stellini, PhD

Abstract

This article presents a clinical workflow for the predictable restoration of anterior teeth with minimally invasive ceramic veneers. After patient data including digital images and impressions are collected, a plaster master cast is made and a digital smile design is created. The expected outcome is discussed with the patient and a silicone template is used to prepare a diagnostic resin mock-up; this step is very useful in helping the patient to understand the treatment plan. The mock-up of the veneers is performed using either a direct or an indirect approach. A definitive impression is taken after a minimally invasive preparation. Finally, the ceramic veneers are cemented. Feldspathic ceramic or lithium disilicate-reinforced glass-ceramic is chosen depending upon the patient's esthetic needs, the occlusal pattern, and the thickness of the veneers. The proposed step-by-step workflow—in which clinician-patient communication plays an essential role—enables the clinician to predictably achieve an ideal esthetic outcome with a minimally invasive approach.

Key Words: ceramic veneers, lithium disilicate, feldspathic, ceramic, mock-up, digital smile design

Introduction

The evolution of ceramic materials has increased and enhanced minimally invasive treatment options for the anterior teeth (posterior teeth can be similarly treated to restore lost tooth height).[1-3] Ceramic veneers have become a well-established treatment modality for the conservative, highly esthetic restoration of malformed, discolored, malaligned, traumatized, fractured, and worn anterior teeth. The recommended superficial preparation within the enamel and adhesive luting facilitates restoration with minimal loss of healthy tooth structure.

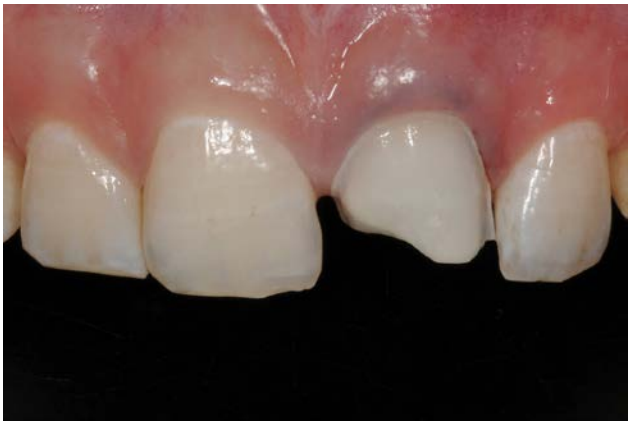
Indications[4] for ceramic veneers with a minimally invasive approach include teeth that are unresponsive to bleaching, tetracycline discoloration, major morphologic modifications, conoid teeth, diastema or interdental triangles to be closed, and augmentation of incisal length or facial prominence **(Figs 1-15)**.

Traditionally, ceramic veneers were fabricated from stacked feldspathic porcelain and used in a "no-preparation" manner in thicknesses of 0.5 to 0.7 mm. Although the goal of not removing healthy tooth structure was admirable, it can provide less-than-desirable results, including bulky veneers and inflamed soft tissues. It should be remembered that the ultimate objective of any dental treatment is to restore health and function, as well as esthetics, using the most conservative method available. Therefore, dentists and consumers have advocated "no-preparation" veneers as an option to conserve tooth structure that is esthetically equivalent to or better than veneers requiring preparation. Significant advantages of conserving tooth structure include lack of need for anesthesia, absence of postoperative sensitivity, better bonding to enamel, minimal flexing stress, longer-lasting restorations, potential for reversal, and higher levels of treatment acceptance.[5-7] Based on data available in the literature, a minimally invasive approach can provide a more esthetic and biologically compatible restoration.[7,8] A minimal preparation of 0.5 mm may allow room for veneers and adequately mask unesthetic areas.

"Although the goal of not removing healthy tooth structure was admirable, it can provide less-than-desirable results, including bulky veneers and inflamed soft tissues.

Although the clinician, along with the dental technician, may prefer and plan for treatment with ceramics, every treatment option should be clearly discussed with the patient. Digital technology can facilitate this important dialogue.[9,10] Digital smile design aims to provide the patient with a clear understanding of the initial clinical situation as well as a simulation of the future restoration's final result. Patients are more likely to request and accept treatment when they have a thorough understanding of the clinical problem and proposed solution.[10-15]

Figures 1 & 2: A patient with discolored #9, diastema between #8 and #9, and inadequate length of #8 and #9.



Figures 3 & 4: No preparation of #8 and traditional veneer preparation of #9.

Figure 5: Feldspathic veneers.

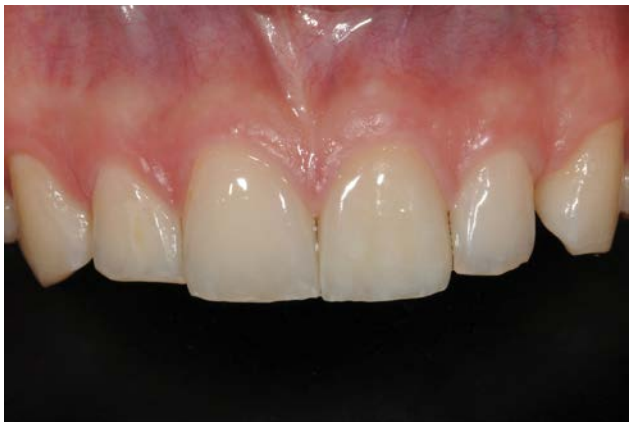
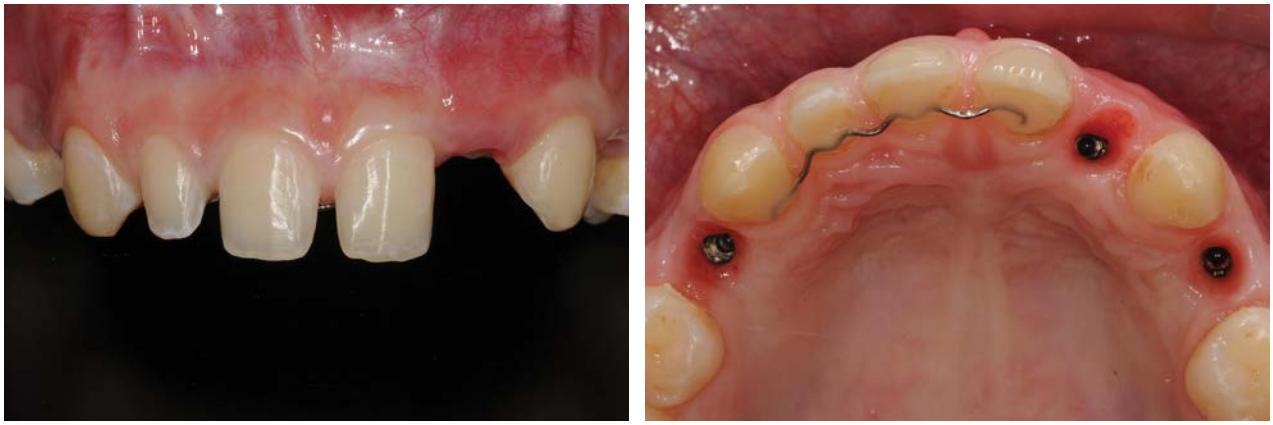


Figure 6: Feldspathic veneers, #8 and #9, after adhesive cementation. *(Dentistry by Dr. Goran Benic, ceramic work by Pascal Müller)*

Figure 7: Close-up image of a patient with esthetic deficits in the anterior maxilla.

> “Significant advantages of conserving tooth structure include lack of need for anesthesia, absence of postoperative sensitivity, better bonding to enamel, minimal flexing stress, longer-lasting restorations, potential for reversal, and higher levels of treatment acceptance.

Figures 8-10: Diastemata between natural teeth and missing #9.



Figures 11 & 12: Situation after minimally invasive preparation of maxillary teeth and implant placement, #4, #9, and #12.

Figures 13-15: Vertical dimension restoration; feldspathic veneers, ##6-11; and porcelain-fused-to-zirconia implant-supported crowns, #4, #10, and #12. *(Dentistry by Dr. Goran Benic, ceramic work by Vincent Fehmer, MDT)*

This article offers a predictable, simple, and systematic workflow for treating natural teeth in the esthetic zone with a minimally invasive approach.

Clinical Workflow: Six Steps

This minimally invasive approach to the treatment of anterior teeth with ceramic veneers is characterized by the following clinical steps:

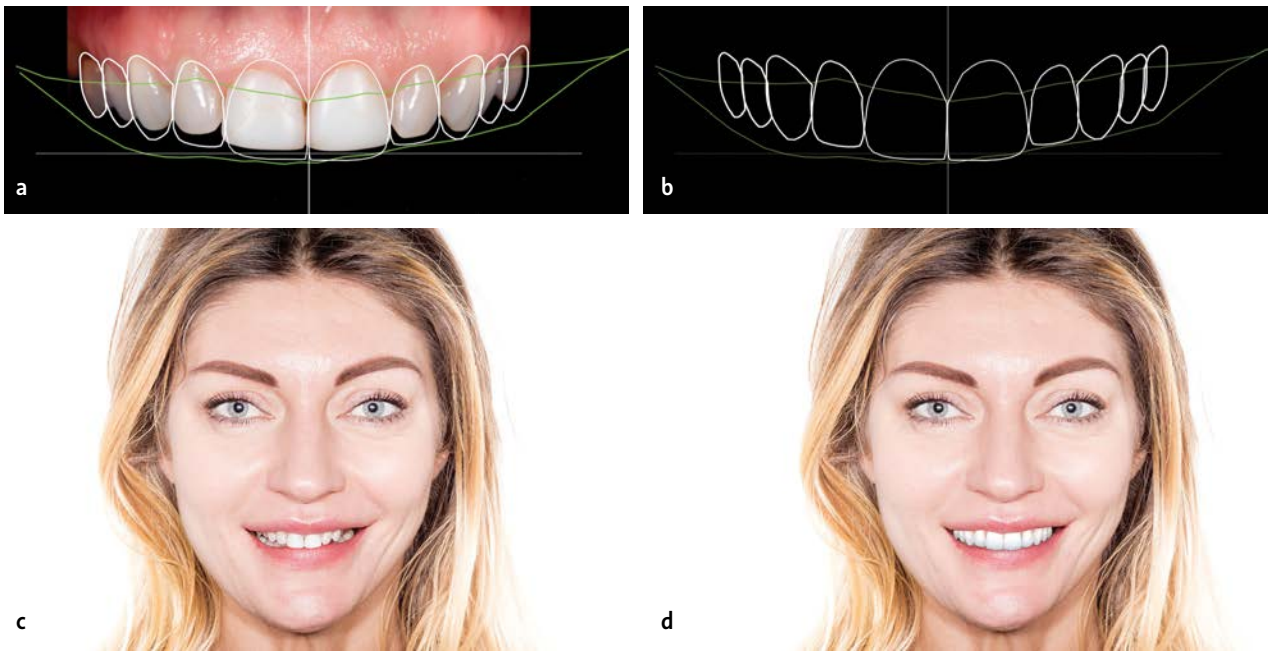
> “Patients are more likely to request and accept treatment when they have a thorough understanding of the clinical problem and proposed solution.

Step 1

At the initial patient visit the clinician listens to how the patient feels about the clinical problem. The clinician must evaluate the patient's motivation for the proposed restoration. Then, the patient's intraoral and extraoral characteristics should be recorded to determine whether he or she is an ideal candidate for a restoration with ceramic veneers. Photographic documentation is crucial in planning the future smile's architecture and discussing the proposed treatment options with the patient. Finally, an impression of the arches is taken to manufacture the master cast, which can be fabricated from alginate, silicone, or polyether material.

Step 2

The master cast is created and used by the dental technician to fabricate the diagnostic wax-up. A medium-value articulator is used to simulate interarch spaces and to evaluate the chances for placing ceramic veneers to restore the esthetic defects **(Fig 13)**. The dental morphology **(Fig 14)** should reflect patient expectations, clinician interpretation, and project feasibility. In addition, a digital simulation of the treatment is provided: the intraoral and extraoral images are used and modified to create a digital representation of the future smile's architecture by following characteristics from the master cast and diagnostic wax-up **(Figs 15-17b)**. The digital rendering is discussed with the patient, who has been recalled and can see more clearly the clinical problem and respective solution. If the patient accepts the therapeutic proposal the technician will provide a silicone template for the mock-up delivery.



Figures 16a-16d: (a) Digital correction of frontal area profile. (b) Ideal tooth morphology. (c) Smile characteristics before treatment. (d) Simulation after rehabilitation with ceramic veneers.

Figure 17a & 17b: Digital simulation of veneers in place: (a) Intraoral. (b) Extraoral.

Step 3

The patient is recalled again to wear the direct or indirect mock-up of the future ceramic veneers. If a direct mock-up is utilized a light-curing or self-polymerizing composite resin can be added in the silicone template by following the diagnostic wax-up features **(Fig 18)**. Cementation usually is not required for mock-up stabilization. The patient can wear the composite mock-up for a number of days depending on resin strength. This clinical step is crucial to treatment plan acceptance.

Figure 18: Intraoral check of silicone template in position for the direct mock-up.

Step 4

After the patient accepts the treatment plan and the clinical simulation of the treatment as described in the previous step, the mock-up can be easily removed and a selective enamel reduction can be performed if necessary. Feldspathic ceramic may require a thickness of 0.3 to 0.5 mm **(Fig 19)**. By following the diagnostic wax-up a silicone template can be provided to guide the clinician during tooth preparation without any unnecessary and counterproductive enamel reduction **(Figs 20 & 21)**. Preparation for ceramic veneers should be performed meticulously to maintain the preparation completely in enamel. However, exposure of considerable amounts of dentin is usually inevitable during the preparation, especially along the cervical and proximal areas. Although new, improved adhesives have been developed, the bond strength of porcelain to enamel is still superior when compared to the bond strength of porcelain to dentin.[16] After a precise impression with a silicone or polyether material, a provisional restoration can be quickly and easily provided by adding composite resin in the template manufactured for the direct mock-up **(Fig 18)**.

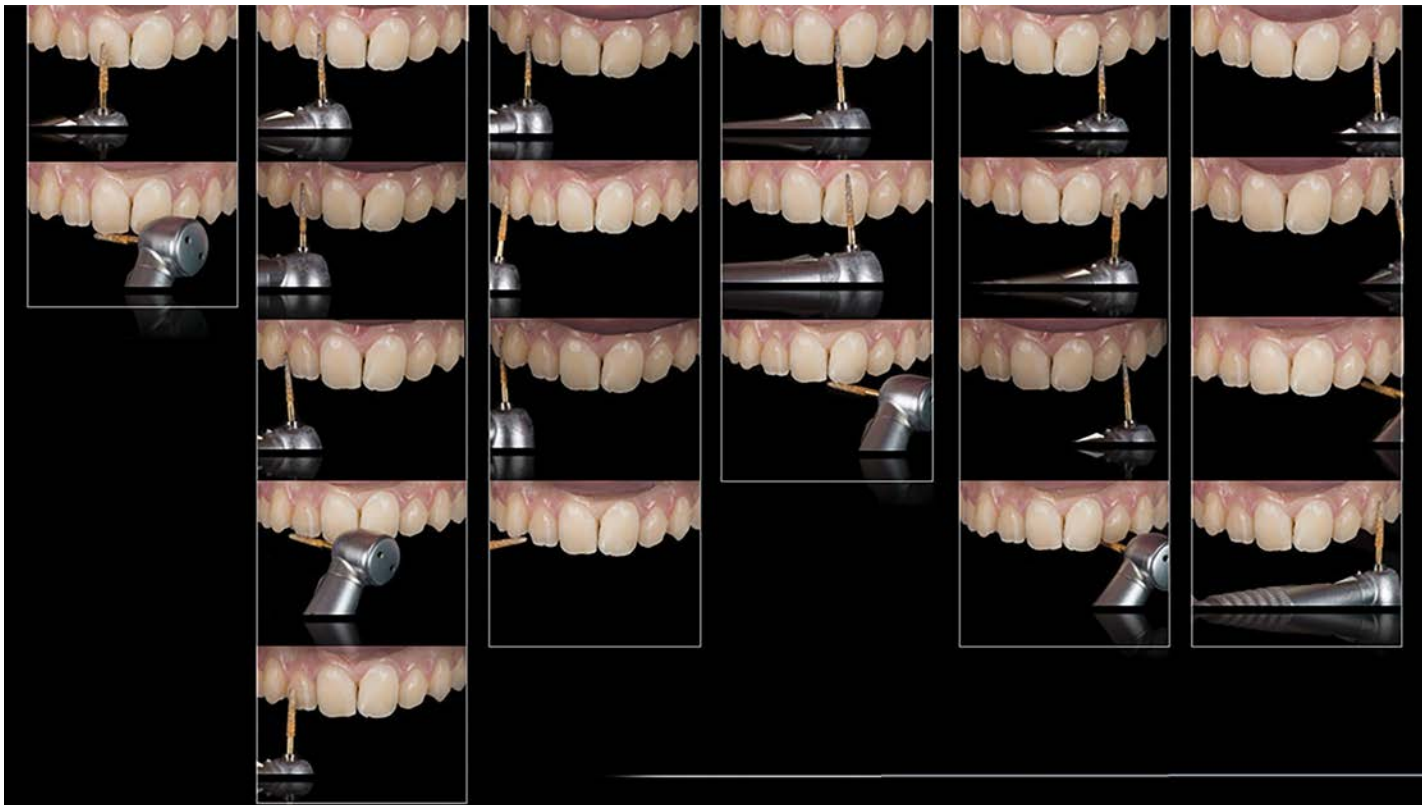


Figure 19: Selective enamel reduction depending on the presence of a minimum thickness for laminate veneer placement.

Figure 20: Silicone template to check the horizontal spaces for veneer placement.

Figure 21: Silicone template to check the vertical spaces for veneer placement.

Step 5
The dental technician manufactures laminate veneers on the new master cast **(Figs 22 & 23)**. Two types of materials are indicated for their translucency and potential to be used in small thickness: sintered feldspathic porcelain and pressable ceramic, which can also be milled using a computer-aided manufacturing technique.

> “The clinical workflow can be employed in the restoration of both anterior and posterior teeth by means of ceramic veneers and ceramic onlays to save as much natural tooth as possible.

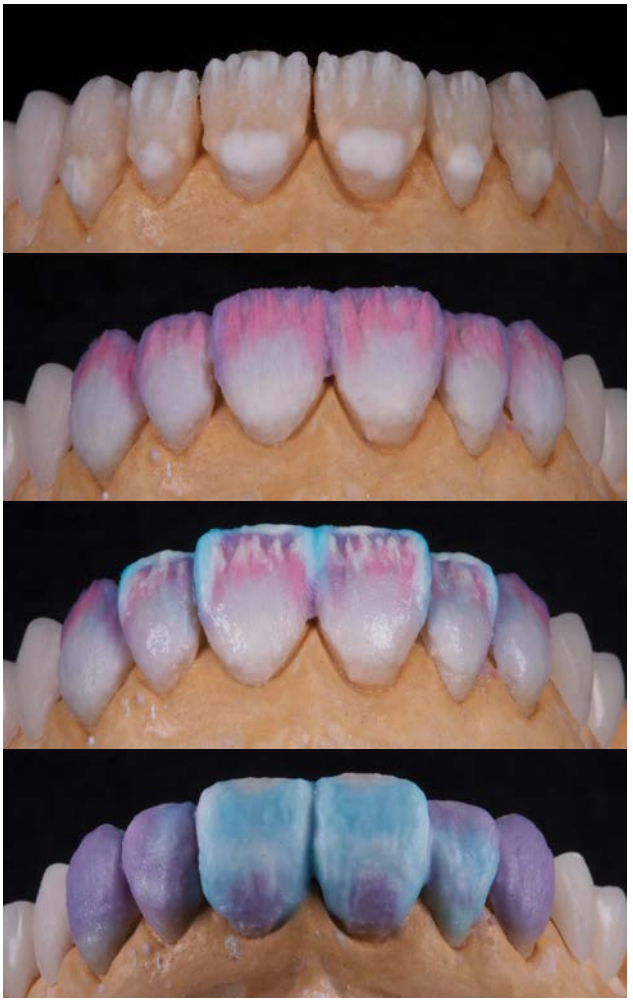


Figure 22: Addition of hand-made ceramic masses.

Figure 23: Laminate veneers before cementation.

Step 6

The veneers are cemented, becoming an integral part of the tooth structure and sharing part of the applied loading stresses during the masticatory cycle. A light-curing luting composite is preferred for cementation. The success of the porcelain veneer is largely determined by the strength and durability of the bond formed between the three components of the veneer complex (tooth surface, porcelain veneer, and luting composite). Also critical is the seating of the veneers; both appearance and durability can be affected if mistakes are made during this phase of treatment.[17] Use of a rubber dam is essential on the mandibular teeth to isolate the lip and tongue and to control moisture. Conversely, a rubber dam is not always recommended for the maxillary anterior teeth as the real cause of debonding or microleakage may be related mainly to preparation not limited to the enamel.[18,19] Cement residue should be removed carefully to avoid soft tissue inflammation **(Figs 24 & 25)**.

Figure 24: One week after cementation the veneers are completely integrated with the surrounding soft tissues.

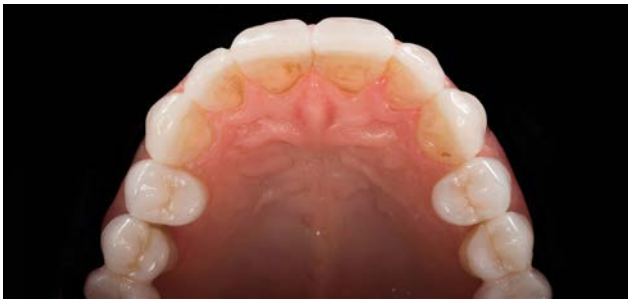


Figure 25: Laminate veneers and ceramic onlays, occlusal view.

