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vol. 29 issue 3
Journal of Cosmetic Dentistry

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Journal of Cosmetic Dentistry

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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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Features

Column

2013 Statement of Ownership, Management and Circulation

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Start Thinking Like a Prosthodontist!

"Stop thinking like a drill-and-fill, one-crown-at-a-time dentist and start thinking like a prosthodontist."

The ADA defines *prosthodontics* as the specialty pertaining to the diagnosis, treatment planning, rehabilitation, and maintenance of the oral function, comfort, appearance, and health of patients with clinical conditions associated with missing or deficient teeth and/or oral and maxillofacial tissues using biocompatible substitutes.[1]

In these challenging economic times, many general dentists are undergoing more education to enrich their knowledge and enhance their skills in specialties where they had previously received an "appetizer"-sized education.

As a result we have clinicians who are superb general dentists but lack the credentialing of a specialist. These clinicians (or, "*general-dontists*," as I call them), typically have practiced for more than 10 years.

A good general practitioner must have some significant knowledge about his/her specialties. It is not enough to simply send a patient to the orthodontist and say, "straighten teeth." Or to the periodontist and say, "treat gum tissue." Or to the oral surgeon and say, "move the jaws." Or to the prosthodontist and say, "fix!"

A good general dentist must "quarterback" the case and devise a restorative treatment plan with clear instructions about the projected outcome. A good restorative dentist must also understand the timing and sequencing of comprehensive cases.

A patient came to my office recently. The periodontist had referred this patient for a second opinion because he was concerned about the lack of a restorative treatment plan. He had completed periodontal therapy and did not know what to do next.

Molar implants had been placed in the 18, 19, 30, and 31 positions. The first thing the orthodontist on my interdisciplinary team asked was, *"Who placed those implants, and why was the gum work done without an orthodontic consult?"*

This patient entered what I call the "circle of specialists." Each specialist did his or her part of the renovation well; however, no one was aware of the final goal or outcome. Each specialist believed they were doing the best they were trained to do, independently of each other. In the end, the patient did not get the functional, esthetic outcome she desired.

How could this have been prevented? Stop thinking like a drill-and-fill, one-crown-at-a-time dentist and start thinking like a prosthodontist.

We can approach optimal care for our patients in two ways: Do it all ourselves, or enlist and direct the support of our colleagues who have been trained in a dental specialty.

When it comes to the esthetic restoration and replacement of teeth and the case appears too complex, the solution is simple. Engage the assistance of the prosthodontist on your team!

Reference

1. American Dental Association (ADA). Specialty definitions. Chicago: ADA; 2003. Available from: http://www.ada.org/495.aspx

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"All the beauty in one profession."

Recreating the Art

by Paulo Kano, DDS, MDT, MSc

Dentists and photographers are similar in many ways. We are excellent observers, and are meticulous in terms of detail. Cognizant of nature and its beautiful, unique aspects, we are constantly observing all around us and creating art. The strong relationship between dentistry and photography, along with numerous technological advances, has helped to improve and create materials and techniques that facilitate clinical and laboratory procedures. Consequently, many dentists allow their artistic side to flourish as a photographer.

Image capture in our profession has improved communication, efficiency, visualization, documentation and planning, greater predictability in treatment outcomes, productivity, quality, and esthetic sense. Furthermore, we are able to capture the beauty of an object with our knowledge of lighting and framing. Improved lenses, lights, filters, and camera settings help us achieve splendid images.

The opalescence in current esthetic restorative materials provides a spectacular optical phenomenon, giving a stunning scattering effect and revealing an amazing spectacle that can be captured in a single or multiple clicks. It is at this moment that the dentist and photographer merge into a single being: the artist.
The combination of art and science makes it possible for us to create many types of images and effects.

The cover image for this issue of the *jCD* shows a tooth that was created in porcelain (IPS e.max Press Impulse opal 1, Ivoclar Vivadent; Schaan, Liechtenstein). It was polished to a thickness of 0.5 mm and applied with glaze liquid IPS e.max. The elements were positioned on the top of cellophane pearly iridescent paper on a white cardstock background.

Camera position and light angulation are very important in capturing a tooth's iridescence and opalescence. Combining this with the shadows on the cellophane paper, this image may lead viewers to believe that they are observing a graphic print.

The cover image was taken by Dr. Paulo Kano, using a Nikon D800 camera and a Nikkor 105 mm 1:2.8 G ED DX AF - S VR micro lens. Speedlight Flash - SB 7000 (Tokyo, Japan); exposure time 1/125-1/250 EV/ automatic ISO / f 32/40; Circular Polarizer Filter PL. Photo dimension: 7360 x 4912.

To read Dr. Kano's clinical essay, please turn to page 38.

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Over the past three decades, the AACD has helped drive awareness about the functional and esthetic benefits of cosmetic dentistry and the advantages of working with an AACD dentist. Along with its respected credential, the AACD has given dental professionals worldwide the tools and education needed to change patients' lives. AACD remains at the forefront of the cosmetic dentistry evolution and continues to attract the world's most innovative dentists and laboratory technicians as they look to the Academy as their professional home—a source of lifelong learning—and affiliation with the best and brightest in comprehensive cosmetic dentistry.

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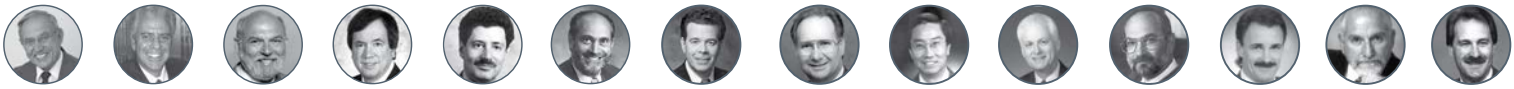

Dr. Kammer *Dr. Morley* *Dr. Landman* *Dr. Kanca* *Dr. Freedman* *Dr. Scharf* *Dr. Golub-Evans* *Dr. Markowitz* *Dr. Mayeda* *Dr. Mabrito* *Dr. Glick* *Dr. Carrick* *Dr. Feigenbaum* *Dr. Lodding*

1984

July 1982:
Dr. Jack Kammer and Dr. Jeff Morley begin corresponding, and refer to the nascent organization as the American Academy of Cosmetic Dentistry (AACD).

July 1983:
They try to organize the very first meeting of the AACD. The meeting, to be held at Orcas Island, WA, is canceled, and the concept of AACD is put on hold.

December 7-9, 1984:
The first meeting of AACD is held in Las Vegas at the MGM Hotel. The meeting fee is $150, and 60 dentists from the U.S. and Canada attend.

Dr. Kammer is elected President of AACD, and a 15-member Board of Directors is elected.

Dr. Michael Miller is appointed to develop a credentialing guideline. Dr. George Freedman helps bridge corporations, universities, and the AACD. Dr. Sid Markowitz helps form AACD leadership concepts and governance. Dr. John Kanca offers breakthrough clinical presentation on total etching in St. Thomas.

Fall 1985:
The first issue of the *Journal of Cosmetic Dentistry (jCD)* is published; editor is Dr. Robert Sandusky.

1989

May 1986:
First Accreditation Examination. One month later, first Accreditation protocol is developed.

August 1987:
The idea for a charitable foundation is developed to increase awareness of cosmetic dentistry and fundraise.

1989:
First affiliate in New York established by Dr. Jeffrey Golub-Evans. Also, the *jCD* notes the five most requested restorations: porcelain veneers, porcelain inlays, porcelain onlays, porcelain jacket crowns, and porcelain fused to metal crowns.

February 1989:
Laboratory technicians are invited to annual meeting and membership for the first time, initiated by Dr. Robert Reyto.

1990s:
Age of Adhesive Dentistry. Encompasses a wide range of restorative procedures and techniques that are clinically viable due to new dental materials, including: dentinal bonding agents, multi-purpose bonding agents, improved composite resins.

1991:
Number of Accredited slots increases to 20 at annual meeting. Framework for AACD affiliates (chapters) is established.

1994

1992:
AACD Fellowship becomes available. First chair, Dr. Daniel Mayeda. Requirement: Must be an Accredited Member for five years.

1992:
Dr. Jim Elias develops Accreditation for laboratory technicians.

1993:
Team program is introduced at the annual meeting in Miami. Also, French and Spanish translations are offered to accommodate a diverse membership.

1994:
AACD Charitable Foundation is established as the AACD Educational Endowment Fund.

1994:
Membership spans 27 countries, and 13 local chapters: Chesapeake, Chicago, Los Angeles, Louisiana, New England, New Jersey, New York, North Central, Northwest, Philadelphia, San Francisco, Southeast, Toronto.

1994:
At the annual meeting in Phoenix, attendance tops 1,000.