Summary

The clinical workflow **(Fig 26)** can be employed in the restoration of both anterior and posterior teeth by means of ceramic veneers and ceramic onlays to save as much natural tooth as possible. A minimally invasive approach for restoring teeth in the esthetic zone should be followed. Clinician-patient communication utilizing tools such as digital smile design, a diagnostic wax-up, and a direct resin mock-up also play a crucial role in facilitating the patient's understanding of a complex treatment plan.

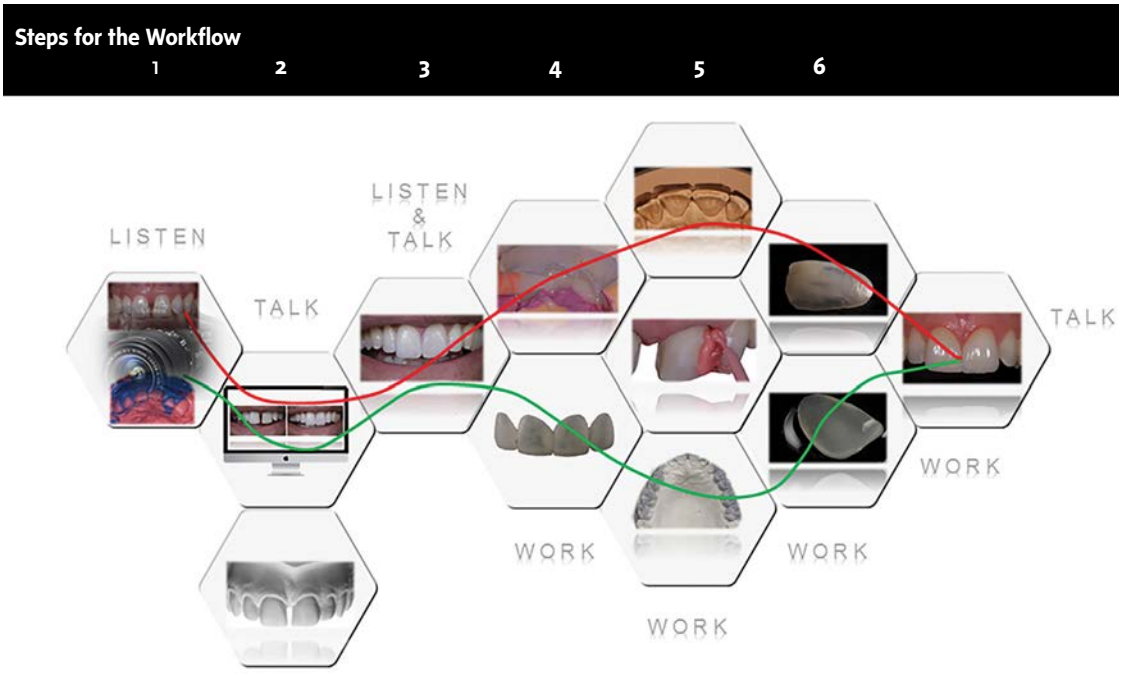


Figure 26: Laminate veneers communication workflow from treatment plan to cementation.

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The One-Bake Technique

A Specific Ceramic Stratification

Nondas Vlachopoulos, CDT

Abstract

Feldspathic porcelain has become a material of choice for esthetic restorations. It can be used with metal or zirconia framework or even alone, built on a refractory model. Having as few firing cycles as possible leads to positive effects and results. This article discusses a "one-bake" technique for creating beautiful esthetic restorations with feldspathic porcelain. The protocol begins with a special framework, the anatomical design of which supports the main developing crests of tooth. This type of design guides the technician in properly applying the different layers of the ceramic material on the framework. Opaques are layered first, followed by porcelain and then enamel. In the final step porcelain is added to the contact point. This technique is designed to provide enhanced esthetic and morphological details.

Key Words: one bake, framework design, shrinkage, veneering, no-mix

> Increasing the number of firing cycles seems to affect the microstructure, physical and mechanical properties, and optical behavior of feldspathic porcelain.

Introduction

Feldspathic porcelain has been a preferred material for esthetic coverage of prosthetic restorations for many years. The metal framework is fabricated following a series of steps, beginning with waxing, casting, finishing, and heat treatment (oxidization). After these steps opaque porcelain is fused on the alloy surface to create a bond between the alloy and porcelain and to hide the metal substrate, followed by extra firings of the veneer. On average, three to four firing cycles are needed to complete a restoration, depending on its size.[1-3] As a result of enhanced technology, many new materials are used today as substrate for feldspathic porcelain layering, such as zirconia and lithium disilicate. Feldspathic porcelain also can be used without a metal or zirconia framework, built on a refractory model or platinum foil for laminate veneer fabrication.[4,5]

Increasing the number of firing cycles seems to affect the microstructure, physical and mechanical properties, and optical behavior of feldspathic porcelain. Additionally, with zirconia frames, numerous firing cycles may affect feldspathic porcelain bonding due to the cooling rate and the mismatch in the coefficient of thermal expansion at the stages of heating and cooling.[6,7]

The author developed the "one-bake" technique to help resolve such issues and create esthetic long-term restorations. For some cases, however, a multiple-bake technique is preferred. It is essential that laboratory ceramists know the various techniques and be able to apply the most appropriate one for each case.

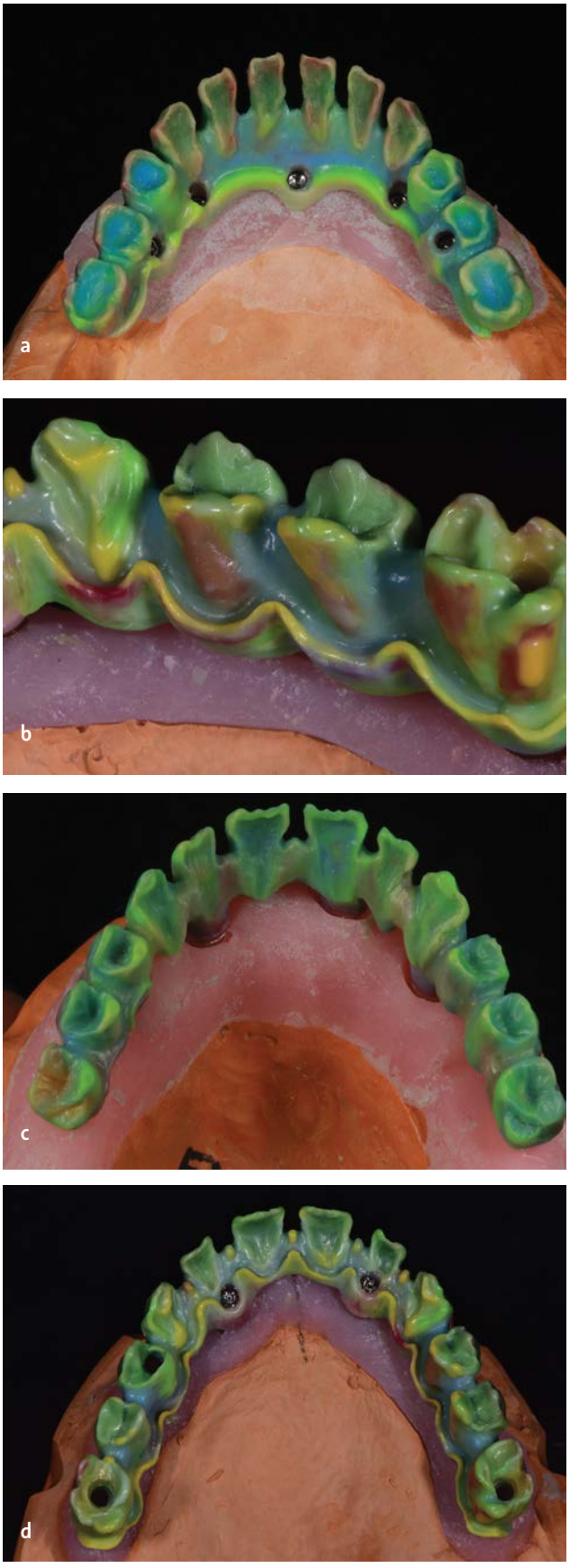
Protocol

Framework Design

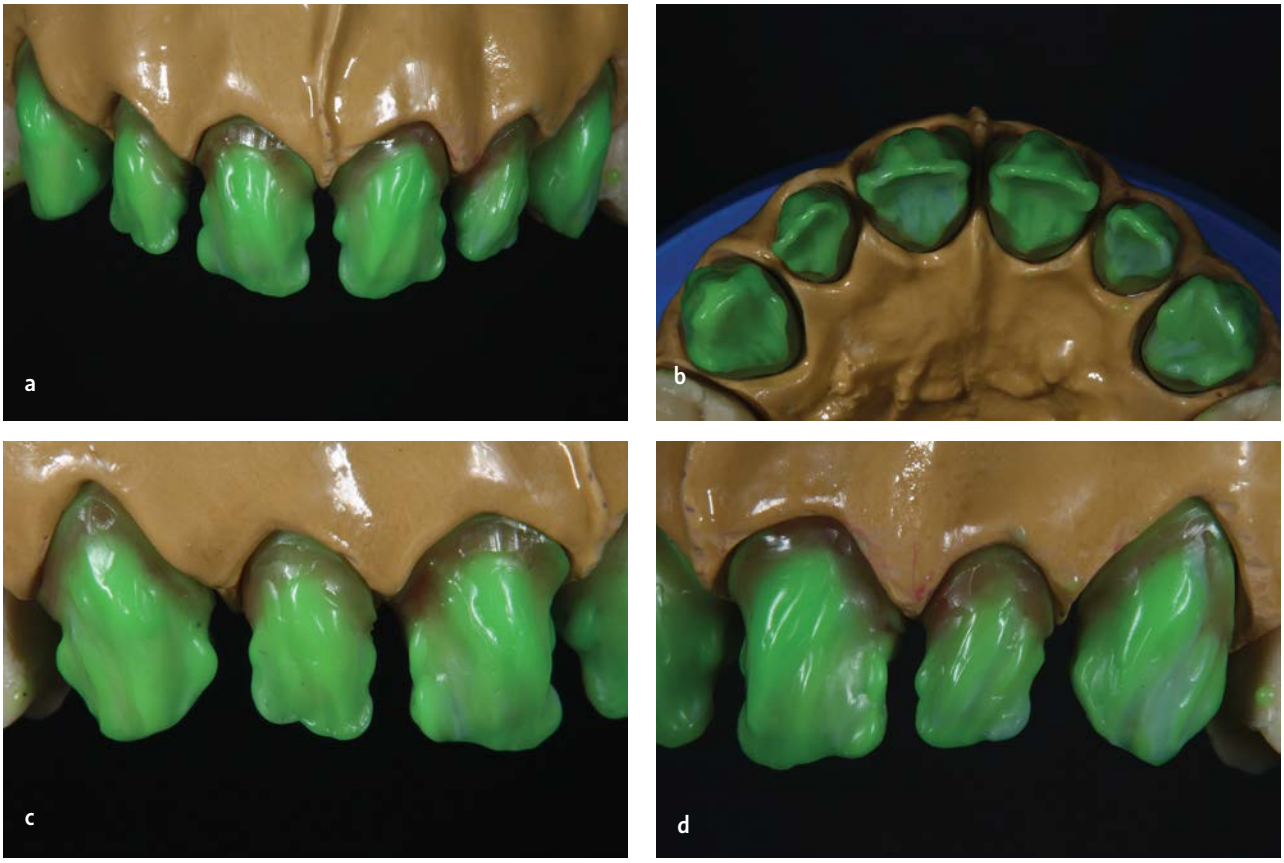
The protocol for the one-bake technique begins with a special framework design. The anatomical shape of the framework, developed at the stage of waxing or milling, is important to properly support the ceramic masses to be layered. The special anatomical design using and supporting the main developing crests of each tooth results in a homogeneous layer of ceramic material. The goal is to achieve a consistent ceramic thickness and to develop a strong framework. The homogeneous ceramic thickness substantially reduces the porcelain's fracture susceptibility.

In this type of design, concavities are mandatory for esthetics and convexities to control the shrinkage stresses that are created from the single firing cycle of porcelain. In addition, this type of design guides the technician in properly applying the different layers, following the morphology of the framework.

In the case of porcelain fused to metal, opaque layering follows framework fabrication as in the conventional technique **(Figs 1a-2d)**.



Figures 1a-1d: Special framework design.



Figures: 2a-2d: Special framework design with concavities and convexities.

Layering

The next and most important step of the one-bake protocol is the consecutive layering of all selected porcelain masses and the single firing cycle at the end. It is important not to mix the porcelain masses with liquid to avoid air inclusion. It is crucial to let the porcelain powder absorb only the necessary quantity of liquid, without mixing it. This way the baked porcelain has no entrapped air, resulting in minimal volumetric contraction and a superior esthetic outcome **(Figs 3 & 4)**.

The stratification begins by applying the opaque dentin at the cervical and incisal areas to manage the opacity and color value. Building of the dentin follows at the selected shade and the correct form so as to give the right hue, but also to ensure adequate and proper space for the transparent and translucent materials. Dentin powders in different colors and densities and with different light transmission properties also may be used at this stage.

> **“It is essential that laboratory ceramists know the various techniques and be able to apply the most appropriate one for each case.”**

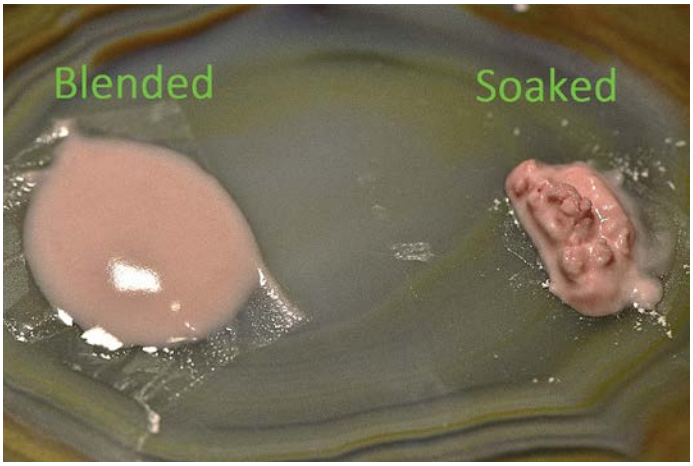


Figure 3: The porcelain masses (blended and soaked) immediately after mixing.

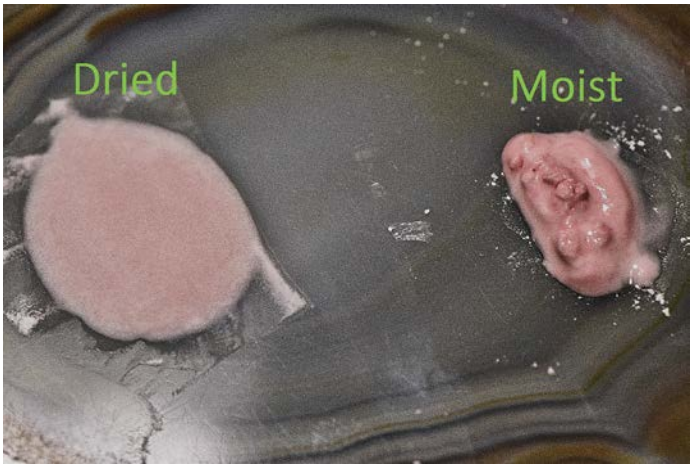


Figure 4: The porcelain masses (dried and moist) 30 minutes after mixing.

Dentin modifiers such as growth mamelons, cervical slides, illusion of depth zones, areas of greater color concentration and stains; and translucent modifiers such as opal incisal and proximal areas and areas with increased color value (as the transition lines) are now placed with extreme care. Dentin and modifiers are carefully covered with a thin layer of super-translucent enamel so the properties of the dentinoenamel junction are visually assimilated and the internal color morphology can be rendered three-dimensionally. Translucent enamels are applied externally so that the ceramic restoration obtains color depth and correct optical properties such as diffusion, scattering, and reflection, and to preserve the color value to correct levels.

Final Step

In the protocol's final step the work is removed from the model and porcelain is added to the contact points. Condensing and moisture removal are achieved with careful vibration and the use of hot air. The well-condensed ceramic mass will result in minimal overall shrinkage, allowing the restoration to be completed in less time and fewer firing cycles. The selection of the proper firing cycle is critical.

Case Presentation

A female patient wished to close the diastemas between her teeth and to decrease her excessive gingival display **(Fig 5)**. The treatment plan included crown lengthening to increase the clinical crowns of teeth ##5-12, which were restored with minimally invasive feldspathic veneers after minimal preparations, to preserve as much enamel as possible **(Figs 6-8b)**. The one-bake veneer porcelain protocol was followed, with feldspathic material for zirconia (CZR, Kuraray Noritake Dental; Tokyo, Japan) used for the layering stratification **(Figs 9-19b)**. The finished veneers are shown in **Figures 20a-20c**. Postoperative images were taken **(Figs 21a-21c)**, and the patient was very pleased with her new, enhanced smile **(Figs 22a & 22b)**.

Figure 5: The patient's initial situation, retracted view.

Figure 6: After crown lengthening.

Figures 7a & 7b: Crown lengthening and minimally invasive preparations.

Figures 8a & 8b: Alveolar plaster model without and with plaster dies.

Figures 9a & 9b: Refractory dies and opaque dentin applied at the cervical and incisal areas to manage the opacity and color value.

a

b

Figures 10a & 10b: Dentin.

a

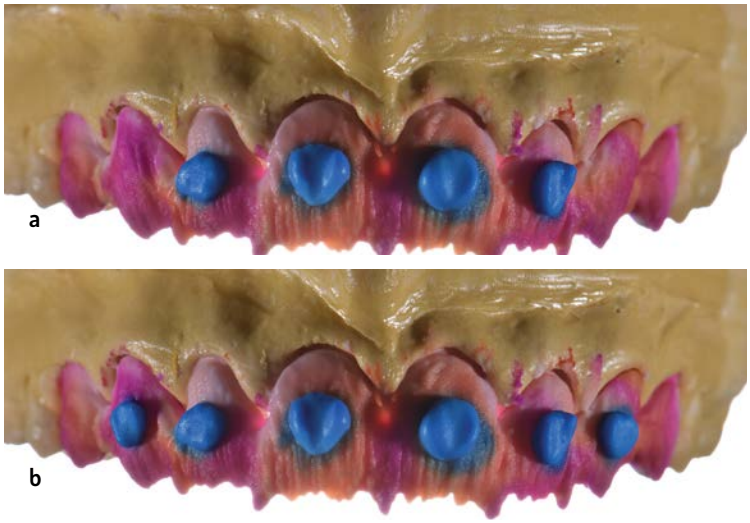
b

Figures 11a & 11b: Opacity modification of the dentin.

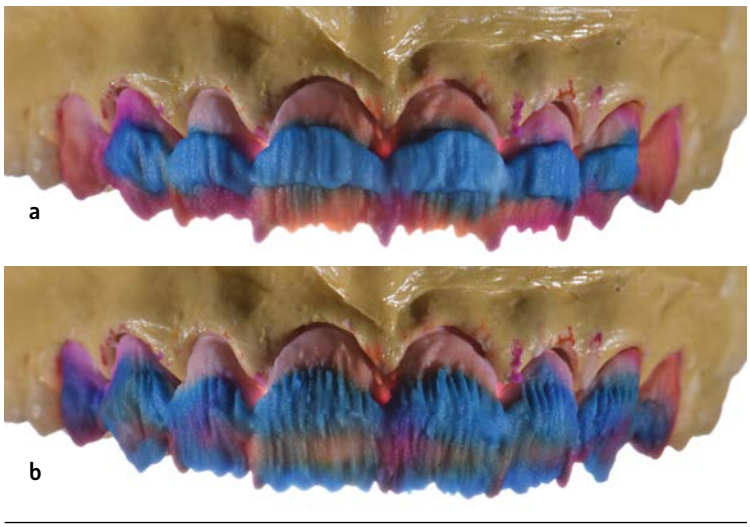
a

b

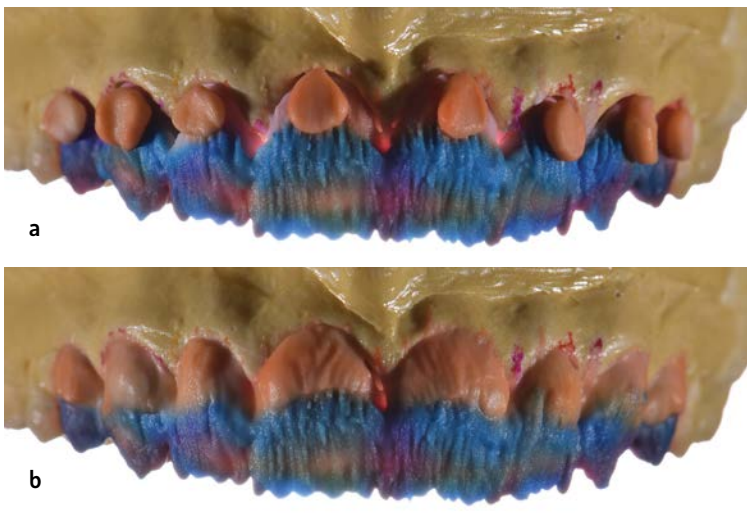
Figures 12a & 12b: Bluish transparent in the interproximal.