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Dr. Okuda


Dr. Malone


Dr. Addleson


Dr. Davis


Dr. Zase


Ms. Kelly


Dr. Bernstein


Dr. Sesemann


Dr. Flax


Dr. Sullivan


Dr. Goodlin


Dr. Ringer


Dr. Hastings

1999

1999:
Standardized point system for grading Accreditation cases is developed, tested, and used.

May 27, 1999:
Proposed by Past President Dr. Wynn Okuda, the AACD Charitable Foundation's Give Back a Smile (GBAS) national program is launched to help restore the smiles and lives of domestic violence survivors.

2000:
AACD turns 15 and enters the new millennium with more than 4,300 members, eight affiliated dental schools, 16 full-time staff members, and a budget of $4 million.

February 24, 2001:
Accreditation protocol changes to a three-tiered system to include the written examination, clinical case submissions, and oral examination.

2002:
"Extreme Makeover" debuts on primetime TV, further driving AACD's relevance to U.S. consumers. Cosmetic dentistry becomes more popular than ever.

July/August 2003:
Membership reaches 5,432.

2004

2004:
AACD celebrates its 20th anniversary in Vancouver, BC. Board of Governors changes nomenclature to the American Board of Cosmetic Dentistry® at the annual business meeting in Vancouver on April 27.

June 25, 2004:
Accreditation digital protocol is approved and introduced.

October 2006:
Fellowship process approved and introduced to laboratory technicians.

2007-2008:
GBAS restores 119 smiles worth more than $1.2 million in donated dental services.

2008:
The economy hits the skids, and many dentists feel the pinch; membership slowly declines for a period before plateauing and climbing once again.

2009

2009:
AACD celebrates its 25th anniversary in Hawaii. AACD undergoes re-branding, starting a focus on responsible esthetics.

2010:
The Academy unveils new logo at the Dallas conference, demonstrating alignment with its responsible esthetics positioning. AACD creates sister relationship with the Japanese Academy of Esthetic Dentistry.

Spring 2010:
The AACD Executive Office moves into its new headquarters building in downtown Madison, WI.

August 19, 2010:
Accreditation opens to non-members, adding another layer of validation to the credential.

Fall 2010:
AACD holds its first international conference—Esthetics Meets Aesthetics—in London, along with European affiliate organizations.

2011:
AACD goes digital with more robust online e-learning, webinars, and a conference app. AACD creates sister relationship with the Korean Academy of Esthetic Dentistry.

2014

2013:
Expanding its influence, the AACD has members in more than 70 countries and every state in the union; the *jCD* reader app exceeds 25,000 downloads; AACD has more than 17,000 Facebook fans and over 8,000 Twitter followers.

2014:
AACD celebrates its 30th anniversary in Orlando at AACD 2014.

2014:
GBAS celebrates its 15-year anniversary.

Restoring Central Incisors

The Synergy and Pathway to Predictable Esthetics

Ana L. Villagrana
Serena Kurt, DDS

Key Words: incisal length, lithium disilicate, reverse smile, indirect restorations, communication, Case Type II

> **"The dentist and ceramist must have excellent communication and work as a team to obtain optimal results."**

Introduction

The most predictable esthetic restorations revolve around the interaction and communication among the dentist, the patient, and the ceramist. Once the treatment pathway is selected, a comprehensive step-by-step plan must be followed to ensure the ultimate success of the case.

There have been many advances in the art and science of dentistry, and introduction of new techniques such as metal-free restorative materials. IPS e.max (Ivoclar Vivadent; Amherst, NY) is one such innovative material. e.max is an all-ceramic lithium disilicate glass ceramic ingot with 400 MPa flexural strength. This makes it possible to provide high-strength, thin restorations with conservative tooth preparations.[1-3]

The ingots of e.max were designed to replicate the opalescence and translucency of natural tooth structure. A wide variety of e.max ingots are available to obtain the final desired shade. The dentist and ceramist must have excellent communication and work as a team to obtain optimal results.

Case Presentation

A 35-year-old female presented with discolored bonding on the facial incisal area on tooth #8. Tooth #9 had incisal edge wear. The patient was self-conscious about her two front teeth, which created a reverse smile line. She wished to lengthen them and make the permanent restorations more color-stable and lifelike to improve her smile **(Figs 1-3)**.

Medical and Dental History

After a thorough examination, no medical contraindications or allergies were found. A comprehensive dental examination revealed soft tissue health, and results of radiographic and oral cancer examinations were within normal limits. There was a history of endodontic treatment in addition to some missing teeth and restorative fillings. The muscles of mastication were asymptomatic, and temporomandibular function was within normal limits, displaying no joint noises or deviations.

Diagnosis and Treatment Plan

A detailed examination included radiographs, the 12 required AACD images; and dental shade analysis, diagnostic models, and bite records. This allowed for communication with the ceramist, who could address the patient's desires. A treatment plan was developed to obtain a predictable result.[4]

The patient's chief complaints about her teeth were as follows:

- poorly blended composite on #8
- disproportionate length of #8 and #9
- reverse smile appearance.

Treatment

Preoperative

An all-ceramic IPS e.max lithium disilicate crown was selected for #8. This tooth had the old stained composite present. An all-ceramic IPS e.max lithium disilicate veneer was chosen to restore #9. These materials were selected to correct the color discrepancy and improve the length-to-width ratio. The central dominance and symmetry between #8 and #9 could be improved by increasing the length of these teeth. Increasing the length of these teeth in relation to the upper canines along the incisal plane would allow for the creation of a harmonious smile, eliminating the appearance of the patient's reverse smile line.[5-6] The goal was to create proportional restorations that matched the patient's natural dentition.

A diagnostic wax-up was made from a preoperative model. This served as a guide and aid in the communication process between the ceramist, dentist, and patient. Preoperative models were sent to the laboratory along with the required images, bite records, and a clear explanation of the patient's desires for the fabrication of a diagnostic wax-up.[7]

Figure 1: Full face, 1:10 view; self-conscious patient displaying reverse smile.

Figure 2: Frontal retracted 1:1 view; discolored bonding on #8.

Figure 3: Retracted 1:2 view; #9 showing incisal edge wear.

The patient was happy with the shape, length, and midline of the proposed wax-up. A silicone matrix was then made to be used by the doctor on the day of preparation to fabricate the temporaries exactly as the wax prototype **(Figs 4-6)**.

At the beginning of the restorative appointment, shade selection was performed and photographs were taken. This was done with and without shade tabs at various angles to show the laboratory as much surface texture and height of contour as possible.

Once the shade was verified, the teeth were prepared **(Fig 7)**.

Chamfer margins were created up to the free gingival margin and enough space was ensured for the proper shape of the porcelain. Retraction cords were placed around the prepared teeth. The stump shade was recorded, photographed, and sent to the ceramist **(Fig 8)**.

Final impressions were taken using Genie VPS impression material (Sultan Healthcare; Hackensack, NJ). The bite registration and photographs were sent to the ceramist along with a complete laboratory prescription detailing the required outcome and patient desires.

In the Laboratory

The ceramist read the prescription, reviewed the images, and examined the mounted models of the provisional restorations and prepared tooth models. The laboratory process began by making a silicone matrix of the provisional restorations that had been approved by the patient.

The matrix was seated on the working model with a small hole on the incisal edge. The matrix was then placed over the tip of the wax injector and the cavity was filled with beige Thowax (Yeti Dental; Engen, Germany), transferring the shape, form, and function from the provisional. After the wax-up was finalized, it was separated using a thin blade (Tanaka Dental; Skokie, IL), spread, and invested in a 100-gram ring, allowing the investment to set **(Fig 9)**.

After bench time was finished, the ring was placed in a burn-out furnace. The case was pressed in the Programat EP 5000 porcelain furnace (Ivoclar Vivadent), cooled, and divested. IPS e.max impulse series Value (V2) ingot was used. This ingot was chosen based upon the patient's stump shade (ND1) and to achieve the final desired shade of BL4 **(Fig 10)**.

Figure 4: Preoperative model.

Figure 5: Diagnostic wax-up, showing proposed shape, length, and midline.

Figure 6: Silicone matrix, made for the doctor to make temporaries.

Figure 7: Prepared teeth.

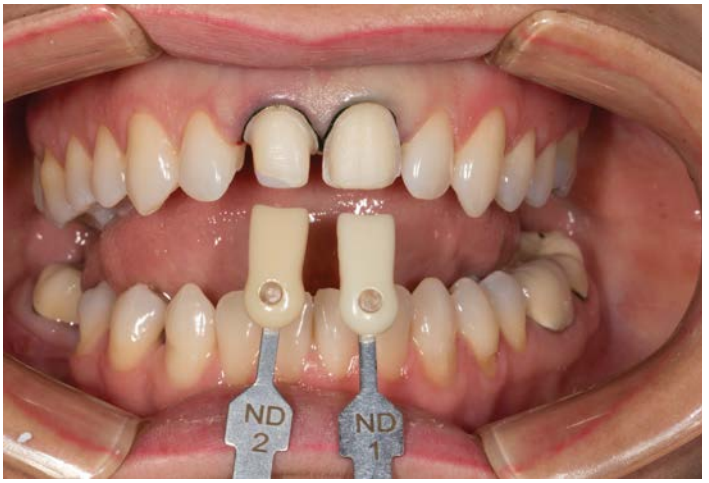

Figure 8: Stump shade selection.

Figure 9: Wax injector.

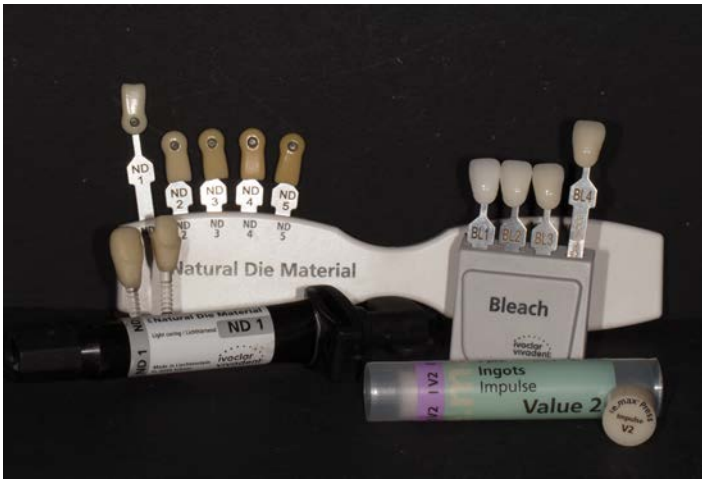

Figure 10: Material shade selection (stump ND1, final shade BL4).

Figure 11: Pressed restoration.

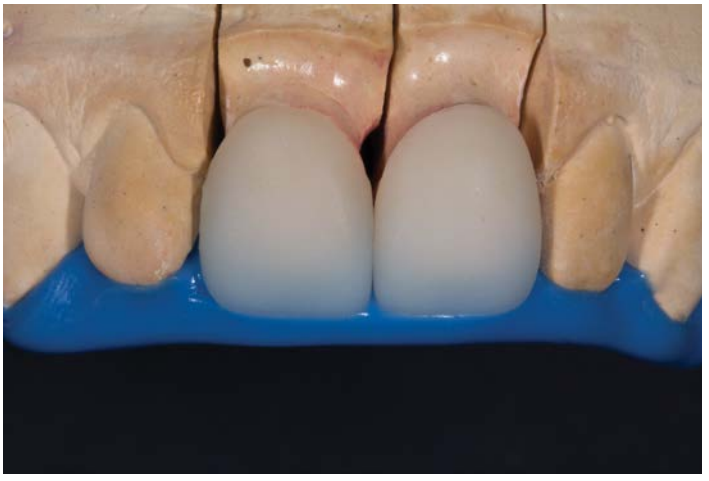

Figure 12: Incisal edge silicone matrix, helping maintain desired incisal length.

Once divested, the restoration was fitted to the working model. Occlusion, and excursive and protrusive movements were checked. An extra solid model was made to check the margins and contacts, and reshape it to the final contour **(Fig 11)**.

Prior to the incisal cutback, an incisal edge silicone matrix was made to keep the incisal length desired for this case **(Fig 12)**.

The images served as a guide to determine how much incisal cutback was needed. Due to the low level of translucency on the incisal third, a bleach color of BL4 was chosen for the final shade. This allowed for similar translucency in the incisal area between the central and lateral incisors.

A cut was made from the buccal incisal one-third surface toward the lingual and 1 mm from the incisal edge. Mesial and distal slots were created to enhance some of the translucency of the tooth **(Fig 13)**. Once the cutback was ready, the restorations were sandblasted, steam-cleaned, and dried. IPS Natural Die Material was made to fabricate and replicate the prepared teeth using stump shade ND1 **(Fig 14)**.

After placing the restorations on the stump die, a stain bake was needed before the first buildup **(Fig 15)**. A mixture of IPS Empress Universal Stain chroma B with a small amount of pink stain was used for the cervical third. Blue stain was used on the mesial/distal incisal corners for translucency effects. The restorations were fired at 725 °C with a one-minute hold.

When the technician was satisfied with the shade, the first layer was made by applying a small amount of IPS e.max Ceram (OE1) on the mesial/distal slots to create translucency, exactly on top of the blue stain **(Fig 16)**.

Line angles were enhanced by the application of Opal enamel 4 (OE4) and then fired at 750 °C **(Fig 17)**. After the restorations cooled they were ready for the full layer. The veneering layer was applied to full contour **(Fig 18)**. Based upon the low level of incisal translucency in the adjacent teeth, Opal Enamel 2 (OE2) was used. The restorations were placed on a honeycomb tray and fired at 750 °C with a one-minute hold. A second incisal was fired using the same OE2 enamel to fill in the final contours and deficient areas and fired again at 750 °C with a 30-second hold.

After the restorations were cooled, they were fitted on the working model to make sure all excursive and protrusive movements and contours were satisfactory. The restorations were placed back on the solid model and a diamond bur was used to

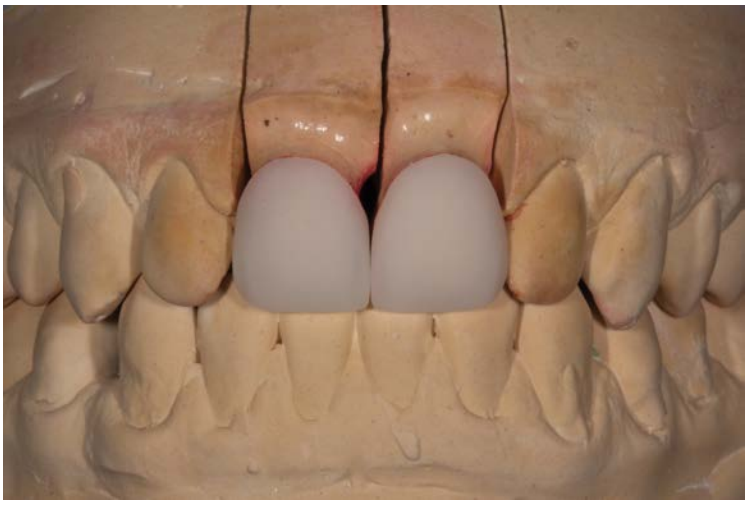

Figure 13: Cutback technique.

Figure 14: Stump die material selection (ND1).

Figure 15: Internal stain bake.

"Anterior restorations in the maxillary region challenge the dentist and the ceramist to match the restorations to the natural dentition."

Figure 16: Mesial/distal (OE1).

Figure 17: Application of Opal Enamel (OE4) on the line angles.

Figure 18: Full veneering layer.

Figure 19: Bisque bake.

Figure 20: Shade verification on stump die.

adjust the contacts as well as the occlusion, size, shape, middle line, and line angles.

After reviewing the images and study models, it was noticed that there was a smooth surface on the upper incisors and defined line angles. Very little texture was needed based upon the study model.[8]

When everything was satisfactory, the restorations were prepared for the final glaze. They were carefully sandblasted on the inner surface and cleaned in an ultrasonic unit. They were then placed on the stump die, and a small amount of stain liquid was applied to the facial surface to expose the color for shade verification **(Figs 19 & 20)**.

The shade guide and the images were compared. Based on this comparison, a mixture of Empress Universal Stain, chroma B with a small amount of pink stain, was applied on the cervical area and baked at 725 °C. Shades were compared for accuracy, and then the units were glazed by applying a thin layer of luster powder (GC America; Alsip, IL) mixed with liquid. The restorations were then baked at 725 °C. After glazing the restorations, they were placed on the solid model again to recheck the fitting. The restoration line angles were polished with a pink rubber wheel (Dedeco; Long Eddy, NY) and Diashine paste (VH Technologies; Lynnwood, WA) with a white bristle brush.

To finalize, the restorations were sandblasted with aluminum oxide (50µ) and etched with 5% hydrofluoric acid for 20 seconds, rinsed, steam-cleaned, and dried. The restorations were properly packaged and delivered to the doctor's office for cementation **(Fig 21)**.

Cementation

The patient was anesthetized and the temporary restorations were removed. The final restorations were evaluated for proper fit and esthetics. Silane (Kerr; Orange, CA) containing resin was applied to the internal portions of the restorations, lightly air-thinned, and placed in a light-proof box.