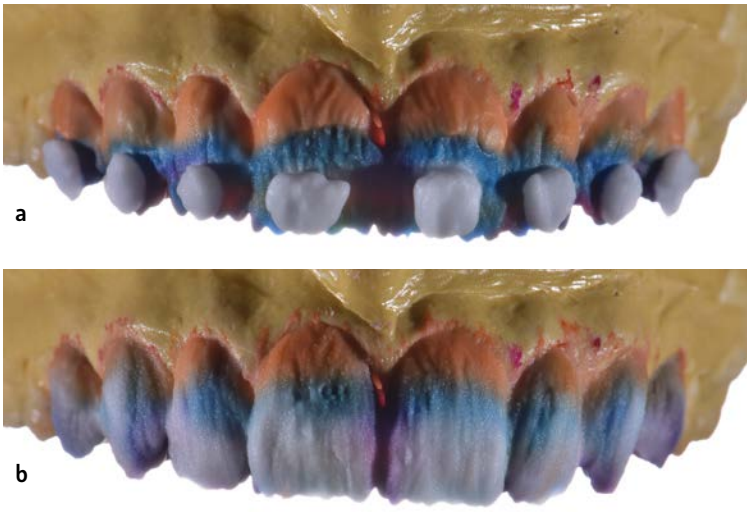
Figures 13a & 13b: Opalescent translucent.



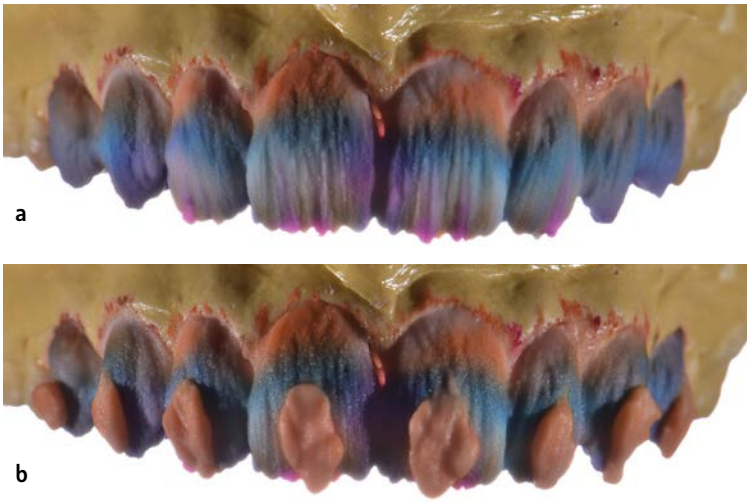
Figures 14a & 14b: Opalescent translucent and incisal application.



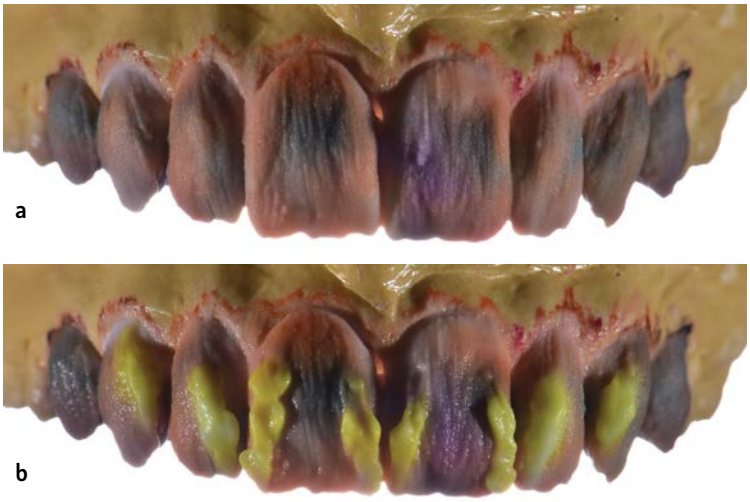
Figures 15a & 15b: Cervical translucent.



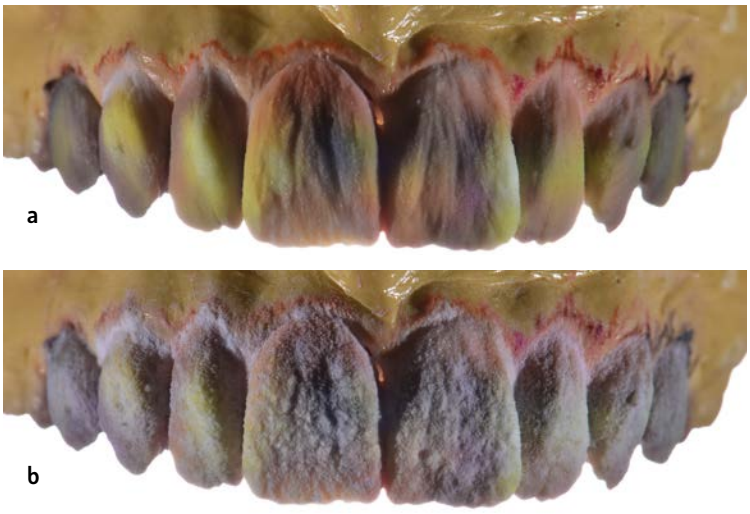
Figures 16a & 16b: Transparent.



Figures 17a & 17b: Mamelons and enamel.



Figures 18a & 18b: Lusters and high-value line angles.



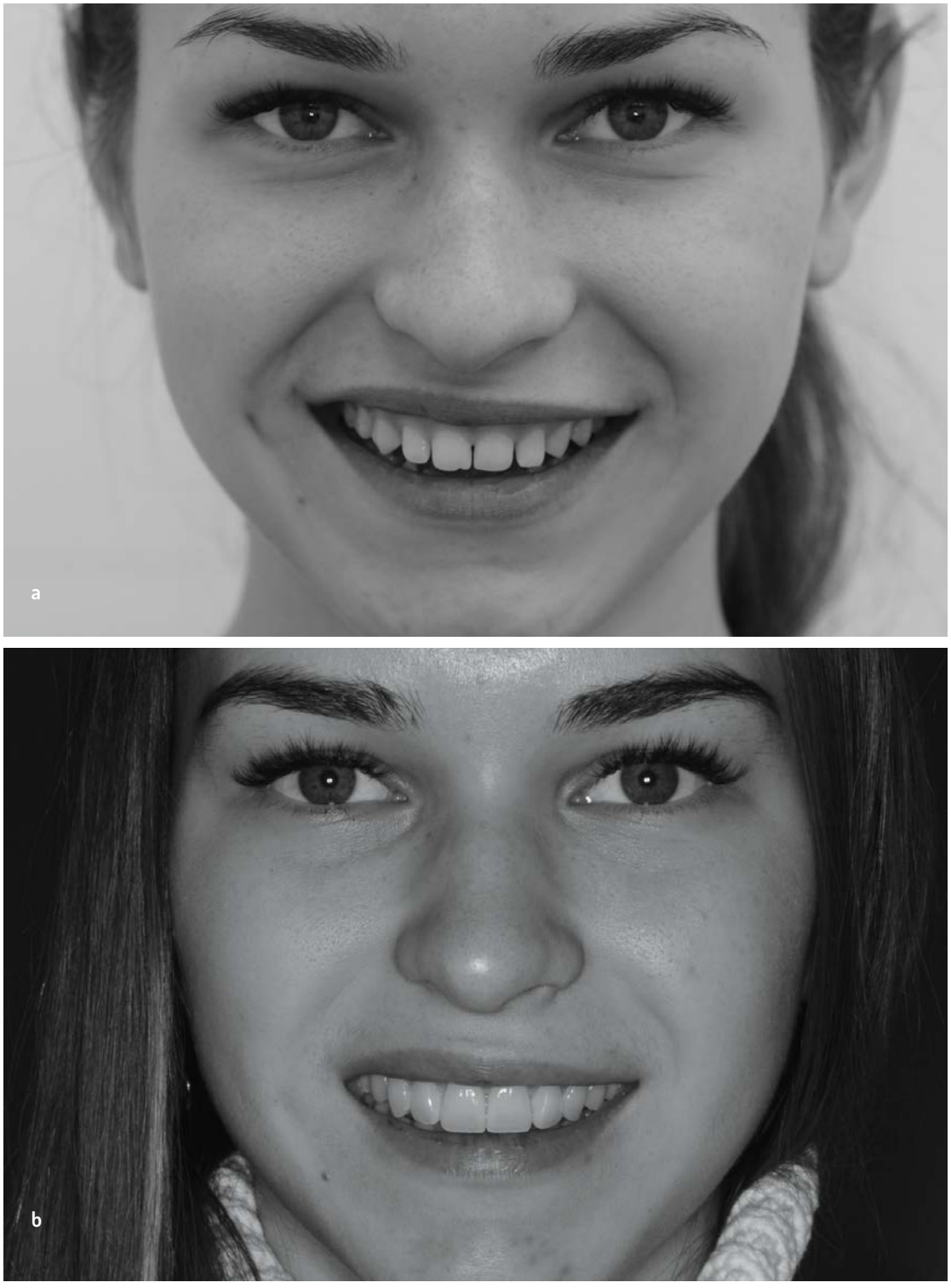
Figures 19a & 19b: Final shape and decalcification external powder.

Figures 20a-20c: Finished veneers.

> **The anatomical shape of the framework…is important to properly support the ceramic masses to be layered.**

Figures 21a-21d: Final result.

> In this type of design, concavities are mandatory for esthetics and convexities to control the shrinkage stresses that are created from the single firing cycle of porcelain.



Figures 22a & 22b: Portraits of the patient before and after treatment.

Summary

The one-bake technique described above is designed to ensure predictable and minimal shrinkage of the veneering porcelain. The duration of the entire procedure is shorter as there is just one firing cycle without having to add new porcelain masses. The optical properties of the ceramic are left unchanged and color masses are diffused in a natural way. The special design of the framework provides guidance for the dental technician during construction, and ensures predictable and controlled shrinkage coupled with avoidance of prolonged mixing of ceramic masses during their preparation. Moreover, use of this technique reduces the pyroclastic flow of porcelain, thus better preserving the shape, esthetic and morphological details, and occlusal contacts. The right degree of opacity, correct shade, color value, transparency, and overall optical properties can be achieved at the first and single firing. Because this technique requires the dental technician to have great dexterity and a delicate touch in correctly positioning different ceramic masses in the right quantity at a single building stage, a learning curve is to be expected.

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“The selection of the proper firing cycle is critical.”

Mr. Vlachopoulos is the owner of AestheticLab in Athens, Greece.

Disclosure: The author is an opinion leader and instructor for Kuraray Noritake Dental. He did not receive any support from Kuraray Noritake for writing this article.

Minimally Invasive, State-of-the-Art Treatment Patients Love.


Charissa Wood, RDH


The Perio Trays® by Perio Protect.

Charissa Wood, RDH practices at Atlanta Dental Spa with Dr. Peter Boulden, a Perio Protect premier provider. Below she gives insights on the secrets of their success.

How has Perio Protect® been successful in your office?
Perio Protect gives our patients a minimally invasive, state-of-the-art tool to treat periodontal disease. Patients embrace Perio Trays for the ease of use and consistent positive results which lead to compliance, trust and confidence in the practice and to the referral of family and friends. It has definitely provided a boost in production, but, best of all, we are helping our patients achieve healthy smiles that they love!

What does Perio Protect® allow you to do that conventional treatments do not?
If the old school paradigm of scaling and root planing was all it took to treat periodontal disease, we'd have a much healthier patient population.

We had hundreds of patients who had multiple rounds of scaling and root planing but still experienced inflammation and bone loss. Once these patients began to use Perio Protect as directed, we saw them achieve and maintain health long-term with reduced pocket depths, edema, inflammation, tenderness, and bleeding.

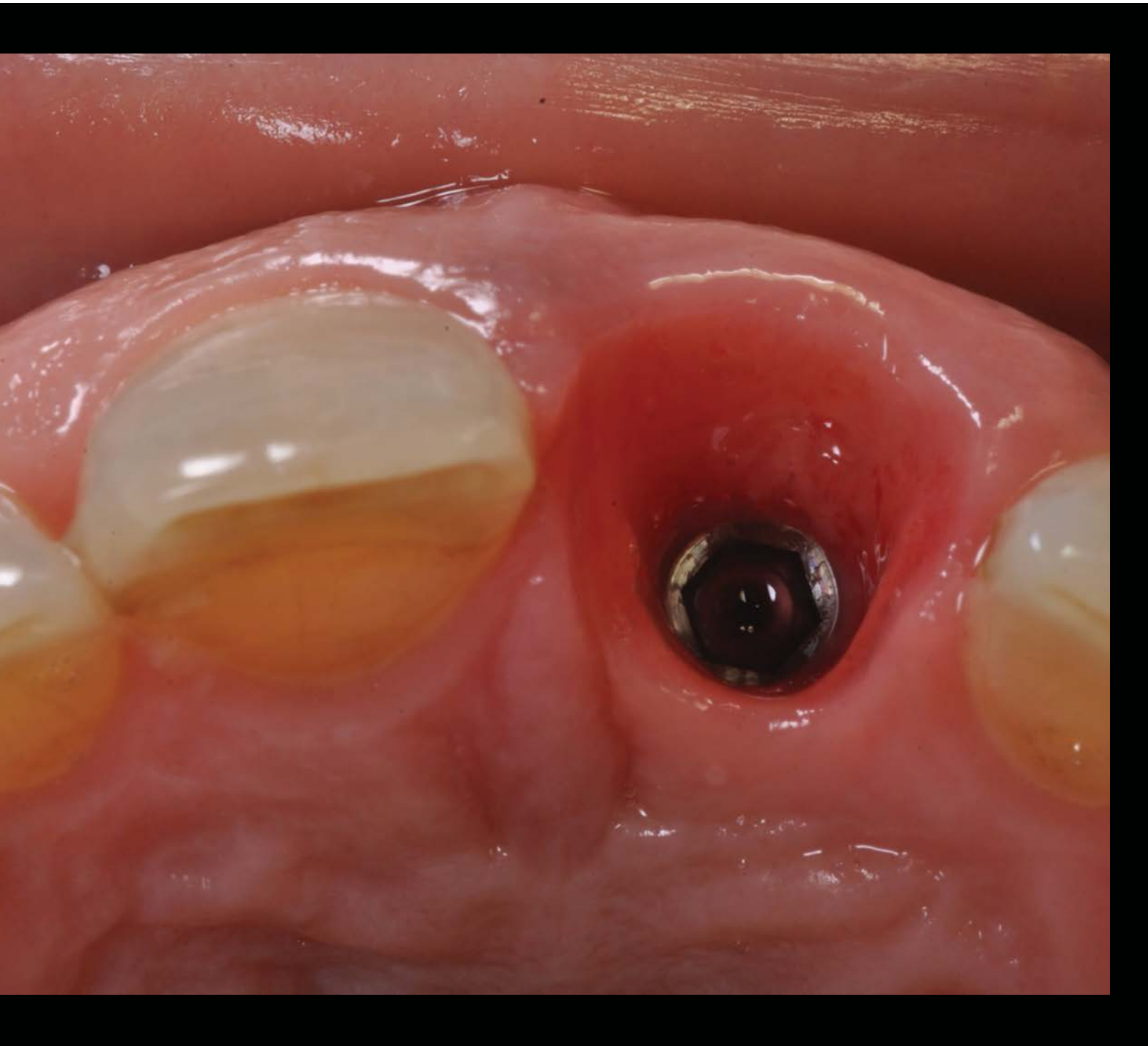
The most appealing advantage for me is that the Perio Tray delivers antimicrobials deep into pockets to address pathogens without creating tissue damage or extensive bacteremia.

Patients just use the trays with 1.7% peroxide gel for 15 minutes. It's that easy. They absolutely love you for giving them a comfortable option that works, freshens their breath, and also whitens their teeth.

How did you get started with Perio Protect in your office?
The science made sense so we decided to just dive in and give it a try! We sat down as a team and decided our price point, established our protocol and verbiage, and learned all the steps needed to get trays made. After our first few cases, we saw how beautifully it worked and were thrilled with the results! The more we saw, the easier it became to recommend to our patients with confidence.

How would you encourage other offices to try Perio Protect?
I think a lot of dental professionals are concerned that Perio Protect will take away from their hygiene profits of scaling and root planing, but it doesn't. It generates additional revenue. Perio Protect is a practice builder because it truly brings your patients to health.

It is also a great tool for the cosmetic and restorative work we do. From implants to veneers, Perio Protect provides longevity with healthy gums.



Surgical Veneer Grafting

Compensation for Natural Labial Plate Remodeling After Immediate Implant Placement

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David A. Garber, DMD
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Abstract

Contemporary implant therapy aims to provide highly esthetic and predictable treatment outcomes while decreasing treatment duration and complexity. The clinician must therefore be cognizant of circumstances with a predisposition toward esthetic outcomes and treatment plan accordingly. Preservation of the surrounding hard and soft tissues associated with an immediate postextraction socket implant to replace a nonrestorable tooth in the esthetic zone is one of the greatest challenges facing the dental team. Several studies have documented the biologic and esthetic benefits of bone graft containment with either a custom healing abutment or provisional restoration. Because esthetic complications increase in patients with a thin periodontal phenotype, additional surgical intervention may be necessary to enhance the surrounding soft tissue architecture before, during, or after implant placement. A combination of bone graft and connective tissue graft can help in overbuilding the socket site and achieve a sustainable and predictable esthetic outcome, especially in patients with a thin gingival phenotype. A case report of a hopeless maxillary left central incisor in a patient with a thin periodontal phenotype illustrates this new surgical and prosthetic approach. Clinical, radiological, and esthetic parameters were recorded to evaluate primary treatment outcomes.

Key Words: extraction socket, implant surgery, single-tooth implants, overbuilding of the socket site, bone socket graft, soft tissue graft

CE CREDIT

Learning Objectives

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

1. **Discuss current recommendations associated with placing an immediate postextraction socket implant in the esthetic zone.**
2. **Appreciate the surgical veneer grafting technique, including dual-zone bone grafting with an epithelial connective tissue graft, and its potential advantages.**
3. **Understand current surgical techniques to assist in predictable treatment outcomes with immediate implants.**

Disclosures: The authors did not report any disclosures.

"The esthetic ramifications of immediate implants, especially for single anterior teeth in the esthetic zone, are of increasing significance."

Introduction

The concept of immediate single-tooth implant replacement in a fresh extraction socket in the esthetic zone with placement of an immediate provisional restoration was introduced in 1998.[1] Since that time, it has become accepted as one of the treatments of choice in esthetic situations. Treatment procedures are condensed into fewer patient appointments, reducing overall treatment time and increasing patient comfort.[2,3] In the past decade, many studies have described this approach as a predictable procedure, with survival rates similar to that of delayed implant placement with or without provisional restoration and bone grafting.[2,3]

Esthetic Ramifications of Immediate Implants

The esthetic ramifications of immediate implants, especially for single anterior teeth in the esthetic zone, are of increasing significance.[4] The actual challenge for clinicians utilizing immediate anterior implant placement protocols is no longer only to achieve osseointegration, the rates of which are extremely high,[5,6] but also to improve protocols that allow for less traumatic, more time-efficient, and highly predictable esthetic treatment outcomes in the more demanding anterior region.[7-9]

Morphological Changes

In fact, while tooth replacement with immediate implant placement and provisionalization (IIPP) has been shown to be a successful procedure, slight facial gingival recession and buccolingual contour shrinkage has been reported following the first year of prosthetic function.[10] Studies show that changes in the morphology of the hard (bone) and soft tissue surrounding an implant are normal phenomena after dental extraction and implant placement. Several studies have documented the biologic and esthetic benefits of bone graft containment with either a custom healing abutment or provisional restoration.[11] The resorption of a postextraction socket is the direct result of trauma to the bone-periodontal ligament (PDL)-tooth complex. Bundle bone born from a functionally loaded PDL is lost following extraction and leads to an almost certain remodeling of residual buccofacial tissues.[12] In any case, the complete maintenance of ridge volume after tooth extraction with preservation techniques utilizing currently available materials as a primary prevention is not yet predictable.[13] Moreover, a study with 92 cases found that 87% had a buccal plate thinner than 1 mm.[14]

The question, therefore, is whether by thickening the soft tissue with a soft tissue graft, the loss of bone volume in the labial area can be compensated for and maintained over time. Accordingly, it has been stated that one can expect there to be at least 1 mm shrinkage of the buccal facial gingiva following immediate implant placement, which possibly can worsen in thin gingival biotypes.[11] It is clear that the thickness of peri-implant mucosal tissues affects abutment material selection in relation to the gingival color, all of which must be in balance to achieve a predictable and sustainable esthetic outcome.[15-18]

Requisites for Esthetic Success

Today, for an anterior implant restoration to succeed esthetically, it must be supported by natural-looking gingival tissue in harmony with the adjacent dentition.[19] This means that the natural appearance of a restoration and the stability of the surrounding gingival architecture are pivotal for a successful treatment outcome. Moreover, for a particular procedure, such as immediate implant placement and loading, the peri-implant gingival tissue condition is highly influenced by the position, quality, and thickness of the bone and gingival tissue, which must be assessed before treatment.[20]

The trend in this area of research is moving toward the idea that increasing peri-implant soft tissue thickness increases the substrate's color-masking ability and bone stability.[21,22] Areas of low esthetic value (molars and premolars) might be of less concern; however, a recession and a ridge collapse can result in an esthetic issue in areas such as the anterior maxilla. Compromised esthetics may be compensated by a low smile line and thick gingival biotype when treating single-tooth cases, but when implant therapy is provided to patients with high esthetic risk profiles, high esthetic demands, and thin gingival biotype, the risk for an esthetic failure is exponentially increased.[23]

According to these considerations and to the fact that in certain patients, such as those with a thin biotype, the esthetic outcome of an implant-supported restoration is mainly dependent on the soft tissue, both in terms of volume and having a natural appearance that is in harmony with the adjacent dentition.[9] The case report presented in this article illustrates an approach that combines dual-zone bone grafting[9] together with a connective tissue graft. The authors have named this protocol the surgical veneer grafting (SVG) technique.

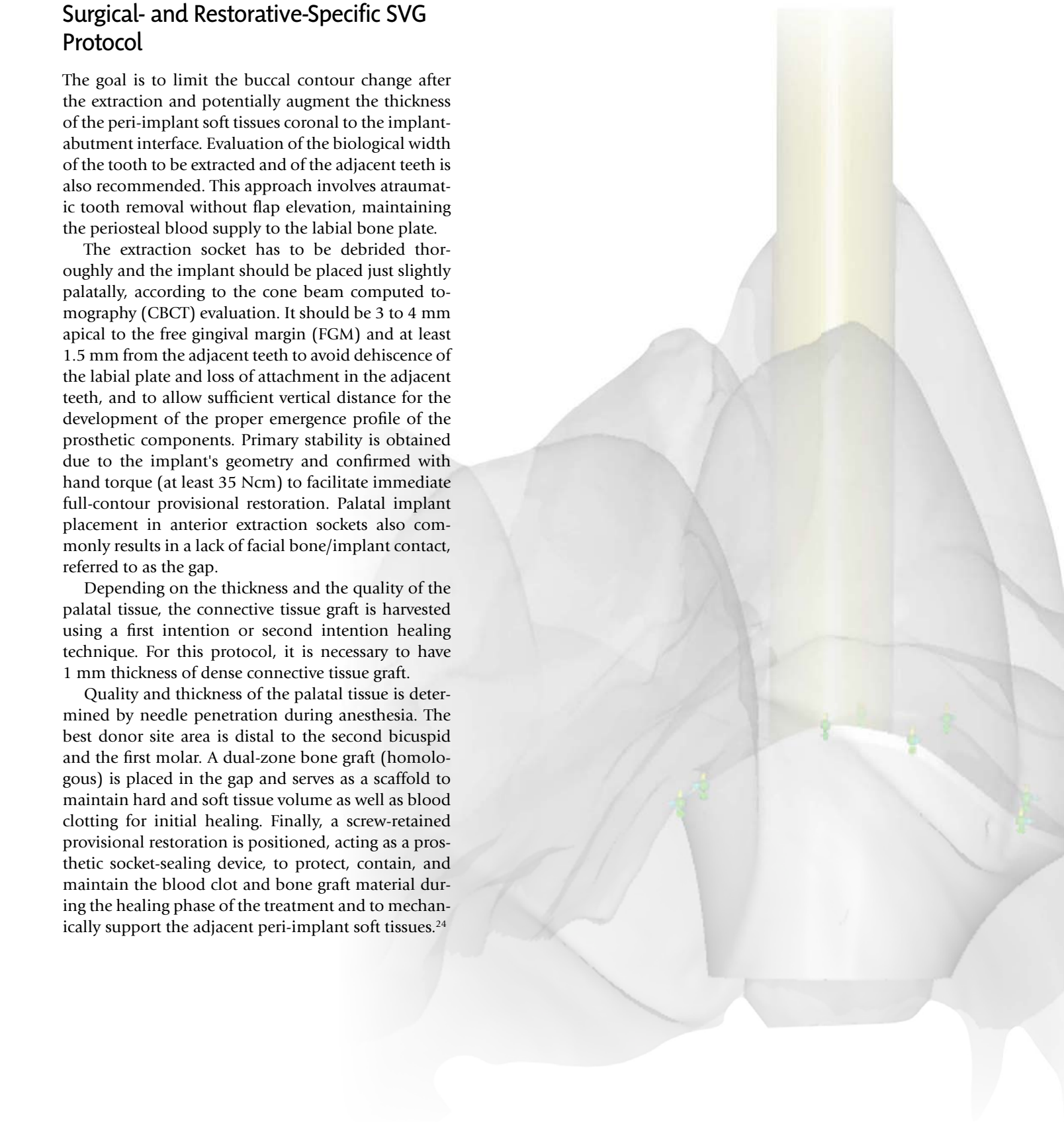
Surgical- and Restorative-Specific SVG Protocol

The goal is to limit the buccal contour change after the extraction and potentially augment the thickness of the peri-implant soft tissues coronal to the implant-abutment interface. Evaluation of the biological width of the tooth to be extracted and of the adjacent teeth is also recommended. This approach involves atraumatic tooth removal without flap elevation, maintaining the periosteal blood supply to the labial bone plate.

The extraction socket has to be debrided thoroughly and the implant should be placed just slightly palatally, according to the cone beam computed tomography (CBCT) evaluation. It should be 3 to 4 mm apical to the free gingival margin (FGM) and at least 1.5 mm from the adjacent teeth to avoid dehiscence of the labial plate and loss of attachment in the adjacent teeth, and to allow sufficient vertical distance for the development of the proper emergence profile of the prosthetic components. Primary stability is obtained due to the implant's geometry and confirmed with hand torque (at least 35 Ncm) to facilitate immediate full-contour provisional restoration. Palatal implant placement in anterior extraction sockets also commonly results in a lack of facial bone/implant contact, referred to as the gap.

Depending on the thickness and the quality of the palatal tissue, the connective tissue graft is harvested using a first intention or second intention healing technique. For this protocol, it is necessary to have 1 mm thickness of dense connective tissue graft.

Quality and thickness of the palatal tissue is determined by needle penetration during anesthesia. The best donor site area is distal to the second bicuspid and the first molar. A dual-zone bone graft (homologous) is placed in the gap and serves as a scaffold to maintain hard and soft tissue volume as well as blood clotting for initial healing. Finally, a screw-retained provisional restoration is positioned, acting as a prosthetic socket-sealing device, to protect, contain, and maintain the blood clot and bone graft material during the healing phase of the treatment and to mechanically support the adjacent peri-implant soft tissues.[24]



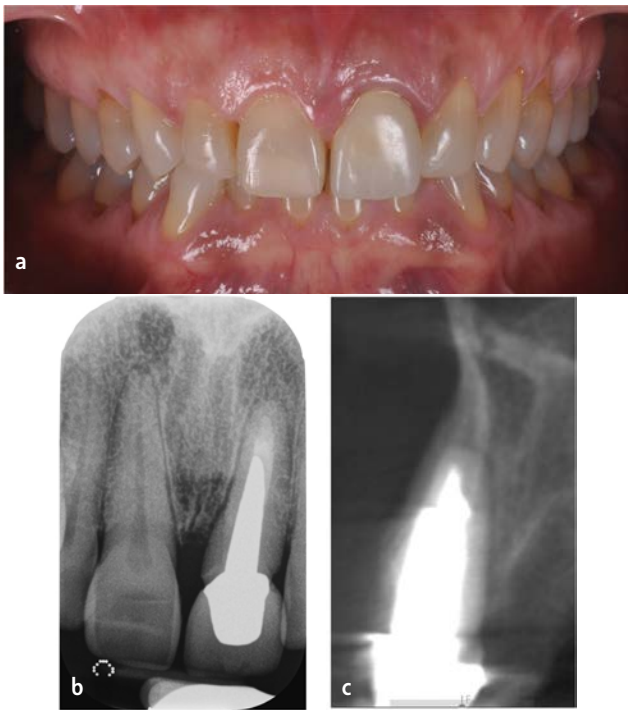
Case Report

Patient Complaint and Evaluation

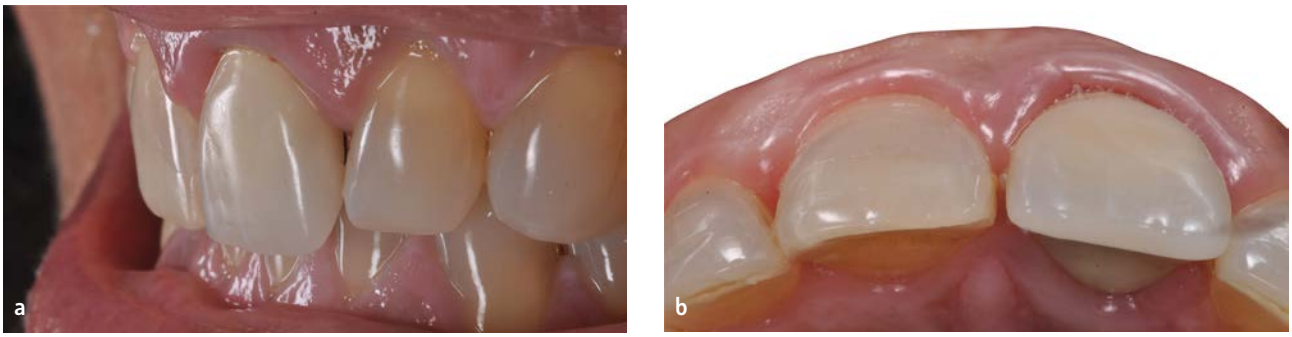
A 43-year-old female presented with pain and evidence of a palatal fracture to the maxillary left central incisor, revealed in the periapical radiograph and CBCT evaluation **(Figs 1a-2b)**.

Preoperative antibiotics (amoxicillin, 2 g) were given orally one hour prior to surgery. After the administration of local anesthesia, sharp dissection of the supracrestal fibers was performed with a 15c blade and the root was removed atraumatically with a periotome and extraction forceps with rotational movements, without elevating any flaps.

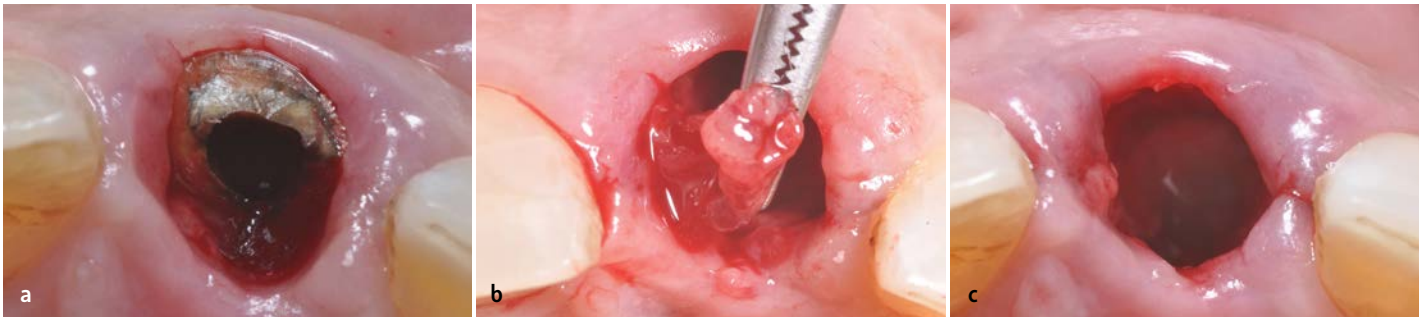
After an accurate socket debridement with a surgical excavator **(Figs 3a-3c)**, a 3.7-mm diameter tapered design and textured surface implant (Tapered Screw-Vent, Zimmer; Warsaw, IN) was placed **(Fig 4)**, following the indications given by the CBCT evaluation and the adjacent teeth, toward the palatal aspect of the extraction socket to a depth of 4 mm from the FGM. Flap elevation was not necessary and the buccal bone plate was intact after tooth removal. A torque value of 40 Ncm was achieved upon implant placement to permit immediate provisional restoration, and the screw-hole axis was at the level of the cingulum of the adjacent teeth **(Fig 5)**.



Figures 1a-1c: Patient with crowned maxillary left central incisors, which had a root palatal fracture evidenced by the periapical radiograph and the CBCT scan.



Figures 2a & 2b: Tissue biotype, whether it is evaluated visually or with a periodontal probe, is indicative of the thickness of the marginal tissues. This case presented with a scalloped gingival architecture with a thin tissue biotype.



Figures 3a-3c: Minimally invasive extraction of the maxillary left central incisor root, avoiding raising a flap and preserving as much of the surrounding hard and soft tissues as possible. The socket was then carefully debrided before implant placement.

Figure 4: An internal connection implant was placed with the implant shoulder 4 mm apical to the FGM.

Figure 5: Once the implant was positioned, the marginal residual gap measured 3 to 4 mm.

Provisional Restoration

A customized provisional sandblasted and silaned titanium cylinder was tightened by hand and sealed with blue wax at the mouth of the screw **(Fig 6a)**. The prefabricated provisional was filled with acrylic resin (Palavit and Paladur, Heraeus Kulzer GmbH; Hanau, Germany), seated into the abutment after protecting the socket with rubber dam in the proper facial and vertical positions, and allowed to set prior to removal.

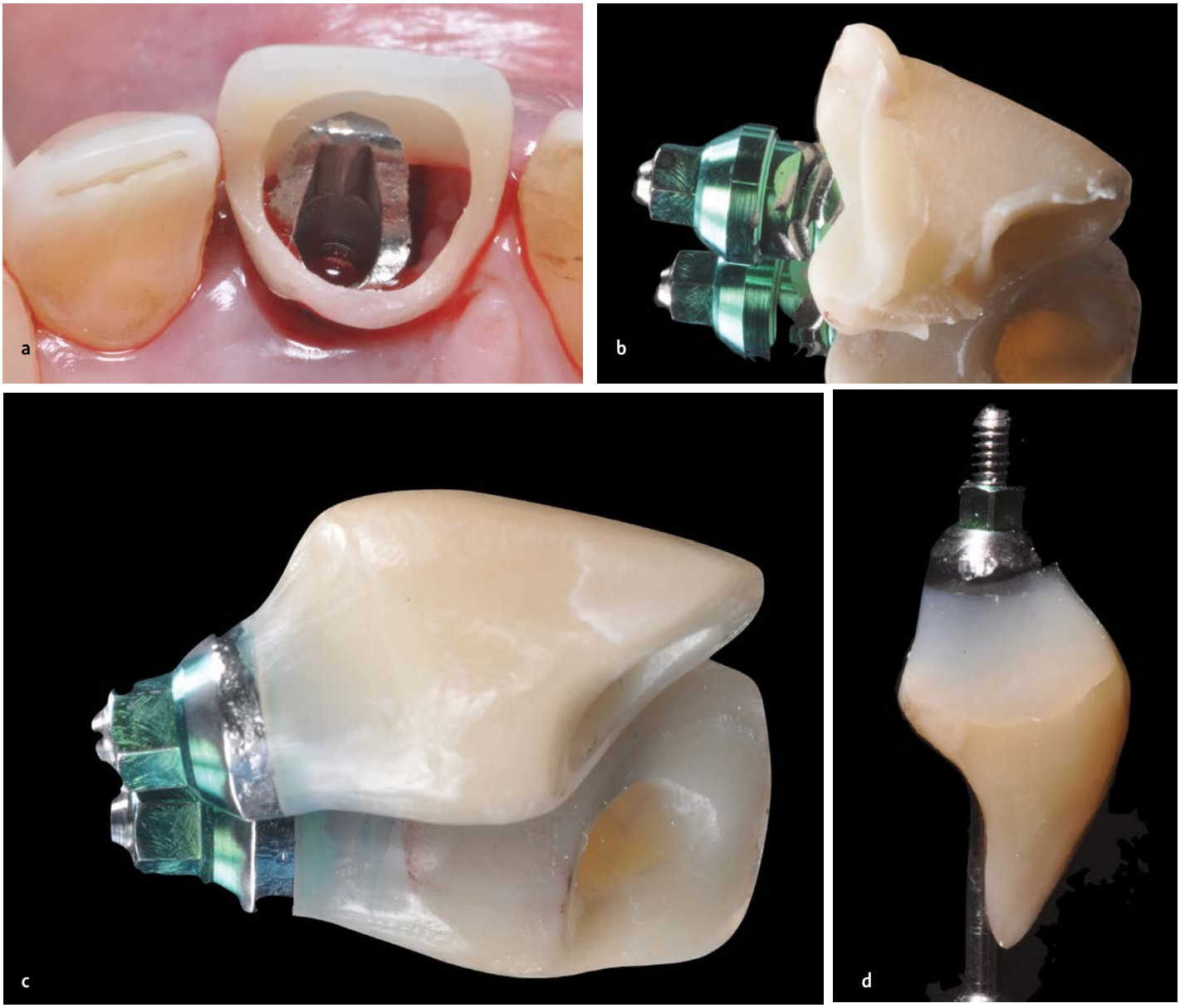
It is crucial to place enough acrylic resin material to secure the abutment mechanically and chemically to the temporary cylinder. However, this must be done without engaging the undercut regions of the proximal contact areas, because doing so would make removal of the provisional restoration extremely difficult and could potentially damage the implant's stability.

The relined provisional restoration was then disinfected and screwed into a laboratory analog, the proximal contact areas were marked with a dark pencil, and the subgingival contours were recreated with flowable composite resin. The contour of the provisional restoration was shaped with burs in a low-speed straight handpiece. The marked proximal contact areas must be respected. Enough resin must be left palatally to keep the provisional restoration intact and stable to the titanium abutment, avoiding any possibility of poor fit.

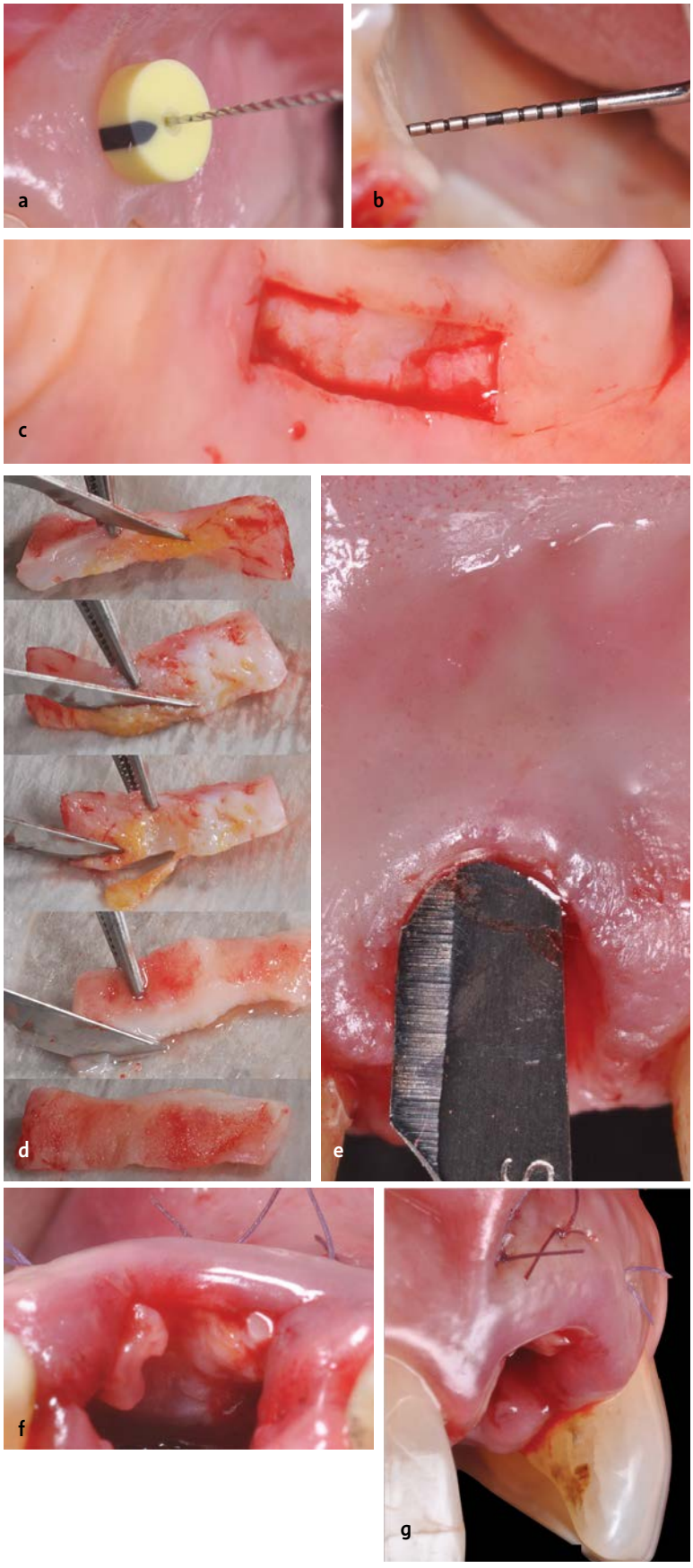
Finally, the provisional restoration must be smoothed and polished, first using rubber-polishing instruments mounted on a straight handpiece and then using pumice stone. The surface colorants should be applied only to the supragingival area of the provisional restoration to avoid interference with healing of soft tissues **(Figs 6b-6d)**. Smoothing the provisional restoration is one of the most important steps in the entire treatment, to promote adhesion of the epithelium in the early stages of wound healing.

The provisional restoration should be fabricated first, prior to placement of the bone and connective tissue graft material, since the graft material must remain intact and uncontaminated during the procedure.[25]

"Studies show that changes in the morphology of the hard (bone) and soft tissue surrounding an implant are normal phenomena after dental extraction and implant placement."