The teeth were etched with 37.5% phosphoric acid (Gel Etchant, Kerr) for 15 seconds, rinsed thoroughly, and lightly air-dried. The dental adhesive (OptiBond Solo Plus, Kerr) was applied to the enamel and dentin surfaces with an applicator tip for 15 seconds in a light brushing motion and light-cured for 10 seconds.

Both restorations were filled with the luting cement (NX3 Universal Resin Cement, Kerr) and

Figure 21: Frontal view of finished case on model.

Figure 22: Full-face postoperative 1:10 view.

Figure 23: Frontal postoperative 1:1 view.

seated gently on the teeth, allowing the cement to slowly flow from all margins. The veneer was spot-cured into place on the facial surface for 10 seconds. The crown was light-cured for five seconds on the buccal and lingual. After removing the excess cement, all surfaces were light-cured for 20 seconds per surface. The margins were finished with a fine diamond bur. The occlusion was checked and the lingual surface of the veneered tooth was adjusted and polished with Jiffy polishing points (Ultradent Products; South Jordan, UT).[9]

Summary

Anterior restorations in the maxillary region challenge the dentist and the ceramist to match the restorations to the natural dentition. Like any relationship, communication between the dentist, the patient, and the ceramist is crucial to properly plan the restorative case. The dentist and the ceramist must work well together and share a great knowledge of materials and techniques for the successful completion of a functional and esthetic restoration.

The success of this case revolved around the concept of placing the patient in provisional restorations that were identical in form, function, and appearance to the definitive restorations. The synergy between the dentist's and ceramist's abilities to reproduce the form and position achieved lifelike restorations that not only satisfied the patient, but also increased her self-confidence **(Figs 22-25)**.[10-12]

Figure 24: Retracted 1:2 view.

Figure 25: Ms. Villagrana; the patient, Imelda Medina; and Dr. Kurt.

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Dr. Kurt earned her DDS from La Salle University in 2009. She owns a private practice at Trust Dental Care, Tijuana, Mexico.

Disclosure: The authors did not report any disclosures.

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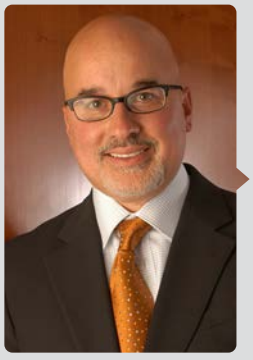

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Examiners' Commentary

When Collaboration Pays Off

J.A. Reynolds, DDS, AAACD

> "Without quality digital photography, it is extremely difficult to achieve the communication necessary for high-level restorative dentistry."

The Accreditation process can be quite a journey. It becomes that much more rewarding when the ceramist and dentist take that trip together. Ms. Villagrana and Dr. Kurt did just that on this Case Type II: One or Two Indirect Restorations. When the collaboration among the dentist, ceramist, and patient is present at the outset, a case can progress seamlessly to the satisfaction of all parties.

In this case, the ceramist was armed with all the pertinent information at the beginning. During the wax-up and treatment-planning phase, mounted preoperative models, images, and detailed explanations of the patient's desired result were all made available. The fabrication phase was aided with many digital images from differing angles and F-stops to help with hue, chroma, value, textures, and translucencies.[1] Preparation shades and models of approved provisionals set the case up for success. Without quality digital photography, it is extremely difficult to achieve the communication necessary for high-level restorative dentistry.

Ms. Villagrana and Dr. Kurt must be commended for striking such synergy in their approach. A majority of examiners passed this case, while noting the following deductions:

- **Criterion #43:** *Have the line angles been properly developed?* In both the frontal and occlusal views, the line angles were not well developed, giving a wide and bulbous appearance. This was noted as a major fault.
- **Criterion #53:** *Is the color (hue, value, chroma) selection appropriate/natural, not monochromatic?* It was noted that there is a somewhat overstated chroma influence in the gingival to the middle third of #8 and #9.
- **Criterion #87:** *Are the contralateral teeth in harmony in terms of size, shape, and position?* Many examiners noted that #9 was wider than #8.

This author noted the nice texture match with the opposing dentition and overall enhancement of the smile created with the added length of #8 and #9, which corrected the reverse smile line **(Figs 1 & 2)**. With a little more attention to line angle development, the perceived width-to-height ratio could have been improved by moving the reflective zones of each tooth toward the center **(Fig 3)**.[2] Transitional line angles outline the central incisor shape, and the expanded interproximal deflective zones can give the illusion of a thinner tooth.[3] The flash from the camera is a good diagnostic tool and it is often helpful to take many images of natural teeth to study and replicate.

Building a team of like-minded specialists will provide enhanced outcomes for our patients **(Fig 4)**. The Accreditation process can help build these relationships and taking that journey together will heighten the learning as well.

Figure 1: Reverse smile line improved with added length to central incisors (preoperative view).

Figure 2: Reverse smile line improved with added length to central incisors (postoperative).

Figure 3: Line angle development may have improved the slightly high width-to-height ratio of the centrals.

Figure 4: Communication + collaboration = great results.

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Dr. Reynolds is an AACD Accredited Member and has been an AACD Accreditation Examiner since 2003. Dr. Reynolds practices in Franklin, Tennessee.

Disclosure: The author did not report any disclosures.

COMBINED USE of

Editor's Note: The digital version of this article shows the clinical steps and artistic details that went into the composition of this case. 

A Challenge in the Esthetic Zone

Nondas Vlachopoulos, CDT

Abstract

This visual essay presents the case of a 20-year-old female with congenitally missing lateral incisors in the maxilla. Clinical examination indicated Siebert Class I defect of the alveolar ridge at sides #7 and #10 and inappropriate distance between the central incisors and the canines.

The treatment plan included the placement of two implants in the area of #7 and #10 with simultaneous bone grafting. Teeth #6, #8, #9, and #11 were to be restored with feldspathic veneers after minimal preparations.

The great buccal bone loss was very noticeable, but the major problem was in the edentulous areas, where the mesial-distal space was too wide to restore lateral incisors naturally.

The ceramic powders used for the layering technique were opacious dentin, dentin, transition dentin, transparent, opalescence transparents, mamelons, enamel, and lusters.[1-3]

The main concern during the layering strategy and the grinding of the restorations was to solve the case's primary problem—the wide diastemas at the upper lateral incisors.

Key Words: feldspathic veneers, diastema, stratification, implant, bone graft, soft tissue management, harmony

Feldspathic Veneers and Zirconia with Implants to Treat Diastemas

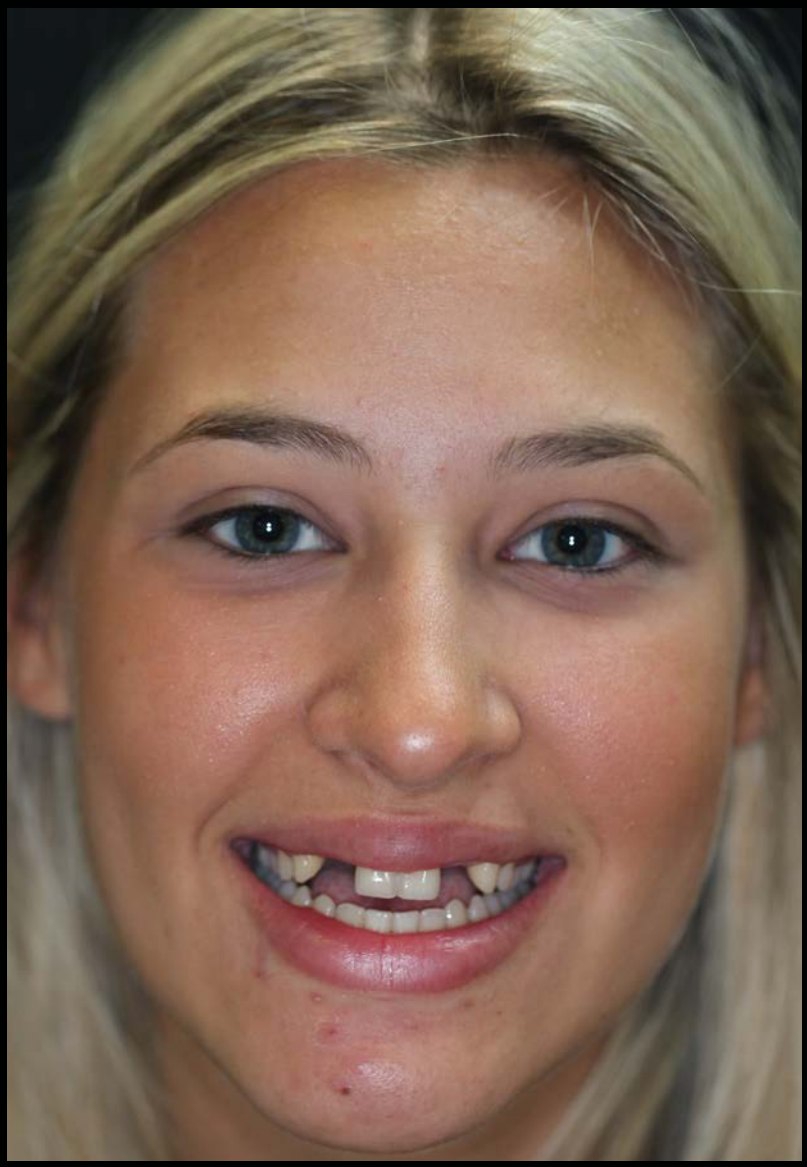


Figure 1: Initial portrait.