Figures 6a-6d: A prefabricated provisional cylinder is adapted to the edentulous and interocclusal space. The occlusal surface is open in order to check for passive fit with the temporary titanium abutment and to allow unscrewing following hardening of the acrylic resin. The subgingival contour of the provisional crown is concave to provide more space for the connective tissue, while the area in contact with the gingival margin is made flat to avoid putting pressure on the facial gingival support. The subgingival contours of the provisional crown were reestablished using a flowable composite resin.



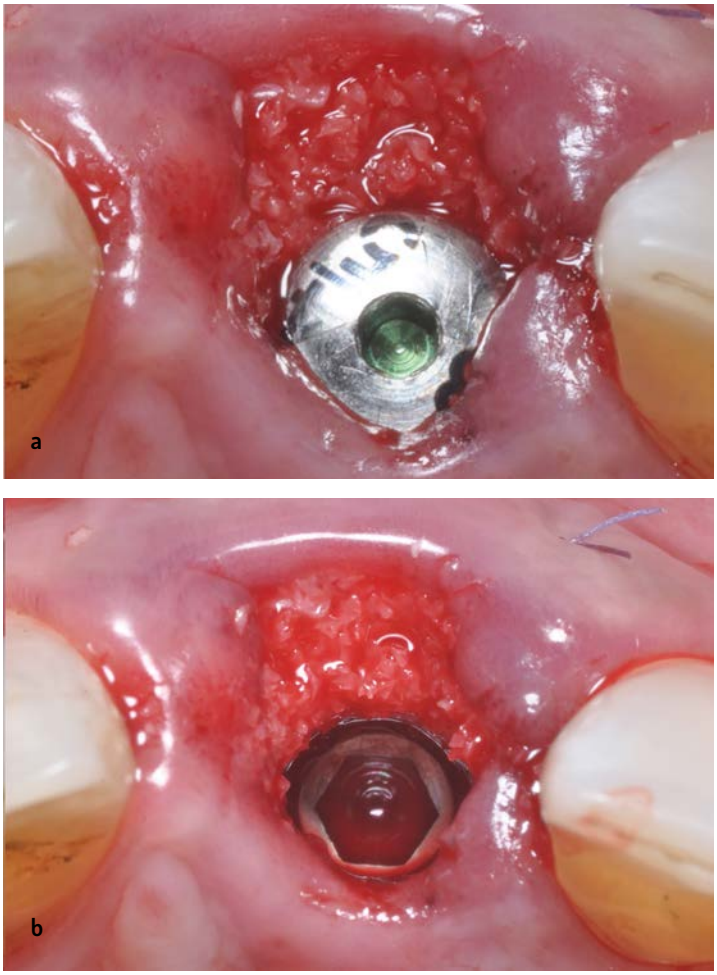
Connective Tissue Graft

After evaluating the palatal tissue thickness and quality **(Figs 7a & 7b)**, it was decided to harvest an epithelial connective tissue using a 15c blade, 2 mm apical to the palatal gingival margin of the second bicuspid and the first molar.

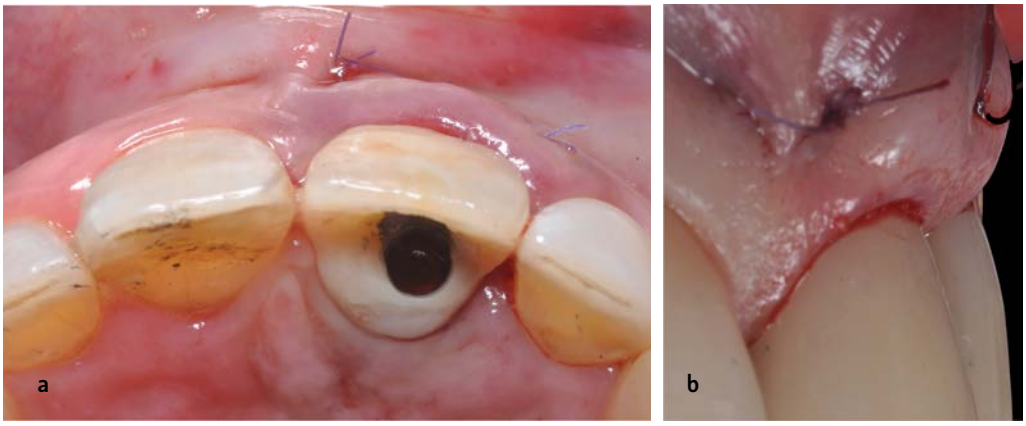
During the first incision, the blade had to penetrate 1.5 mm. This incision had to be horizontal, the most coronal one being 10 mm long. The two vertical incisions, 6-mm long, then had to be made and, before the last apical horizontal incision, the graft had to be prepared with a partial thickness incision and starting from the mesiocoronal angle, avoiding extensive bleeding in the surgical area, leaving the submucosa to protect the bone **(Fig 7c)**. The epithelial connective tissue graft was now 1.5 mm thick, 10 mm long, and 6 mm high. The epithelial tissue was removed chairside (as was, eventually, the fatty glandular soft tissue) with a new 15c blade, oriented to the support plan. This would enable us to obtain a white, dense, 1-mm thick connective tissue graft **(Fig 7d)**. On the recipient site, a partial thickness envelope was created 3 mm apical to the mucogingival junction toward the adjacent teeth, and the graft was stitched intramurally with a 6.0 suture (Omnia SpA; Fidenza, Italy) to stabilize and properly adapt the graft, minimizing the blood clot **(Figs 7e-7g)**. With this approach, the connective tissue graft gains blood supply both from the flap and from the periosteum.

Figures 7a-7g: Prior to harvesting the graft, it is suggested to assess the thickness of the palatal donor site and also the thickness of the gingiva around the tooth to be extracted with the use of an endodontic wire. Finally, the amount of tissue to be harvested, which is related to the root profile of the site to be augmented, must be evaluated. The tissue is harvested with a 15C scalpel. After being deepithelialized chairside, the connective tissue is allocated inside the partial thickness envelope flap and fixed intramurally with three single suture points using a 6.0 resorbable suture.

The final phase was to pack the bone graft material into the remaining gap. To accomplish this, a narrow, flat-contoured healing abutment was screwed into the implant after removing the provisional restoration. A homologous cancellous bone graft material (Puros, Zimmer) was used to pack the bone particles up to the gingival margin, giving the blood time to incorporate within the particles. The abutment should be tall and narrow enough to allow the bone graft to be placed and packed against it with a dedicated instrument, to the most coronal aspect of the gingival margin, maximizing the amount of graft material that can be placed into the labial gap **(Fig 8a)**. The flat profile-healing abutment was then removed, leaving the bone graft material undisturbed **(Fig 8b)** and the provisional restoration was repositioned and tightened with 20 Ncm torque. The provisional restoration had subgingival contours that enabled it to support the soft tissue profile and help protect the blood clot as well as the bone and the connective tissue graft. While screwing in the provisional restoration, cleared from dynamic occlusion, excess bone graft material was removed with a periodontal probe to the level of the gingival margin and a postoperative x-ray was taken **(Figs 9a & 9b)**.



Figures 8a & 8b: The marginal gap is filled with small-particle bone graft. The dual-zone bone grafting (placement of the bone graft not only in the gap between the implant and the labial bony plate but also in the zone above the implant-abutment junction) provides support and volume to the hard and soft tissues.



Figures 9a & 9b: Occlusal and profile views of the screw-retained provisional restoration in place the day of surgery. Note the overbuilding of the socket site.

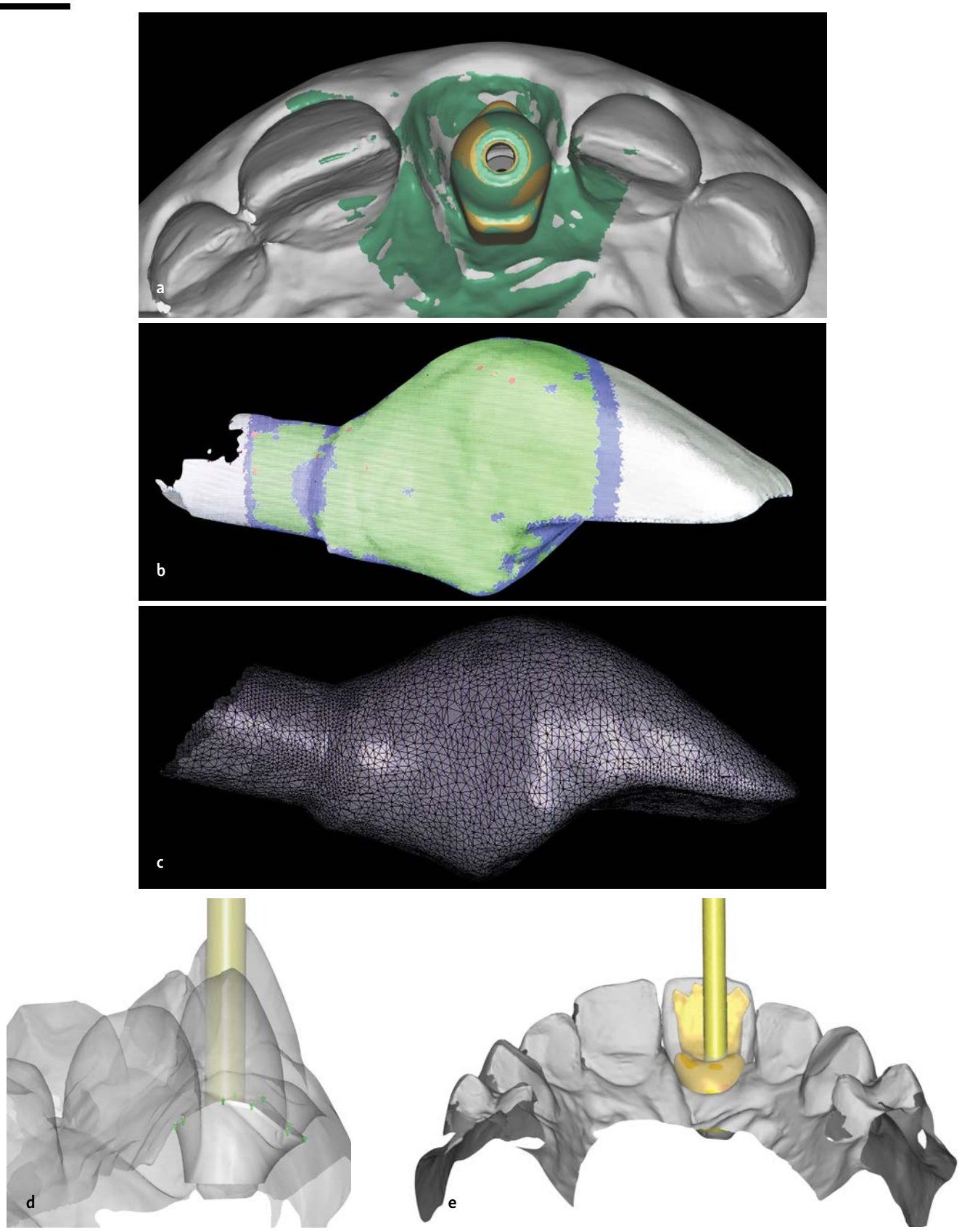
Postoperative

The patient was instructed to rinse three times a day for one minute with chlorhexidine digluconate (0.12%) and to avoid removing plaque by mechanical means at the surgical sites for three weeks. Sutures were removed three weeks postoperatively and the patient was asked to commence plaque removal at the provisional with a soft-bristled toothbrush and to rinse twice a day for one minute for an additional month. She also was instructed to follow a semi-liquid diet for the first week and then soft foods for the next two months.

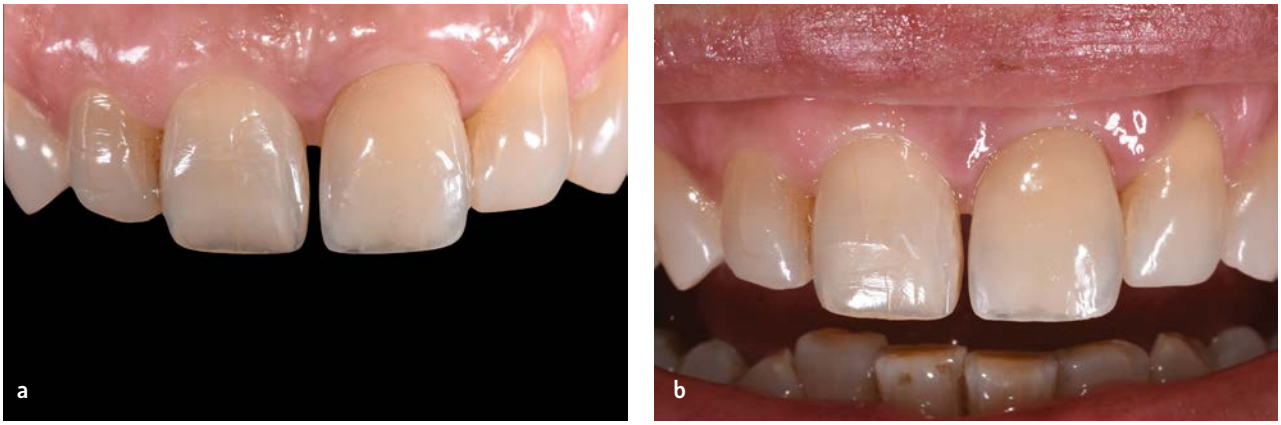
The patient returned for regular follow-up appointments; at the four-month visit a periapical digital film was taken to verify healing **(Fig 10a)**. The provisional restoration was removed at that time and a healthy prosthetic running room was noted **(Fig 10b)**. Subsequently, an optical digital impression was taken, capturing the subgingival soft tissue profile by scanning the provisional restoration contour chairside **(Figs 11a-11c)**. Using CAD/CAM technology, the dental laboratory was able to design, project, and fabricate a screw-retained layered zirconia crown to be constructed with titanium base **(Figs 11d-12b)**.[26] An 18-month intraoral occlusal view **(Fig 13)** and 24-month CBCT scan **(Fig 14)** show excellent bone levels around the implant, especially in the facial plate interface. At every follow-up appointment, the periodontal health surrounding the restoration was controlled by the probing depth evaluation.

Figures 10a & 10b: Clinical situation after four months of healing following first removal of the provisional restoration. Note the excellent preservation of tissue volume and the proper balance between white and pink esthetics.

"The goal is to limit the buccal contour change after the extraction and potentially augment the thickness of the peri-implant soft tissues coronal to the implant-abutment interface."



Figures 11a-11e: CAD/CAM technology was used to duplicate the prosthetic running room in the design and production of the zirconia substructure on titanium base. CAD software provides total control during the prosthetic design. Opposing dentition, restorative volume, soft tissue contour, and screw-hole axis are all shown in the same image, permitting precise design of the zirconia abutment.



Figures 12a & 12b: Definitive prosthetic restoration in place. The definitive crown is screw-retained.
(*Laboratory work by Luca and Matteo Dondi, Bologna, Italy*)

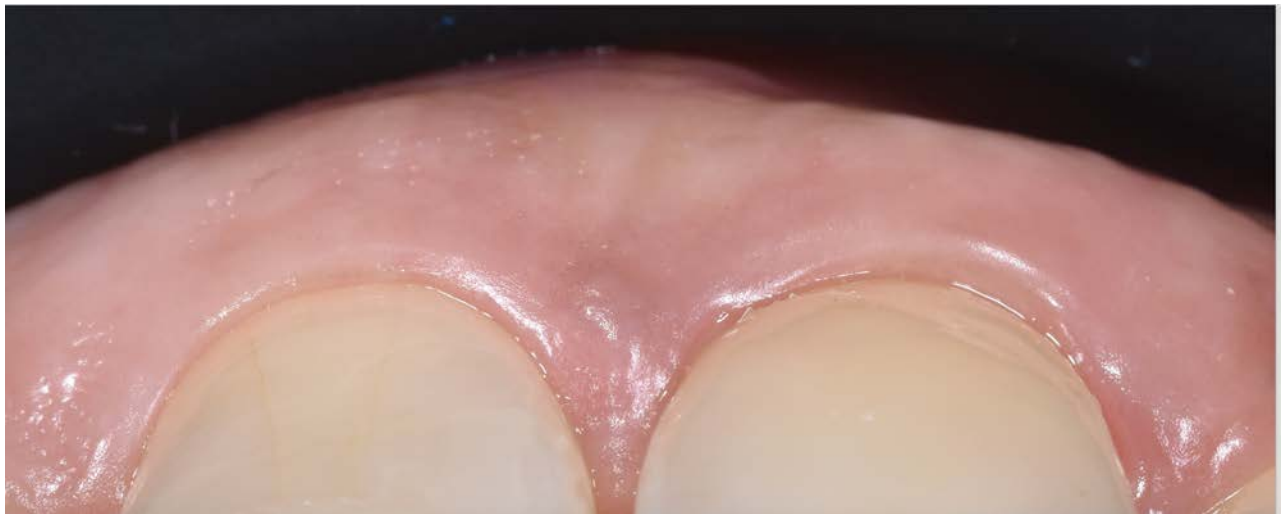


Figure 13: Intraoral occlusal view at 18 months shows not only integration of the facial contour of the implant site compared with the adjacent teeth, but also stability of the ridge contour over time.

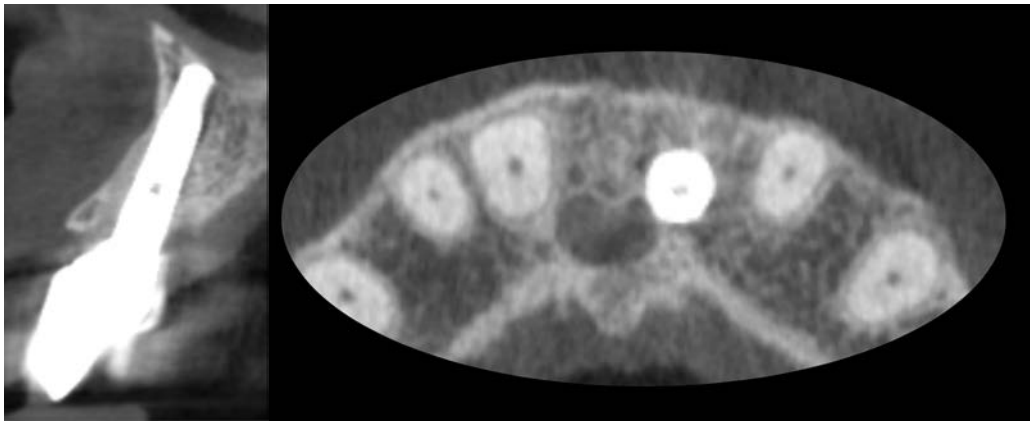


Figure 14: CBCT scan taken 24 months after surgery. Note how the overbuilding of the socket worked. The amount and stability of the peri-implant marginal bone is optimal.

Discussion

Single-implant treatment has been found to be highly predictable in terms of implant survival rates.[27-29] Classical parameters seem little affected by the timing of implant placement relative to tooth extraction and variations in the surgical[30] and restorative procedures.[31,32]

To decrease the duration of patients' surgical phase, postextractive implants were used. Postextraction socket implant replacement survival rates are equivalent to those of delayed placement, while decreasing the number of clinical procedures.[33] In addition, bone grafting is not a requirement for immediate implants, even those with large labial gaps, to achieve osseointegration of the implant.[34]

Dual-Zone Concept

In 2012, Chu and colleagues[9] evaluated the buccolingual contour change in immediate implant placement and provisionalization cases and introduced the dual-zone concept. This concept, linked to the achievement of esthetic success, demonstrates why it is critical in the early phases to take not only buccal photographic references but also occlusal views to begin evaluating what must be done to make the definitive restoration blend in with adjacent teeth.

The dual-zone protocol suggests to bone graft the residual gap up to the gingival margin at the time of the placement; this would limit the changes in the buccal contour and potentially enhance the thickness of the peri-implant soft tissue, and, therefore, the overall esthetics of the final restoration.[19] The study's conclusion was that placing a bone graft into the residual labial gap around an anterior implant in a postextraction socket is helpful in limiting the amount of faciopalatal contour change. The study's authors postulated that to achieve predictable esthetic success, the critical clinical keys that must be respected are:

- atraumatic tooth removal without flap elevation
- placement of a dual-zone (bone and tissue zone) bone graft in the residual gap around an immediate fresh extraction socket implant
- a screw-retained provisional restoration acting as a prosthetic socket seal device.

Other Studies

Araújo and colleagues[33] showed that xenograft particulate material can be incorporated and encapsulated into the peri-implant mucosal tissues with bone grafting and immediate implant placement. These particles may act as benign foreign bodies when a localized inflammatory response is absent. This volume increase can create a masking effect that would overcome gray-colored abutments and enhance the esthetic outcome.

What was still unknown were the effects of connective tissue grafting alone on the peri-implant soft tissue dimensions. Chu and colleagues[9] also state that esthetic complications increase in patients with a thin periodontal phenotype; therefore, an additional surgical intervention may be required to improve the surrounding soft tissue architecture before, during, or after implant placement.

The remaining question is whether it is necessary to place a bone graft and a connective tissue graft in association with a provisional restoration at the time of implant placement. In some cases (i.e., for patients with a thick biotype) just one type of graft may suffice, with the understanding that not all procedures are 100% successful (risks being loss or infection of the graft).