Introduction

Prosthetic restorations in the esthetic zone are always a challenge for the dental technician. Especially when it comes to complicated cases, where the need for optimum results in the areas of esthetics, function, and biocompatibility necessitates the use of different all-ceramic restorations, implants, and their combination.[4]

This article addresses the case of a 20-year-old female after an unsuccessful orthodontic treatment, with congenitally missing lateral incisors in the maxilla. Clinical examination indicated Siebert Class I defect of the alveolar ridge at sides #7 and #10 and inappropriate distance between the central incisors and the canines.[5,6]

“Prosthetic restorations in the esthetic zone are always a challenge for the dental technician.”

Case Study

The patient's initial appearance is shown in **Figure 1**.

The treatment plan included the placement of two implants in the areas of #7 and #10 with simultaneous bone grafting. Teeth #6, #8, #9, and #11 were to be restored with feldspathic veneers after minimal preparation.[7]

The great buccal bone loss was very noticeable **(Fig 2)**, but the major problem was at the edentulous areas, where the mesial-distal space was too wide to restore lateral incisors naturally **(Figs 3 & 4)**.

Grindings and grooves on the enamel while removing the brackets after the orthodontic treatment were also very obvious **(Figs 2 & 3)**.

The initial objective was to design and then to construct restorations for the six anterior teeth with the most harmonious ratios.

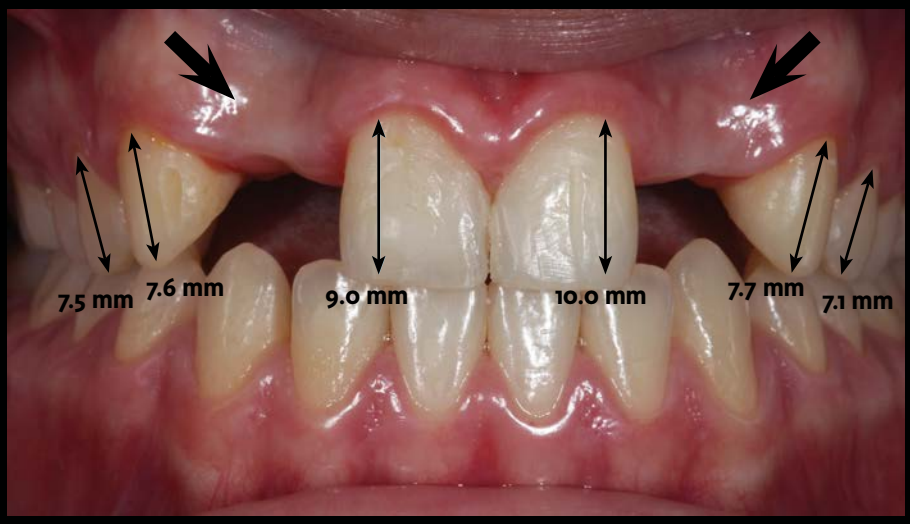


Figure 2: The lengths of the clinical crowns were quite harmonious.

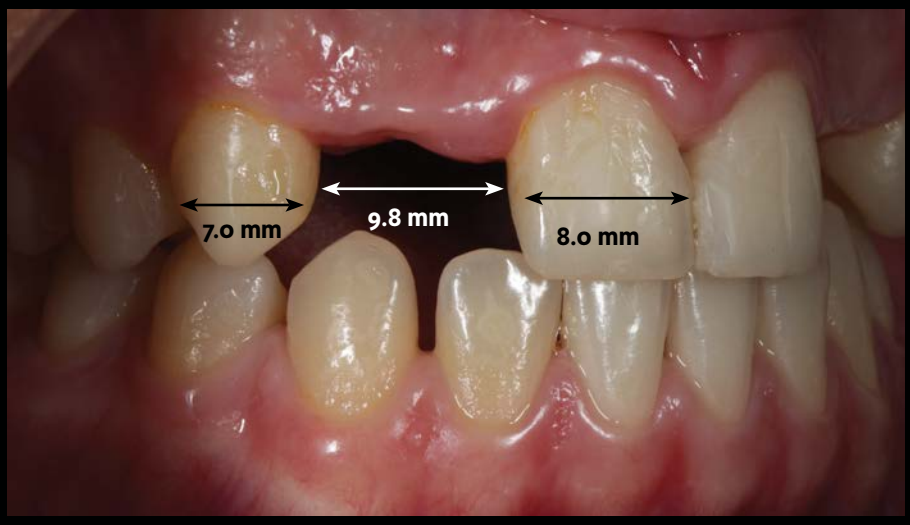


Figure 3: Dissimilarity among the mesio-distal dimensions at side #7.

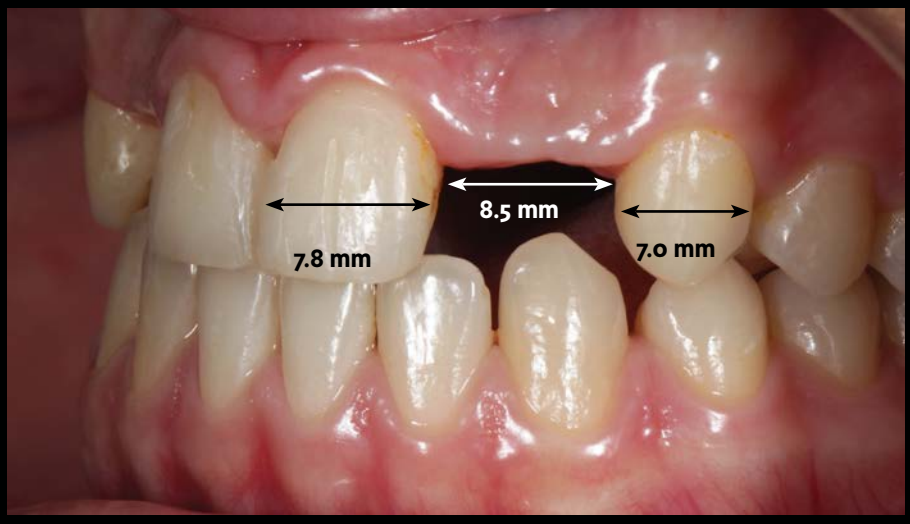


Figure 4: Dissimilarity among the mesio-distal dimensions at side #10.

A diagnostic wax-up was performed on the working cast to provide the surgeon with information about the correct position of the implants and the bone graft needed **(Figs 5 & 6)**.[8] The implants were placed in the areas of #7 and #10 **(Fig 7)**.

After the first impression was taken, the provisional restorations were constructed. Soft tissue management was achieved after three readjustments of the acrylic provisional restorations (forming the desired emergence profiles and the subgingival peri-implant areas) **(Fig 8)**.

Figure 5: Gingiva wax-up.

Figure 6: Diagnostic wax-up.

Figure 7: Implants in the areas of #7 and #10.

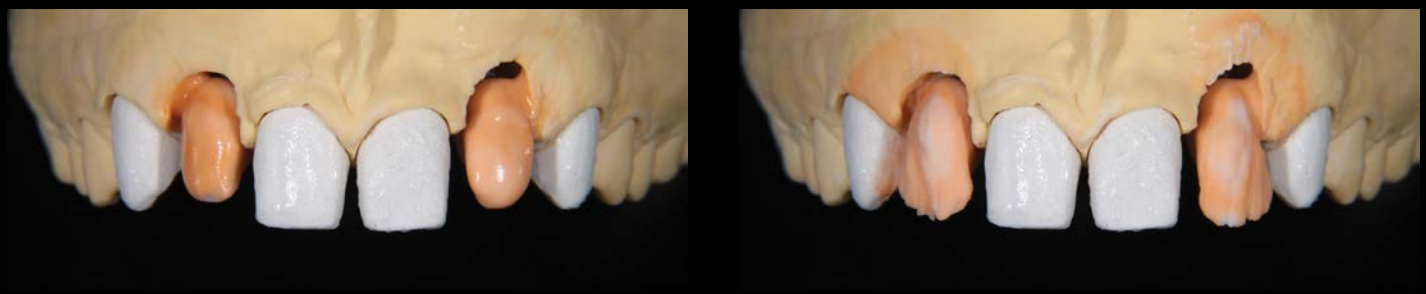
Figure 8: Abutments for temporary restorations.