A study by Grunder[35] comparing three-dimensional contour change with connective tissue grafting (12 patients) and without it (12 patients) showed that only 1.1 mm of facial tissue change occurred without the graft and 0.3 mm of facial tissue change occurred with the graft, measured at 3 mm from the FGM, if an implant was placed with only a healing abutment and without flap elevation. Neither a bone graft nor provisional restoration was placed in this group of patients. This is considerably less change than was presented in several classic studies with flap elevation and intact sockets.[36]

Linkevicius and colleagues[21] affirmed that tissue thickness was shown to affect crestal bone stability around implants, indicating that initially thin mucosal tissues can cause crestal bone loss after implant placement at one year in situ. It has also been proposed that a minimum of 3 mm of peri-implant mucosa is required for a stable epithelial connective tissue attachment to form. This soft tissue extension is usually referred to as the biologic width around implants, and it serves as a protective mechanism for the underlying bone.

Kan and Rungcharassaeng[37] implied that bilaminar subepithelial connective tissue graft (SCTG) in conjunction with immediate tooth replacement procedures is a technique-sensitive procedure with inherent risks that must not be overlooked; inadvertent thinning or perforation of the flap or partial exposure of the SCTG can result in partial or complete necrosis of the SCTG. In this study, 2 of 10 patients experienced connective tissue graft necrosis. However, the authors also stated that IIPP in conjunction with a connective tissue graft is more likely to result in sufficient peri-implant tissue thickness to conceal underlying restorative materials than when performed without a connective tissue graft. The key of the surgical veneer grafting protocol presented in this article likely is the partial-thickness approach, which may help the connective tissue graft receive a higher percentage of blood supply guaranteed by the periosteum, avoiding the potential risk of necrosis. A pivotal role is played

by the tissue graft thickness: 1 mm of dense connective tissue is required to achieve less shrinkage over time, compensate the coronal bone crest remodeling, and obtain an optimal esthetic integration linked not only to the thickness, but also to the surface and the color of the adjacent tissues.

In a two-year randomized clinical trial,[38] 47 participants were randomly assigned to the test group (immediate load postextractive implant treated with SCTG placed using the tunnel technique in the labial area)[39,40] and the control group (immediate load postextractive implant treated without the connective tissue graft) with an allocation ratio of 1:1. Both groups received deproteinized bovine bone mineral in the gap. The bone graft was placed only in the bone zone, not in the tissue zone. Patients were observed at baseline, crown insertion, one-year follow-up, and two-year follow-up. At the two-year visit, the test group showed a statistically significant increase of mean KM thickness of 34.29% (0.5 mm) and a mean recession of 10.01% from the initial KM highness (0.2 mm). A statistically significant difference was also reported when comparing different gingival biotypes: thick biotypes showed minor soft tissue shrinkage and recession with respect to thin biotypes. The correlation analysis showed a direct correlation between gingival thickness and pink esthetic score, highlighting the importance of thickening soft tissues to obtain more predictable esthetic results. In fact, soft tissue changes observed, although small, were within the clinical threshold for detectable change and therefore would have esthetic implications.

In this study, the final outcomes were fairly encouraging. However, the bone graft in both groups was incorporated only on the labial aspect of the bone zone; whereas, the surgical veneer grafting protocol presented in this case report, the bone graft was packed up to the gingival margin, including in the tissue zone area. As described by Tarnow and Chu[34] in fact, the role of the bone graft in the tissue zone plays a key role, helping to maintain the buccal palatal dimension despite the bone remodeling that occurs after tooth extraction.

It is the current authors' opinion that this last surgical indication could enhance the final esthetic outcome even more, especially in patients with a thin biotype and scalloped architecture in the esthetic area.

Summary

In situations in which a highly esthetic outcome is important, immediate implant placement should be performed with caution, particularly if there is damage to the facial bone wall or if the tissue biotype is thin. For these reasons, this protocol should be considered a technique-sensitive procedure and cases should be selected carefully.

Use of a connective tissue graft combined with socket bony grafting at the time of immediate implant insertion in the esthetic zone is an effective treatment option to compensate for the expected loss of labial soft tissue volume and to maintain good esthetic results over time. However, to safely implement a new treatment into everyday practice, data from long-term clinical studies are required. Such data for this particular treatment are not yet available.

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"...this protocol should be considered a technique-sensitive procedure and cases should be selected carefully."

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Implants

AGD Subject Code: 690

The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article *Surgical Veneer Grafting: Compensation for Natural Labial Plate Remodeling After Immediate Implant Placement* by Dr. Alessandro Agnini, Dr. Maurice Salama, Dr. Henry Salama, Dr. David Garber, and Dr. Andrea Mastrorosa Agnini. This article appears on pages 70-85.

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1. The primary advantage of immediate implant placement is which of the following?

a. Fewer appointments, increased patient comfort.
b. Reduced cost for the patient.
c. Although the survival rate is less than with delayed implant placement, the patient does not have to be without a tooth.
d. Osseointegration is far superior with immediate implant placement than with delayed implant placement.

2. Which of the following is to be expected with immediate implant placement?

a. Decreased osseointegration than with delayed implant placement.
b. Increased osseointegration than with delayed implant placement.
c. Slight facial gingival recession and buccolingual contour shrinkage.
d. Improved survival rates compared to delayed implant placement.

3. What changes should be expected in the morphology of the bone and soft tissue that occur after an extraction and immediate implant placement including a bone graft?

a. Treated correctly, there should be little or no bone remodeling.
b. Slight facial gingival recession.
c. Extensive buccolingual contour shrinkage.
d. The extent of bone remodeling is directly proportional to the diameter of the extracted root.

4. Why does postextraction resorption occur?

a. Bundle bone forms in the postextraction socket and then resorbs.
b. Bundle bone forms due to immediate function against the remaining periodontal ligament (PDL).
c. Extraction causes the loss of the blood supply to the adjacent interproximal bone.
d. Trauma to the bone-PDL-tooth complex occurs during tooth extraction, which leads to bone remodeling.

5. Which of the following is the correct sequence for immediate implant placement following tooth extraction in the surgical veneer grafting technique?

a. Place the implant, followed by immediate provisional restoration, then gum graft, then healing abutment, followed by bone graft, then replace provisional.
b. Place the implant, then bone graft, followed by gum graft, followed by immediate provisional restoration.
c. Place the bone graft, then implant, then gum graft, followed by immediate provisional restoration.
d. Place the gum graft, then the implant, then immediate provisional, then bone graft.

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A New, More Personal Vision of Esthetics

Full-Mouth Rehabilitation of a Patient with Tetracycline Stains Using All-Ceramic Restorations

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Abstract

Restorative work, whether for a single restoration or a full-mouth rehabilitation, requires that esthetics be thoroughly evaluated before treatment to obtain a harmonious and pleasing outcome. While esthetics is often considered from an objective standpoint of measurements and proportions, this article proposes a new vision of more subjective esthetic principles, termed *perceptual forces*. The article's goals are to demonstrate the importance of these perceptual forces as well as their subtle and determining mechanisms to highlight that an esthetic approach cannot be restricted to a limited area, as esthetic interactions can manifest away from the area of interest. A case report of a full-mouth rehabilitation utilizing all-ceramic restorations for a patient with a large central diastema and tetracycline stains is presented.

Key Words: perceptual forces, diastema, all-ceramic, tetracycline, esthetics

CE CREDIT

Learning Objectives

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

1. **Understand a technique with which to thoroughly evaluate esthetics before treatment.**
2. **Visualize more subjective esthetic principles.**
3. **See how esthetic interactions can manifest away from the main area of interest.**

Disclosures: The authors did not report any disclosures.

Introduction

The goal of any prosthetic restoration is to be functional and esthetic by fulfilling the prosthetic triad of biology, mechanics, and esthetics. Whereas the functional aspect can be fairly well-defined as constituted by a biologic basis (e.g., biologic width, tissue biotype) and mechanical principles (e.g., anteroposterior spread, cantilever, law of beam), esthetic fundamentals are not so easily outlined. The dental composition[1] is considered esthetic when it triggers in the observer a pleasing feeling that depends upon the harmony and balance of esthetic elements.

Objective elements of esthetics, such as measurements and proportions, have been addressed in the literature,[2-4] whereas subjective elements have received less attention as they appear more elusive even if they are as essential to esthetics. The primary author has identified and defined these subjective elements as *perceptual forces* in an attempt to advocate a vision of esthetics that is more personal and customized,[5] as opposed to standardized esthetics that rely solely on objective parameters. These perceptual forces are often referred to in art and psychology but (to the authors' knowledge) have not been clearly defined in dentistry. However, it is by describing and understanding the mechanisms that support perceptual forces that we will be better able to comprehend the subjective tenets of esthetics. These appear paramount to achieve a more individualized esthetic result that would no longer depend solely upon proportions and measurements.

Definition of Terms

Perceptual Forces: Repulsion and Attraction

Perceptual forces express the impression of motion or stability in the dental composition. These forces are the result of the convergence, parallelism, or divergence of the long axes of the teeth, with verticality expressing dominance; horizontality suggesting stability; and obliquity, dynamism **(Figs 1a-1c)**. If the long axes are convergent, the observer has an impression of attraction and perceives the composition elements as coming closer to each other. If the long axes are parallel, there is a perceived absence of motion; the observer has an impression of stability, almost of stillness, from the composition. If the long axes are divergent, the observer has an impression of repulsion and perceives the composition elements to be moving away from each other with a feeling of instability.

The following factors also influence perceptual forces, as they are all intertwined.

Rhythm: Monotony and Dynamism

Rhythm is expressed along the horizontal axis of the dental composition. Several aspects contribute to the rhythm, such as the occlusal plane, the gingival outline, or the change of color in adjacent teeth. For example, if the rhythm is relatively flat, the smile seems monotonous, worn out, and the observer unconsciously associates it with old age **(Fig 2a)**. However, in some instances, chromatic variations appear with age and the rhythm of the composition can become more lively and dynamic. On the contrary, if the rhythm is more energetic, there is an impression of dynamism associated with youth, related to the well-defined anatomy, prominent cusps, and large incisal embrasures **(Fig 2b)**.

Another factor is color, which can express monotony if the color of adjacent teeth is fairly monochromatic; whereas the rhythm seems more dynamic if there are a variety of shades next to each other. In short, rhythm is regulated by morphochromatic variations.

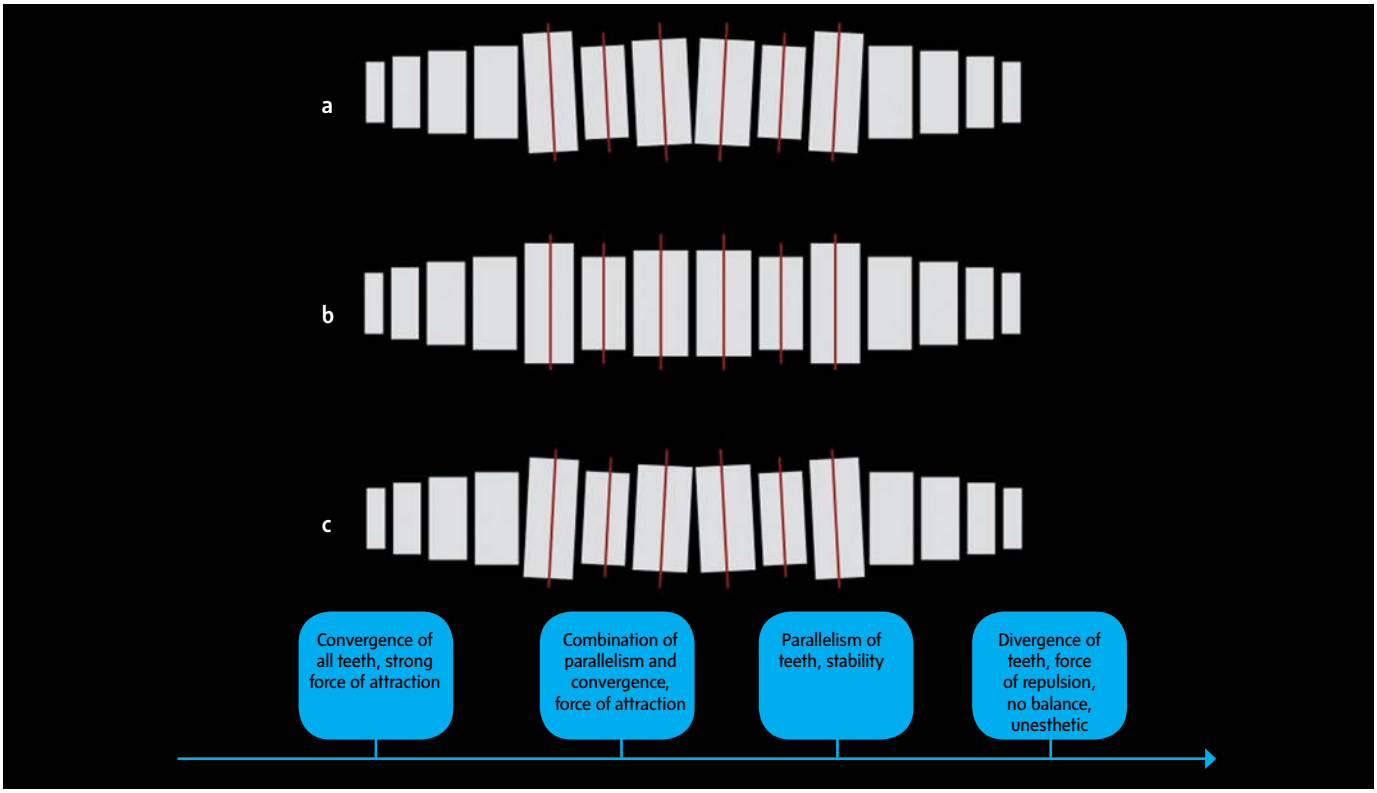
Radial Symmetry: Order and Disorder

Radial symmetry is expressed in relation to the dental midline. To be harmonious, it is crucial that facial and dental midlines coincide in a range of +/- 2 mm so that most observers are not aware of any asymmetry.[6] Radial symmetry includes several factors, such as proportion, shape, position, and color. Symmetry of proportion, position, or color tends to express order or even monotony if excessive, whereas asymmetry may evoke disorder but also sometimes dynamism when subtly used **(Figs 3a & 3b)**.

Dominance: Unity and Individuality

Dominance is the ability of an object to draw attention to itself; in other words, to captivate the eye. Dominance is directly related to the ability of the teeth to reflect light, which is dependent upon their proportions, line angles, relative size, and position in relation to the other teeth in the dental composition **(Figs 4a & 4b)**.

If all the teeth are on the same plane, they reflect a similar amount of light, and there is an impression of unity in the composition. When that unity is overwhelming it can interfere with the individuality of each tooth. If more anterior, central incisors and canines reflect more light and express dominance and some individuality in relation to the rest of the composition. Depending on the size of the anteroposterior discrepancy, this may create personality as well as disharmony. On the other hand, if central incisors and canines are more posterior than the lateral incisors, the dental composition will appear to lack harmony and balance.



Figures 1a-1c: (a) Convergence, force of attraction. (b) Parallelism, stability. (c) Divergence, force of repulsion.

Figures 2a & 2b: (a) Monotonous rhythm. (b) Dynamic rhythm.

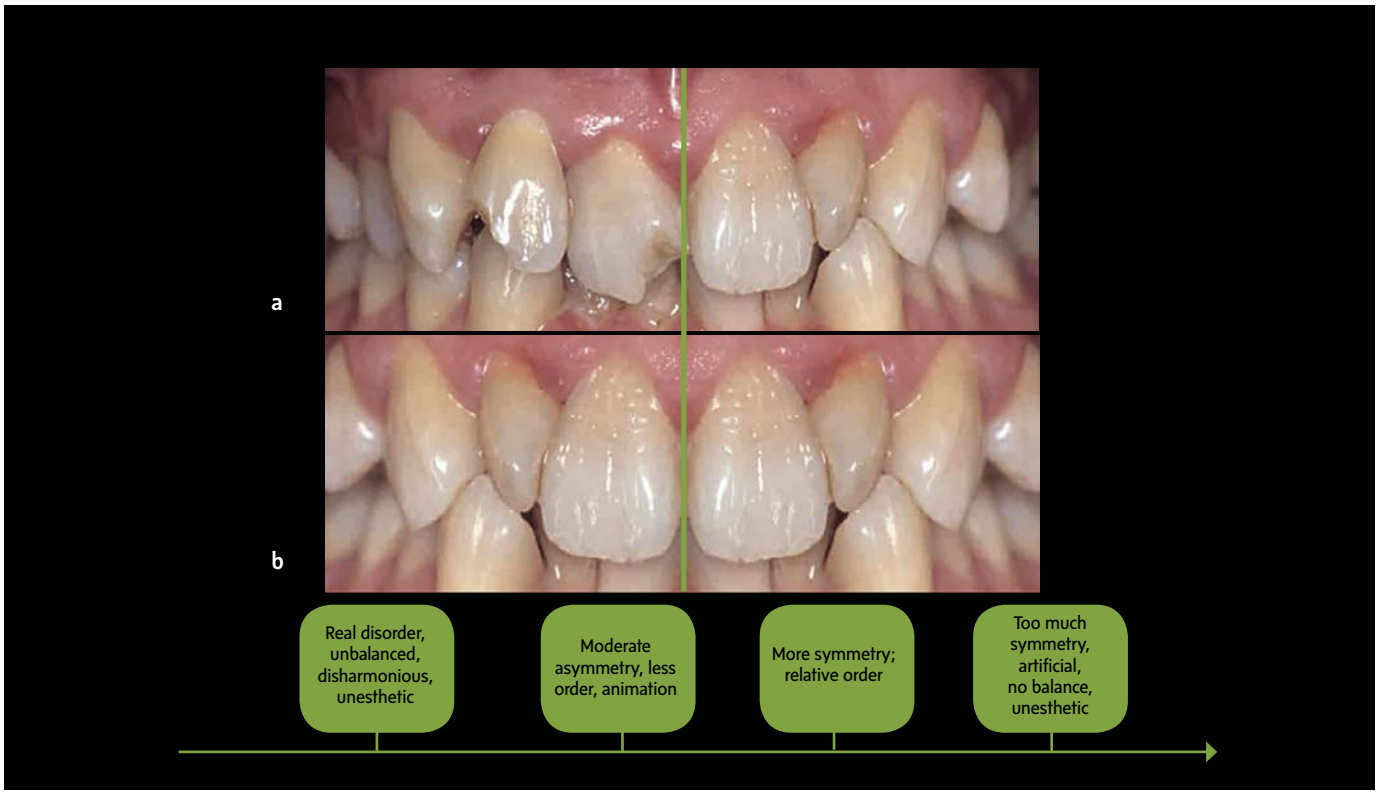


Figure 3a: Pretreatment, there is asymmetry of shape, proportion, position, and color. **Figure 3b:** When the image is manipulated to obtain perfect symmetry, even if the occlusion is imperfect, the composition already seems more harmonious and appealing.

Figure 4a: The central incisors and canines are more anterior than the lateral incisors. As a result, they appear very dominant, with a strong sense of individuality relative to the rest of the dental composition. **Figure 4b:** The degree of exposition of the lateral incisors due to their position and configuration of the cental incisors.

Tetracycline Stains

Tetracycline stains, which involve a radial asymmetry of color, pose an additional esthetic challenge. Intake of tetracycline drugs during tooth development causes intrinsic brown staining.[7] According to various studies, its prevalence varies from 0.4% to 6%.[8-10] Tetracycline stains can be treated in many ways, from bleaching and laminate veneers to more conventional full crowns, as indicated in cases of large areas of dentin exposure and to correct major malpositions when the patient declines orthodontic treatment, as in the case presented below.[11]

Metal-ceramic restorations have historically proven to be a predictable treatment for tetracycline staining.[12] However, all-ceramic restorations have improved mechanically to exhibit success rates similar to metal-ceramic restorations.[13] All-ceramic restorations also provide a better esthetic outcome and are known to be more biocompatible with the gingiva.[14]

The authors opted to use zirconia copings layered with feldspathic porcelain for this case. The zirconia provides high flexural strength **(Table 1)** and has the ability to conceal the abutment tetracycline stains. The layered feldspathic porcelain can mimic the interaction between light and the layers of dentin and enamel.

The following clinical case report describes the full-mouth rehabilitation of a woman with tetracycline stains and a large central diastema by means of all-ceramic restorations, utilizing perceptual forces and their underlying components to achieve an esthetically pleasing result.

> **"...it is by describing and understanding the mechanisms that support perceptual forces that we will be better able to comprehend the subjective tenets of esthetics."**

Table 1: Comparative Flexural Strength of Porcelain

Type of Ceramic	System	Flexural Strength (MPa)
feldspathic	Vita	100
leucite	IPS Empress	120
lithium disilicate	IPS e.max Press or IPS e.max CAD	300-400
alumina	Procera	650
zirconia	Lava or DC - Zirkon	900-1200

Case Report

Clinical Findings

A 50-year-old female presented with a chief complaint of unsatisfactory esthetics, including a large central diastema that she wished to reduce but not eliminate. The extraoral examination revealed no facial asymmetry, no muscle tenderness or temporomandibular joint (TMJ) disorder, and an average smile line.[15] There was no apparent deviation of the facial and dental midlines **(Figs 5a-5c)**. The intraoral examination revealed a thick biotype with no apparent gingival inflammation and no recession. There were multiple tetracycline stains, a large central diastema but no mobility, unsatisfactory occlusal relationships, no loss of vertical dimension of occlusion, and adequate fillings on teeth ##2, 3, 14, 15, 17-19, 30, and 31 **(Figs 6a & 6b)**. The occlusal examination revealed canine function on the left and right sides and a vestibular position of #9. The radiographic examination revealed no thinning of the TMJ ligaments, clear sinuses, no bone loss, no periapical lesions, and no secondary caries **(Fig 7)**.

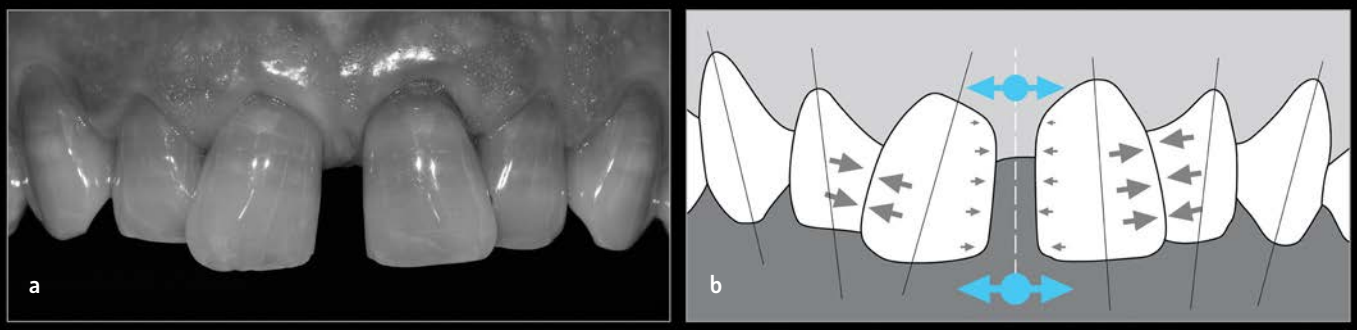
Evaluation of Perceptual Forces

Due to its size and configuration, the central diastema created a marked rupture between the two central incisors. This rupture was even more noticeable as it was unevenly distributed. In fact, the divergence of the central incisors created unequal perceptual forces that strengthened the cohesion between central and lateral incisors and therefore impeded the unity of the central incisors **(Figs 8a & 8b)**. However, this feeling of instability around the central incisors, caused by their divergence, was minimized by the convergence of the lateral incisors, canines, premolars, and molars **(Figs 9a & 9b)**.

Figures 5a-5c: (a) Full-face image of patient. (b) Tetracycline stains. (c) Large central diastema.

Figures 6a & 6b: Stains, diastema, and malpositions.

Figure 7: Panoramic radiograph before treatment.



Figures 8a & 8b: Photograph and diagram of the initial central diastema.

Figures 9a & 9b: Convergence of the lateral incisors, canines, premolars, and molars.

> **Perceptual forces express the impression of motion or stability in the dental composition.**

The centripetal perceptual forces were opposed to the progress of the dissociation posteriorly. The perceived influence of the diastema depends upon the orientation of all the teeth in the composition. The verticality of the lateral incisors, canines, premolars, and molars establishes the unity of these teeth and as a result marginalizes the two central incisors from the rest of the composition **(Fig 10a)**. When the posterior teeth are convergent, the divergence of the central incisors is somewhat reduced. The unity of the central incisors could not be restored as the divergence in this case was too strong **(Fig 10b)**.

When parallelism and verticality involve all the teeth, the unity of the two hemi-arches is reinforced, which gives an impression of stability. It is the size of the diastema that will determine whether the unity of the composition is truly compromised around the midline. The parallelism of the central incisors contributes undeniably to oppose the dissociation as the perceptual forces of attraction are evenly distributed.

The consistent rhythm and the cohesion of the rest of the composition initiated by the parallel vertical long axes of the teeth seem to emphasize the influence of the diastema **(Fig 10c)**. The coexisting parallelism of the central incisors and the convergence of the other teeth seem to create a reduced perception of the two hemi-arches. The rupture of the rhythm around the midline is no longer as influential perceptually. The central incisors, the only two parallel teeth, reinforce the cohesion corroborated by their chromatic and morphological similarities. In these conditions, the diastema must be very wide to counterbalance the unity of the pair **(Fig 10d)**.

The divergence of the central incisors seems to bring these teeth closer to each other in the cervical area and to push them apart in the incisal edge area. This divergence/convergence interaction creates a rotation that strengthens the dissociation caused by the diastema. The impression of imbalance probably has its origin in this perceived instability **(Figs 11a & 11b)**.

Reorienting the central incisors with an orthodontic or prosthetic treatment modifies greatly the direction and intensity of the perceptual forces. The convergence tends to unify the central incisors, which appear to be nearing each other, more noticeably in the incisal edge area than in the cervical area; this implies a motion of rotation, a vector of instability. Moreover, the asymmetric configuration of the incisal edges impedes the unity of the pair **(Figs 12a & 12b)**. To unify the pair, it is necessary to restore the morphological symmetry of the central incisors by positioning the incisal edges on the same horizontal line. It is wise to maintain a discrepancy between the incisal edges of the central and lateral incisors as it reaffirms their dominance and minimizes their dissociation. However, the triangular configuration of the diastema highlights an uneven distribution of perceptual forces and creates some motion around the midline, which is visually disturbing **(Figs 13a & 13b)**.

By recontouring the distal aspect of the incisal edge and by vertically reorienting the mesial aspect of the central incisor, the divergence is corrected and the resulting verticality has two merits: First, verticality confirms the dominance as it is a vector of such and consequently reinforces the unity around the midline. Second, it restores a perfect reciprocity of the mesial aspects of the central incisors around the midline. The rigorous parallelism of central-diastema-central perceptually unifies these two teeth despite the physical dissociation **(Figs 14a & 14b)**.

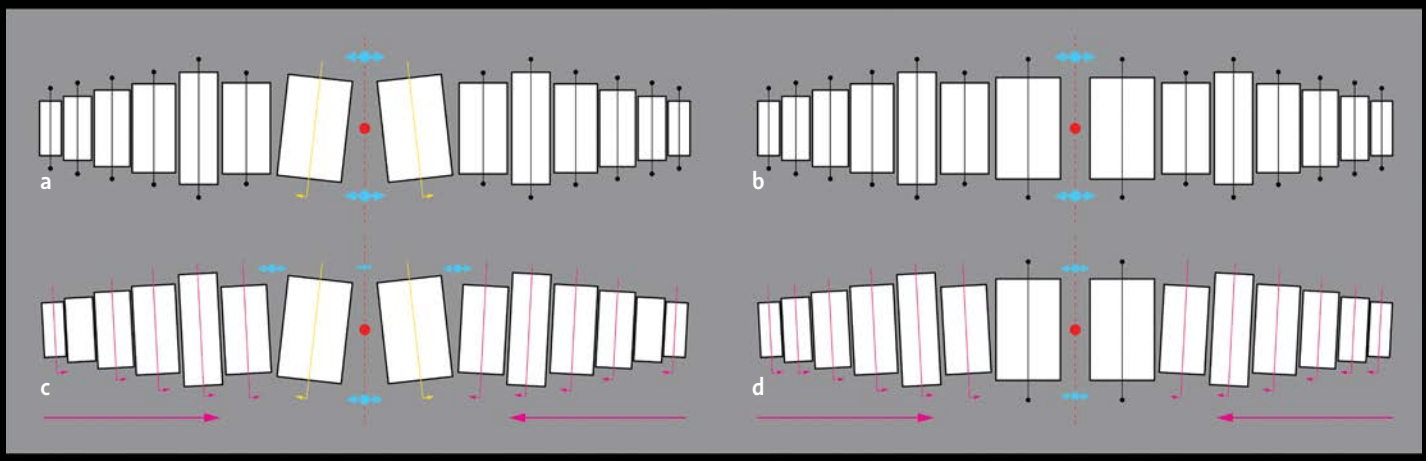
To restore balance of the perceptual forces around the diastema, it is necessary not only to reduce its size but also to modify its configuration. When the black background highlights the separation of the pair and takes a rectangular shape, the perceptual forces are evenly distributed with equal intensity. The resulting cohesion hides the interruption of the rhythm **(Figs 15a & 15b)**.

The balance between unity and individuality in the presence of a diastema can be drastically modified by recontouring the adjacent teeth and reorienting the perceptual forces **(Figs 16a & 16b)**. The crowding **(Figs 17a & 17b)** must be corrected. Realigning the incisors, however, would cause the diastema to disappear **(Fig 17c)**, an option that the patient strongly rejected.

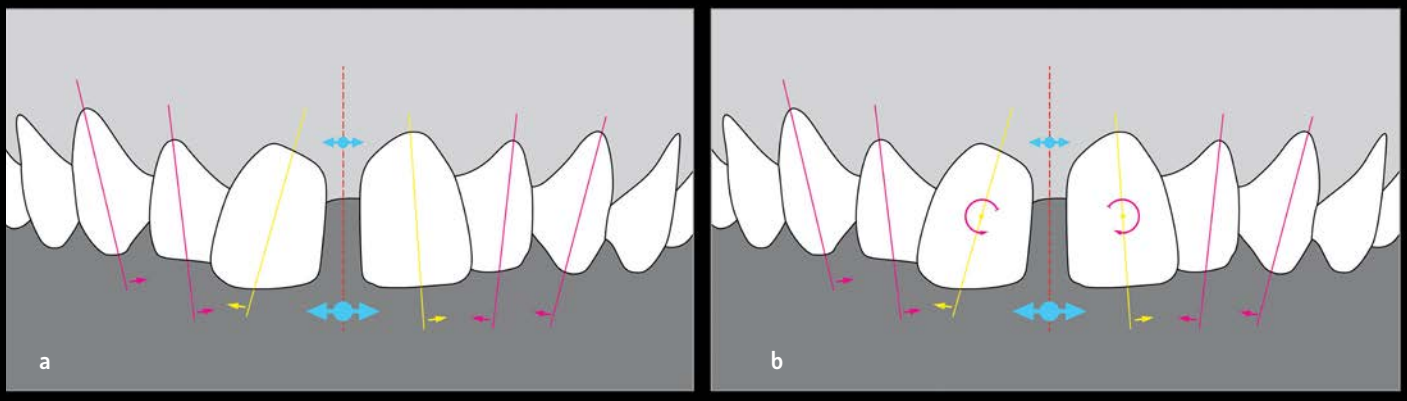
Maintaining a diastema and realigning the teeth implies reducing the width of the central incisors, which would result in four incisors with a fairly similar mesiodistal dimension **(Fig 17d)**. This compromise consequently would affect the dominance of the central incisors and the balance of the height-to-width ratio. Therefore it is necessary to reduce not only the lateral incisors' actual width but also their perceptual width **(Fig 17e)**. To do so, it is helpful to rotate the lateral incisors contrary to the central incisors, which are positioned in the frontal plane.

The ability of the central incisors to reflect light restores the balanced height-to-width ratio but also strengthens the dominance and, indirectly, the cohesion of the pair **(Fig 17f)**. As a result of the restored cohesion, this optimization of light reflection minimizes the perceived influence of the diastema.

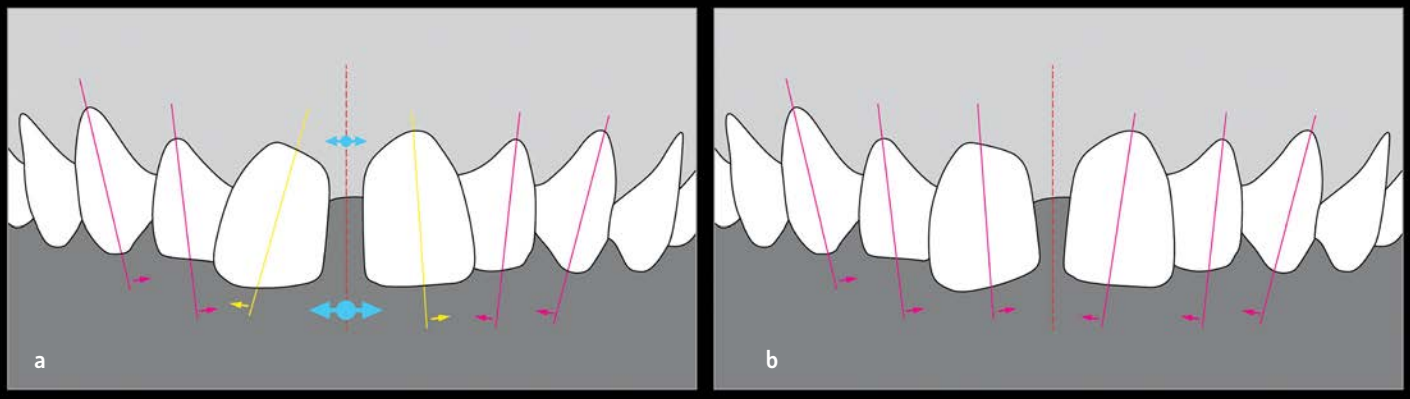
> **"Symmetry of proportion, position, or color tends to express order or even monotony if excessive, whereas asymmetry may evoke disorder but also sometimes dynamism when subtly used."**



Figures 10a-10d: (a) The two central incisors are marginalizd from the rest of the composition. (b) The unity of the central incisors cannot be restored as the divergence is too strong. (c) Perceived emphasized influence of the diastema. (d) The central incisors, the only two parallel teeth, reinforce the cohesion.



Figures 11a & 11b: Divergence/convergence interaction creating a rotation that strengthens the dissociation caused by the diastema.



Figures 12a & 12b: The convergence tends to unify the central incisors, which appear to be nearing each other, more noticeably in the incisal edge area than in the cervical area.

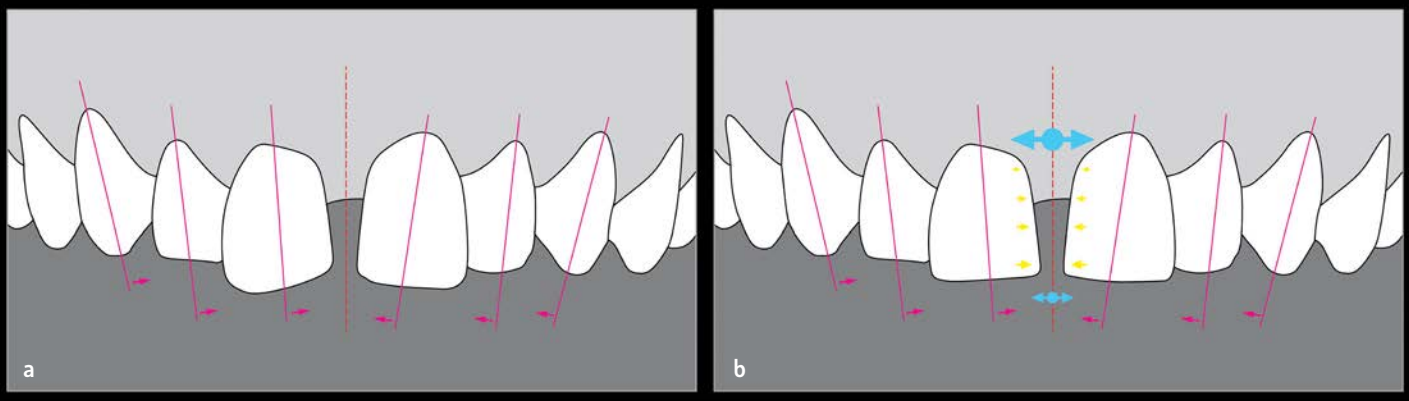
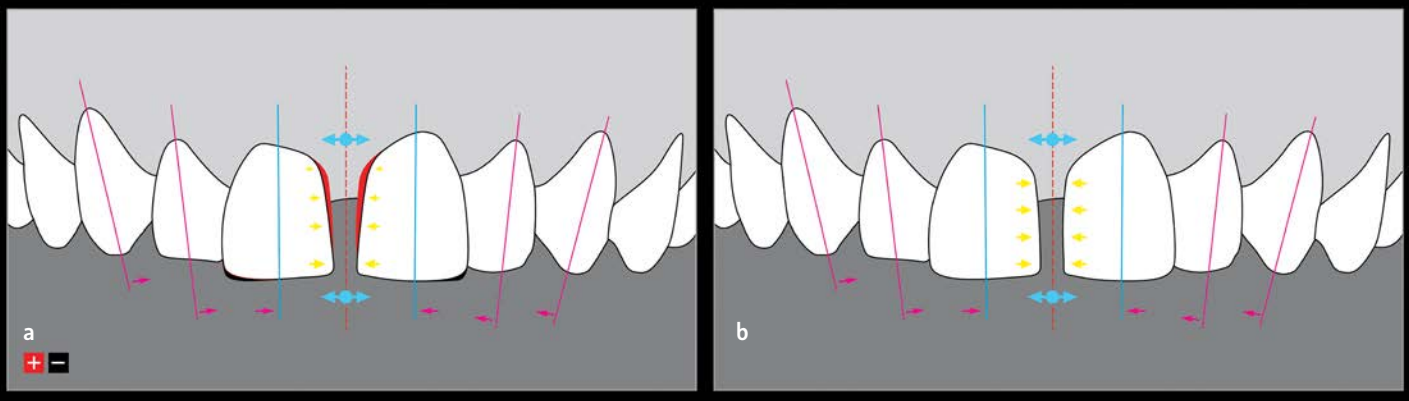
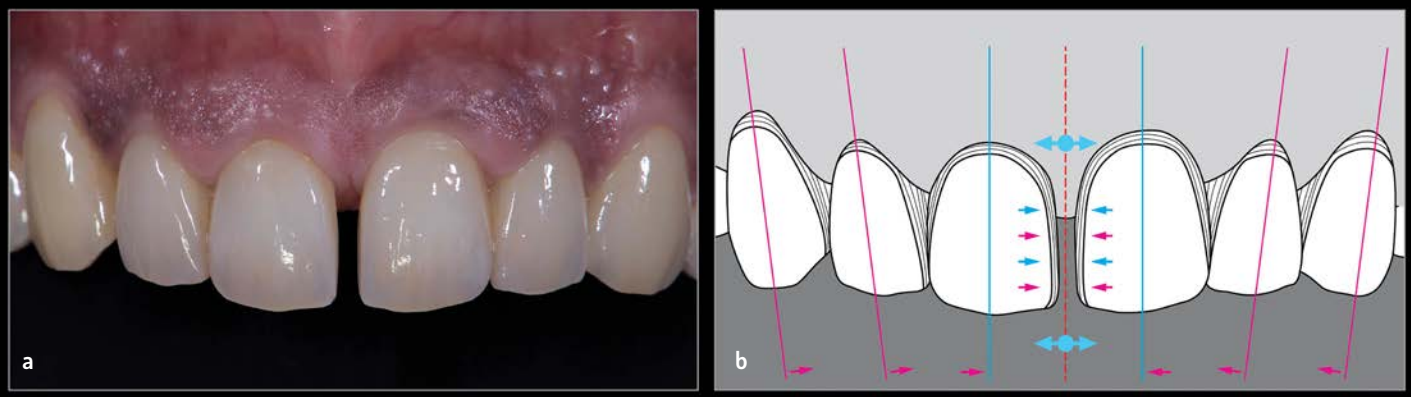


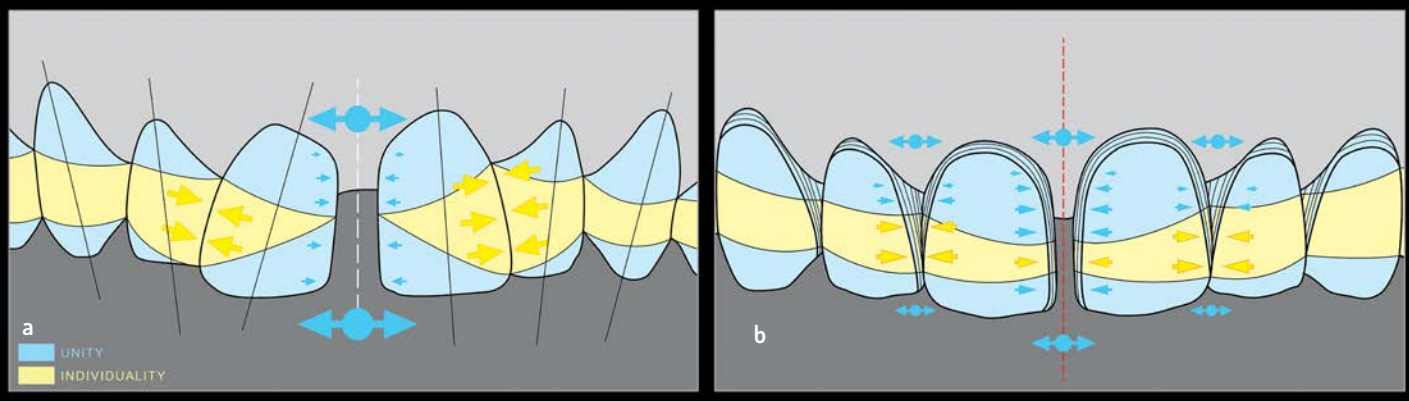
Figure 13a & 13b: The triangular configuration of the diastema highlights an uneven distribution of perceptual forces and creates some motion around the midline, which is visually disturbing.