Laboratory Procedure

After the final impression, CZR feldspathic ceramic material for zirconia (Noritake Dental; Nagoya City, Japan) was used for the layering stratification **(Figs 9a-20b)**.

Figure 9a: Titanium abutments for zirconia CAD/CAM crowns were used. An alveolar model was constructed so that the maximum gingiva information was preserved.

Figure 9b: The zirconia crowns and the refractory dies in the alveolar model. A foundation firing was applied beforehand.



Figures 10a & 10b: The balance in opacity and translucency between the different materials of zirconia crowns and veneers was initially achieved by using different opacity ceramic materials.


Figures 11a & 11b: Dentin and secondary frames on the incisal and interproximal.


Figures 12a & 12b: Dentin and transition dentin.


Figures 13a & 13b: Secondary dentin with more opacity, mixed with 50% opaque dentin to support the middle incisal third.


Figures 14a & 14b: Aqua Blue 2 opalescence (Noritake Dental) in the interproximal and Transparent Blue (Noritake Dental) in the middle third to improve the depth illusion.

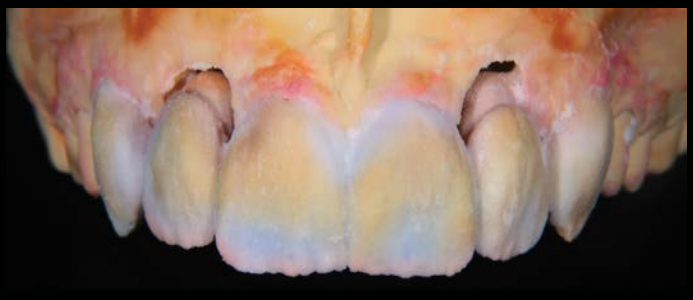

Figures 15a & 15b: Transparent Blue and Aqua Blue 1 and 2 on the incisal. Cervical Transparent (CCV2, Noritake Dental) on the cervical areas.


Figures 16a & 16b: Pure transparent TX (Noritake Dental) on the middle and incisal third like a canvas, where the mamelons would be applied.


Figures 17a & 17b: Yellowish and whitish mamelons on the transparent canvas.


Figures 18a & 18b: Cover with enamel (Noritake Dental).

Figures 19a & 19b: Halo effect and lusters (Noritake Dental).



Figures 20a & 20b: White powder (Noritake Dental) to increase the external brightness and to create a thin layer like a calcification film.

Figure 21: The final result.

Figure 22: The final result in relation to the antagonists.

Figures 23a & 23b: Lateral views of the final result.

Figure 24: Candid snapshots of the patient.

Figure 25: Portrait showing the patient's highest smile line.

Summary

The key to a successful esthetic result is the teamwork among the dentist, the dental surgeon, and the dental technician.

The choice of the optimum treatment plan and the restoration's type, as well as knowledge of the techniques and the proper materials in collaboration with the dental technician's talent, leads to satisfied patients[9,10] **(Figs 21-25)**.

Acknowledgments

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> "The key to a successful esthetic result is the teamwork among the dentist, the dental surgeon, and the dental technician."

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Disclosure: The author is an official instructor for Noritake Dental Inc. (Nagoya, Japan); and Noritake (Athens, Greece).

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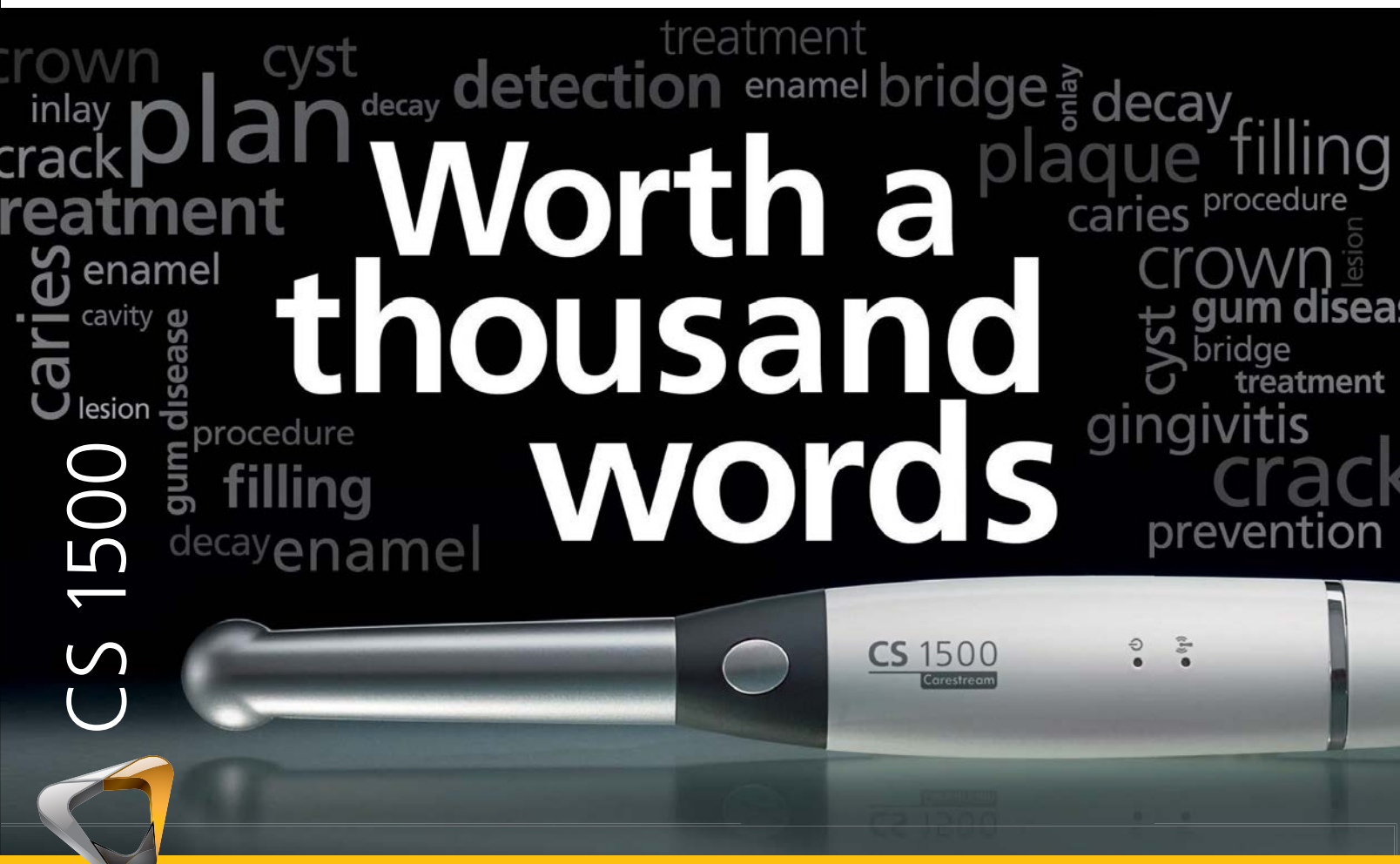

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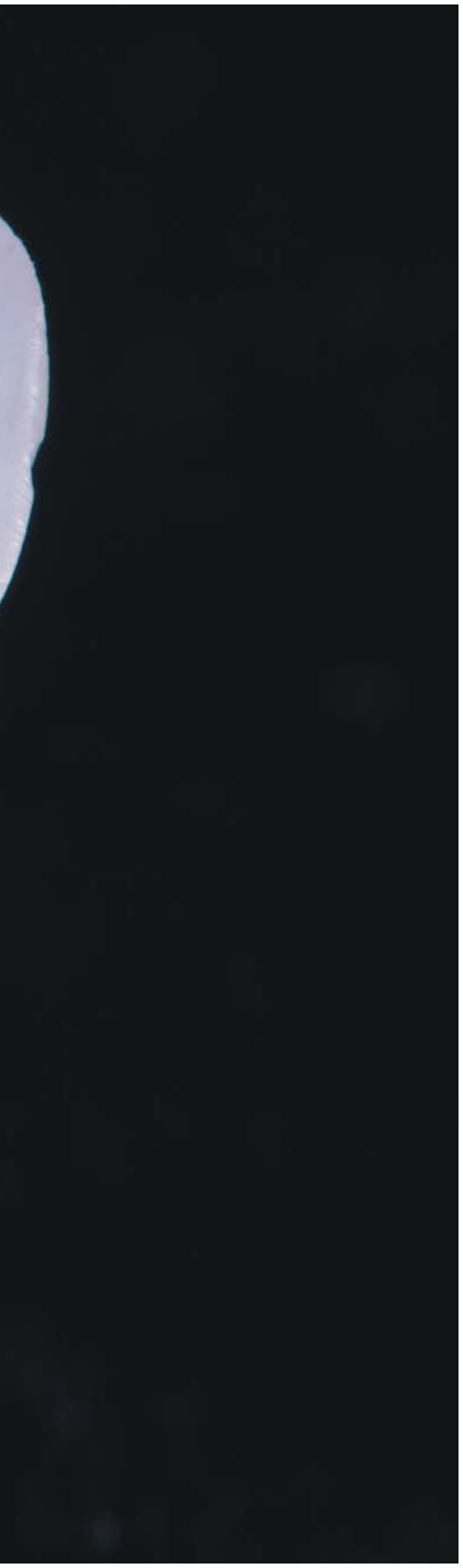

Resurrecting Natural Tooth Anatomy

Clinical Case Report: Class I Direct Resin-Based Composite

Paulo Kano, DDS, MDT, MSc
Priscila Saito Thiemi, DDS

Abstract

This article presents two clinical cases with three Class I direct resin-based composite (RBC) restorations. After caries removal and final preparation, the placement and sculpture were effected without using any type of rotatory instruments or burs. The restorations were achieved using only brushes and composite instruments to recreate the natural anatomy of the teeth. These cases show how, as a result of proper diagnosis and treatment planning, this restorative approach can become a clinical reality.

Key Words: class I, resin-based composite, buildups

"In the quest for beauty, people seek solutions from all fields of the health sciences for improved esthetics and increased self-esteem."

Introduction

If we believe that our current world is largely the result of radical developments and advances in concepts, trends, and technology, this should hold true for dentistry as well. Clinicians today practice in a highly technically oriented society with powerful computers, handheld devices, and other advances in technology that have an impact upon dentistry and patient expectations. The practitioner is challenged to meet patients' demands utilizing the most current technology and restorative techniques to rebuild tooth form and function and restore patients' smiles in the most conservative manner.

In the quest for beauty, people seek solutions from all fields of the health sciences for improved esthetics and increased self-esteem. Consequently, esthetic and restorative dentistry plays an important role in attracting patients. Resin-based composite (RBC) offers esthetic solutions that attract the general public to the dental practice.

The following clinical cases demonstrate that the proper technique and correct utilization of the materials can provide a magnificent outcome, leading to decreased treatment time and limiting the use of burs.

Case Presentations

Examinations and Treatment Plans

In Case 1, a 17-year-old female presented with a primary caries lesion on tooth #30 that required restoration. Clinical and radiographic examination revealed the primary caries lesion **(Figs 1a & 1b)**.

In Case 2, a 20-year-old female presented with a recurrent caries lesion and fracture of the amalgam restoration on tooth #30 and primary caries lesion on tooth #31 that required restorations. Clinical and radiographic examination revealed the primary caries lesion **(Fig 2)**. In both clinical cases, patients accepted the clinician's recommended treatment plan, which consisted of direct buildup with the RBC (IPS Empress Direct, Ivoclar Vivadent; Schaan, Liechtenstein). This restorative material was selected for its combination of esthetics, range of shades, and favorable clinical handling that permitted effective buildup as highlighted later.

Figure 1a: Case 1: Initial photograph, the patient presented with a primary caries lesion on tooth #30 that required restoration. Clinical examination revealed the primary caries lesion.

Figure 1b: Case 1: Removing the caries.

Figure 2: Case 2: The patient presented with a recurrent caries lesion and fracture of the amalgam restoration on tooth #30 and primary caries lesion on tooth #31. Clinical examination revealed the primary caries lesion.

Treatment Descriptions

The RBC shade was selected comparing the IPS Empress Direct dentin and enamel shade guides to the natural tooth structure. The shade guide was placed beside the area of the tooth where its natural shade was best represented. Shade was determined under natural lighting and prior to rubber dam isolation so that teeth were hydrated.

After rubber dam isolation, the teeth were pumiced **(Fig 3)** using an ICB brush (Ultradent Products; South Jordan, UT). Caries was removed and the preparations were completed using a carbide (330) and diamond (850 - 014 - 2135 FF) bur to achieve rounded internal angles and 90° cavosurface margins without a bevel **(Fig 4)**. The teeth were acid-etched for 15 seconds using Total Etch (two steps) phosphoric acid 37% (Ivoclar Vivadent), extending the etchant beyond the preparation margin **(Fig 5)**. After completely removing the acid, the region was dried, avoiding the collapse of the collagen fibers. This may be achieved by aspirating the water or by placing a small, slightly moistened sponge in the dentin region. After thoroughly rinsing and drying the enamel, Tetric N-Bond nanofill single-component adhesive (Ivoclar Vivadent) was applied according to the manufacturer's recommendation. The adhesive was rubbed gently and thoroughly in the preparation using a microbrush, the excess was removed, the solvent evaporated using the air jet, and it was light-cured for 20 seconds **(Fig 6)**.

From the beginning of the restoration, the anatomy of the natural dentin must be mimicked. It is important to recognize that the dentin has a pyramidal and sinuous topography and the occlusal border coincides with the dentino-enamel junction **(Fig 7)**. The replication of the natural tooth anatomy in the final restoration requires careful attention to detail throughout the restorative procedure.

> "Direct RBC procedures provide the operator with considerable control over the outcome, and are often a more conservative and economic treatment option in comparison to indirect restorations."

Figure 3: After rubber dam isolation, teeth were pumiced.

Figure 4: Removing the caries and preparing the cavity using a carbide (330) and diamond (850-014-2135 FF).

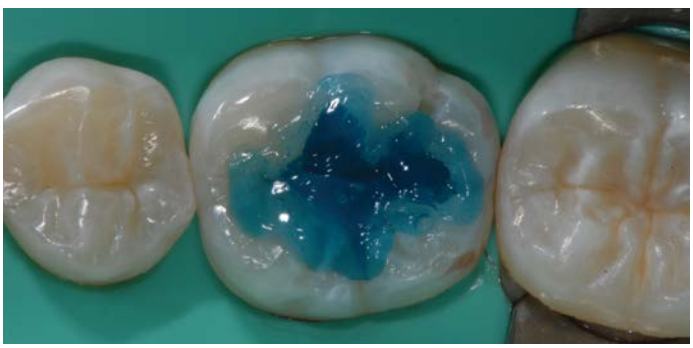

Figure 5: The tooth was acid-etched for 15 seconds.[1]

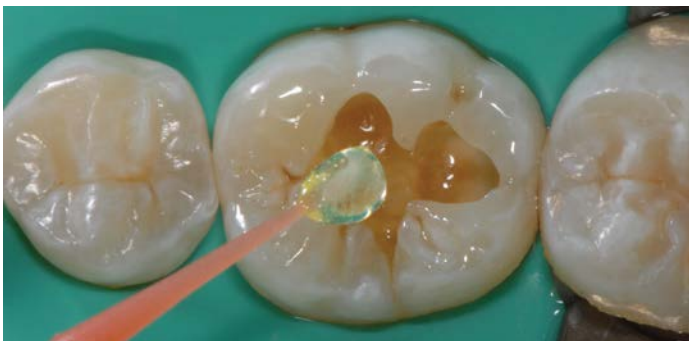

Figure 6: The adhesive was rubbed gently and thoroughly in the preparation using a microbrush, the excess was removed, the solvent evaporated using the air jet, and it was light-cured for 20 seconds.[1]