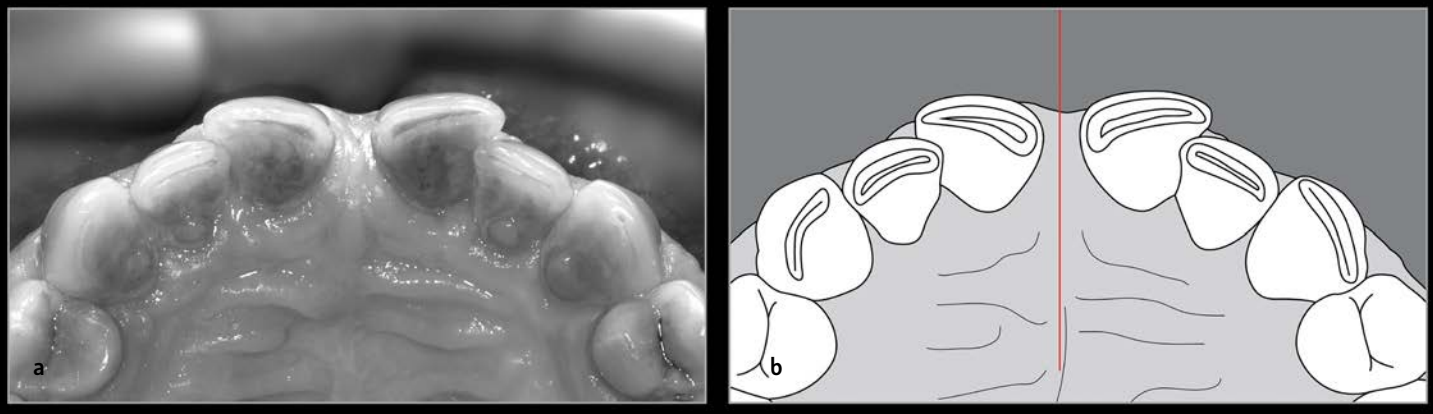
Figures 14a & 14b: The rigorous parallelism of central-diastema-central perceptually unifies these two teeth despite their physical dissociation.



Figures 15a & 15b: (a) When the black background highlights the separation of the pair and takes a rectangular shape, the perceptual forces are evenly distributed with equal intensity. (b) The resulting cohesion hides the interruption of the rhythm.



Figures 16a & 16b: It is possible to modify the balance between unity and individuality by recontouring the adjacent teeth and reorienting the perceptual forces.



Figures 17a & 17b: The patient's crowded dentition.

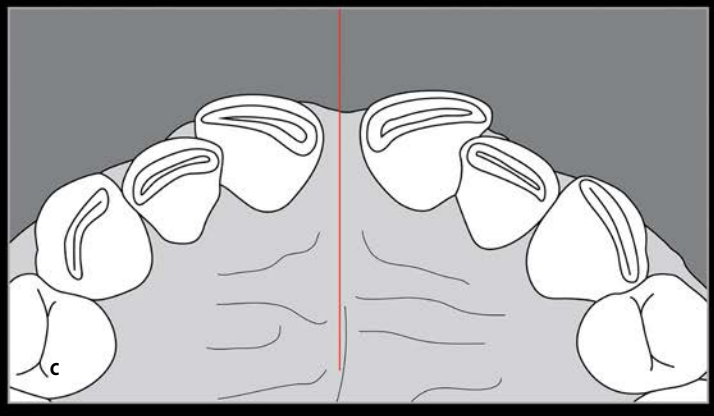


Figure 17c: Illustration of the patient's dentition without the central diastema.

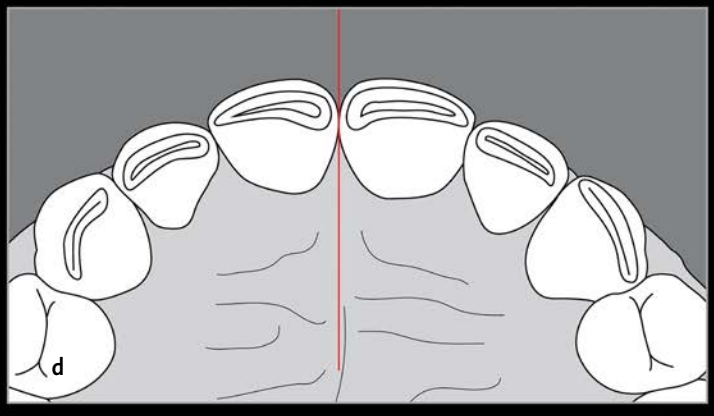


Figure 17d: The four central incisors showing similar mesiodistal dimensions.

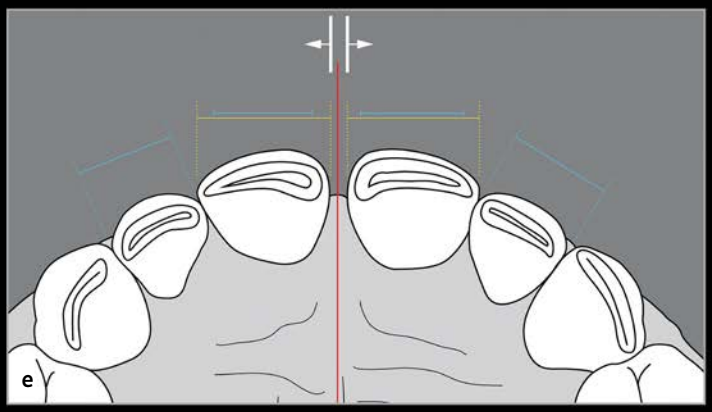


Figure 17e: Reduction of the lateral incisors' width both actually and perceptually.

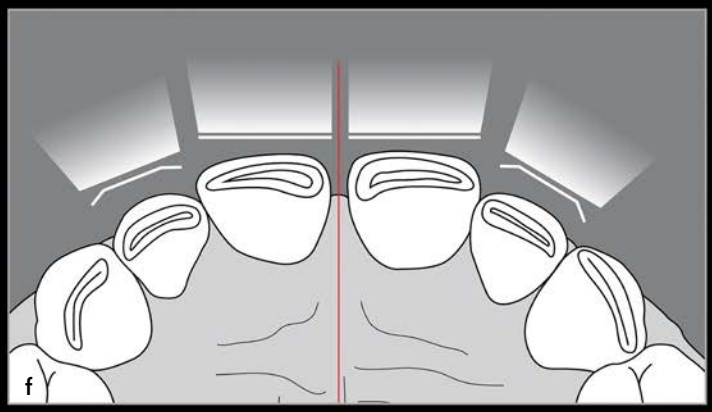


Figure 17f: The optimization of light reflection minimizes the perceptual incidence of the diastema thanks to a restored cohesion.

Treatment

Maxillary and mandibular complete-arch impressions were made using irreversible hydrocolloid impression material. Diagnostic casts were fabricated from Type III dental stone and mounted on a semi-adjustable articulator using an arbitrary facebow transfer.

The teeth were prepared with a chamfer finish line that was located subgingivally. During the preparation of #9 and due to its distobuccal inclination, a root canal treatment was performed. After obtaining the patient's esthetic approval of the final design thanks to the provisional restorations **(Figs 18a-18c)**, the preparations were refined **(Figs 19a-20b)** and definitive impressions were made using additional silicone impression material. The impressions were poured with a Type IV dental stone. The casts were pindexed and the dies were ditched and articulated. The definitive restorations were fabricated using zirconia copings layered with feldspathic porcelain **(Fig 21)**. The restorations were delivered and cemented with a compomer **(Figs 22a-25b)** and a final panoramic radiograph was taken **(Fig 26)**. The patient was very pleased with the final outcome **(Figs 27a-28b)**.

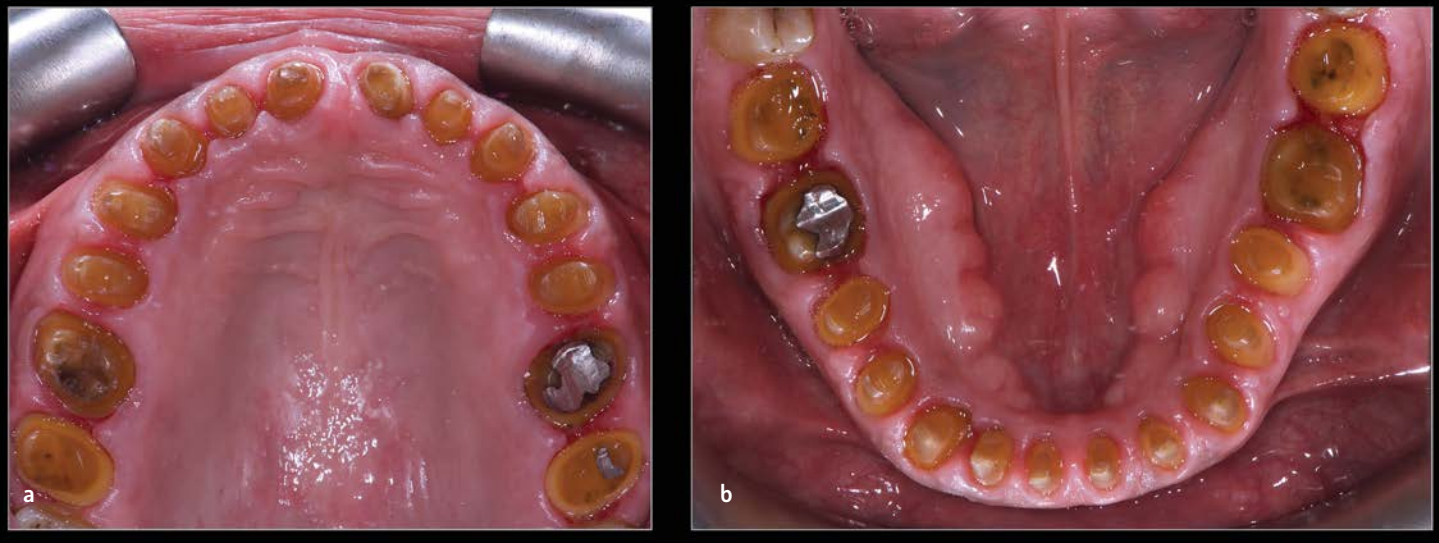
Discussion and Summary

The current prevailing esthetic approach should be reconsidered, as it often relies exclusively on objective parameters such as measurements and proportions. Esthetics, however, is foremost a perception. By studying the mechanisms ruling the subjective aspects of esthetics, the perception of it is no longer unconscious; rather, it becomes quite deliberate. This approach enables the practitioner to provide a more customized treatment. It is time to recognize the importance of cultivating the more emotional, sensitive aspect of our intelligence.

> **"When that unity is overwhelming, it can interfere with the individuality of each tooth."**

Figures 18a-18c: Frontal views of the provisional restorations.

Figures 19a & 19b: Frontal views of the refined maxillary and mandibular preparations.

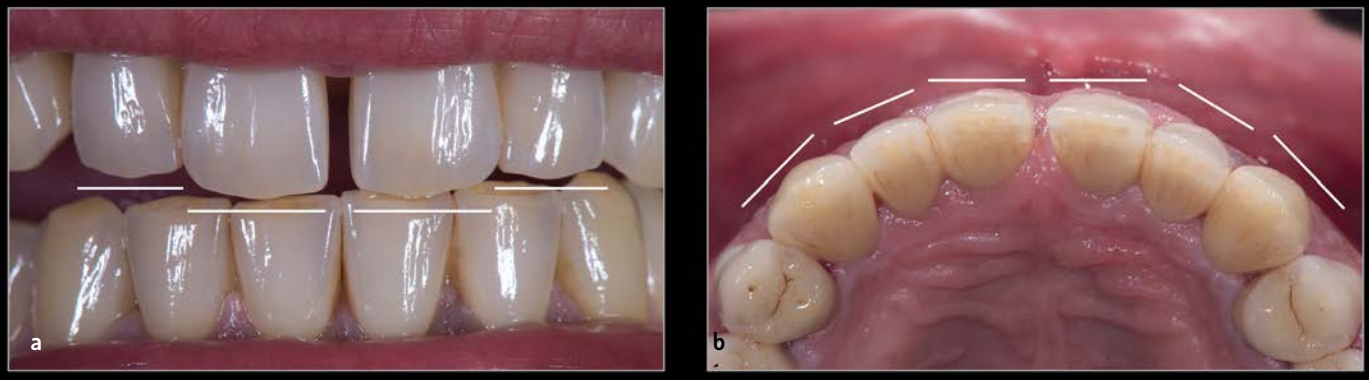


Figures 20a & 20b: Occlusal views of the refined maxillary and mandibular preparations.

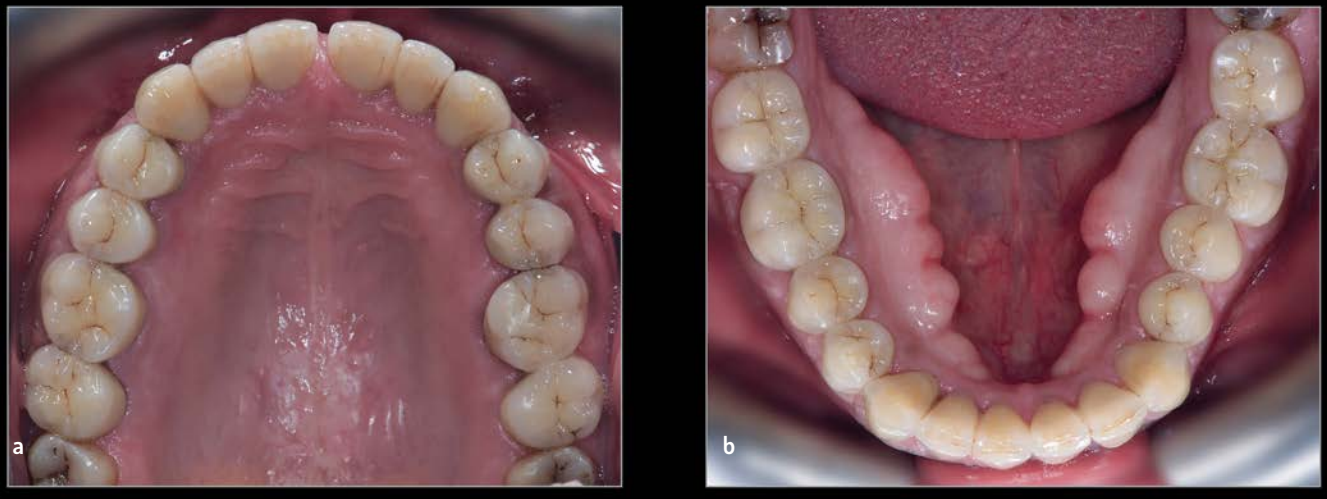
Figure 21: The definitive all-ceramic restorations.

Figures 22a & 22b: Lateral views of the definitive all-ceramic restorations.

Figures 23a & 23b: Intraoral frontal views of the definitive all-ceramic restorations one year later.



Figures 24a & 24b: The definitive restorations.



Figures 25a & 25b: Occlusal view of the definitive maxillary and mandibular restorations.

Figure 26: Panoramic radiograph after treatment.

Figures 27a-27d: (a, b) Before treatment. (c, d) After treatment.

Figures 28a & 28b: Before and after treatment.

> **Due to its size and configuration, the central diastema created a marked rupture between the two central incisors.**

In the case presented, a full-mouth rehabilitation employing a new esthetic approach was successfully performed on a patient with tetracyline stains. This approach does not rely solely upon objective measurements leading to standardized esthetics. Rather, it utilizes perceptual forces that are themselves intertwined with other subjective esthetic values such as rhythm, radial symmetry, and dominance, and helps to achieve a more customized esthetic outcome in a more predictable manner.

Acknowlegement

The authors thank Mr. Carlos Cañellas (Soldeu, Andorra) for creating the illustrations used in this article.

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“It is time to recognize the importance of cultivating the more emotional, sensitive aspect of our intelligence.”

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1. Dental composition

a. consists of measurable, objective, and subjective elements.
b. is considered esthetic when its results are visually pleasing.
c. described by objective elements is largely undefined.
d. for individual esthetic results tends to depend solely on proportion and measurement.

2. Perceptual forces

a. can express the impression of motion or stability in the dental composition.
b. are the result of the convergence, parallelism, or divergence of the horizontal plane of the dentition.
c. have the ability to vertically express passiveness, and to horizontally suggest fluidity and motion.
d. should be considered only after the implementation of subjective, measurable elements of composition.

3. Parallel long axes

a. give an impression of dynamism or fluidity.
b. when convergent, produce feelings of attraction and stability.
c. evoke an absence of motion.
d. when divergent, create feelings of repulsion and stability.

4. Rhythm

a. is a feeling best expressed in the vertical axis of the dentition.
b. that is flat is observed in youthful, dynamic dentition.
c. can be derived from the occlusal plane, gingival outline, or the altering of color in the adjacent teeth.
d. can become more lively and dynamic if chromatic tendencies are monochromatic and uniform.

5. Monotony is expressed in the dental composition by

a. utilizing a variety of shades, creating morphochromatic variation.
b. creating a dynamic feeling of motion.
c. utilizing well-defined anatomy, prominent cusps, and large incisal embrasures.
d. a monochromatic color scheme throughout a flat incisal plane.

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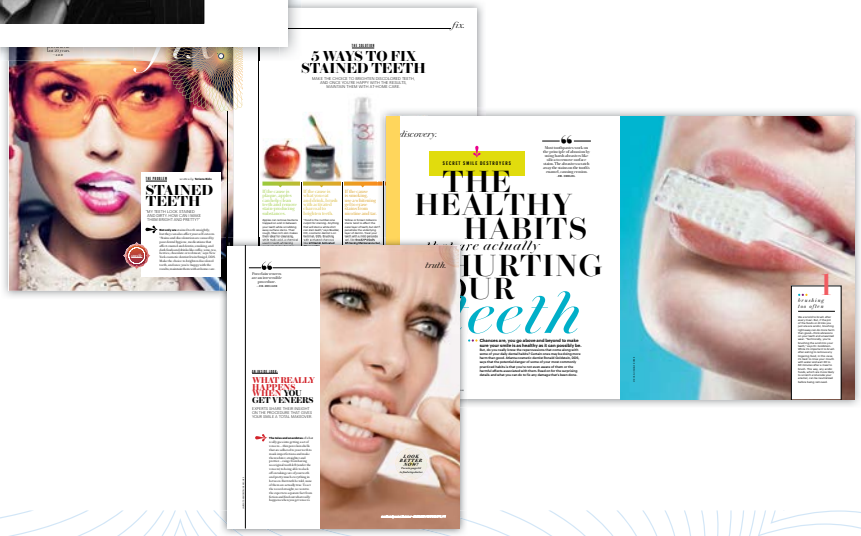

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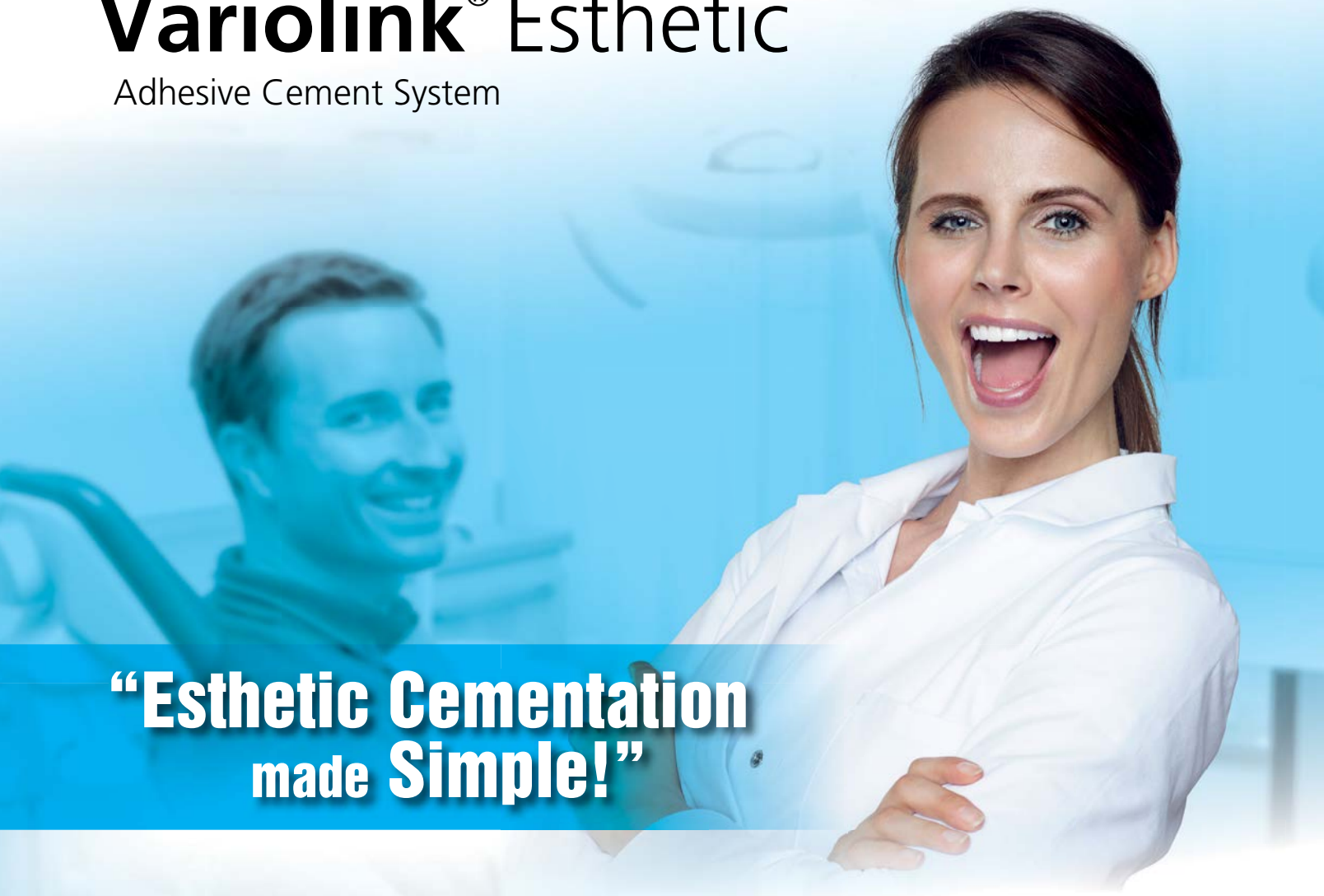

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