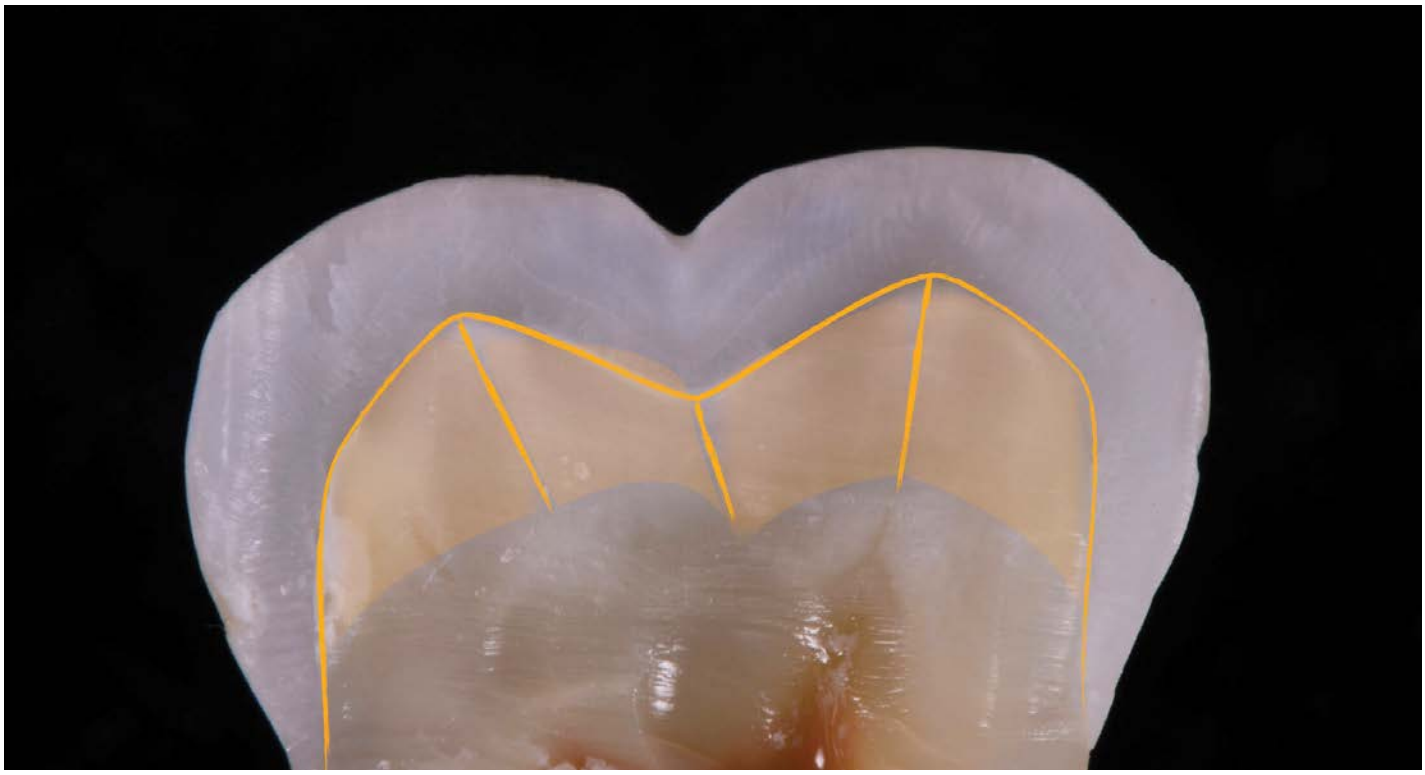

Figure 7: The dentin has a pyramidal and sinuous topography and the occlusal border coincides with the dentino-enamel junction.

The RBC was applied in small increments (1 to 2 mm) following these anatomical criteria **(Figs 8a & 8b)**. The first layer was a dentin shade that was gently condensed on the pulp floor, circumventing the cavity, which will lead to a pyramidal conformation. Each layer was cured for 40 seconds using a Bluephase LED (Ivoclar Vivadent) curing light delivering adequate energy to thoroughly cure the RBC.

The next RBC layer was the enamel shade; proper placement of this layer was important to reproduce the surface morphology, final sculpture, and natural appearance of the teeth **(Figs 9a & 9b)**. The completed restorations have correct position of the grooves, the slopes of the cusps, and rebuilding of the original occlusal anatomy. A #2 Thompson explorer, an IPC TN carver (American Eagle Instruments; Missoula, MT), and a fine brush were used to mimic these characteristics. The RBC was shaped on the surface without excess,

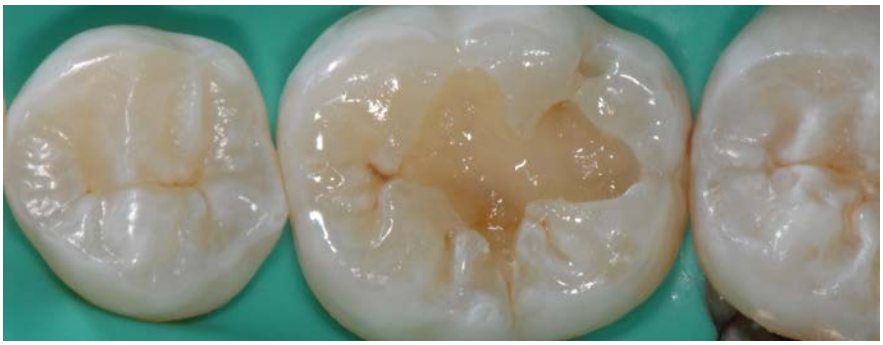

Figure 8a: Case 1: The RBC was applied in small increments (1 to 2 mm). The first layer was a dentin shade that was gently put on the pulp floor. Each layer was cured for 40 seconds.

Figure 8b: Case 2: The same method was used as in Case 1.

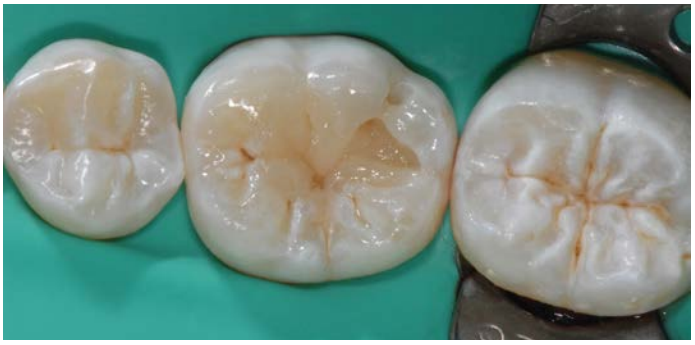

Figure 9a: Case 1: The next RBC layer was the enamel shade and it reproduced the surface morphology.

Figure 9b: Case 2: The same method was used as in Case 1.

Figure 10a: Case 1: The characterization of the central groove using tints.

Figure 10b: Case 2: The same method was used as in Case 1.

Figure 11: Helioseal was mixed with Tetric N-Flow and applied with a fine brush removing all the excess, leaving it only in the retentive areas and deep grooves.

promoting correct adaptation between the tooth structure (cavo-surface margin) and the RBC restoration. The characterization of the central groove was made **(Figs 10a & 10b)** using a tint (Tetric color brown, Ivoclar Vivadent) and light-cured for 20 seconds.

Then, Helioseal was mixed with Tetric N-Flow (both Ivoclar Vivadent) and applied with a fine brush removing all the excess, leaving it only in the retentive areas and deep grooves **(Fig 11)**. Oxiguard Panavia (Kuraray; New York, NY) was applied **(Figs 12a & 12b)** so the entire dispersion layer (resin layer inhibited by oxygen) could be polymerized, avoiding the sticky layer on the surface of the final restoration. After removal of the rubber dam the occlusion was checked to ensure the correct contact areas with no interferences **(Fig 13)**.

The final polishing was done using a low speed and a brush (goat hair) and polishing paste, to achieve the final gloss, over the entire restoration. Thus the anatomy, texture, and polish were achieved without any removal of restorative material or tooth structure with a finishing bur, giving a natural appearance to the tooth. This RBC restorative technique provides an excellent esthetic and functional result.

Summary

The final results **(Figs 14a & 14b)** demonstrate that this approach presents a great potential for esthetics. Doing the restorations without the use of burs allows less surface porosity. And according to the manufacturer,[2] the fluorescent qualities of IPS Empress Direct are very similar to the natural teeth. The restorations have a bluish

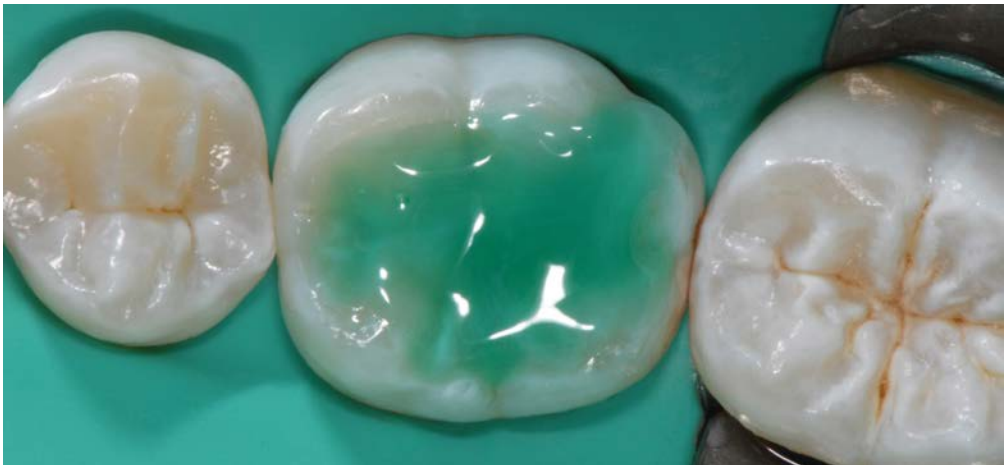

Figure 12a: Case 1: Oxiguard Panavia was applied, avoiding the sticky layer on the surface of the final restoration.

Figure 12b: Case 2: The same method was used as in Case 1.

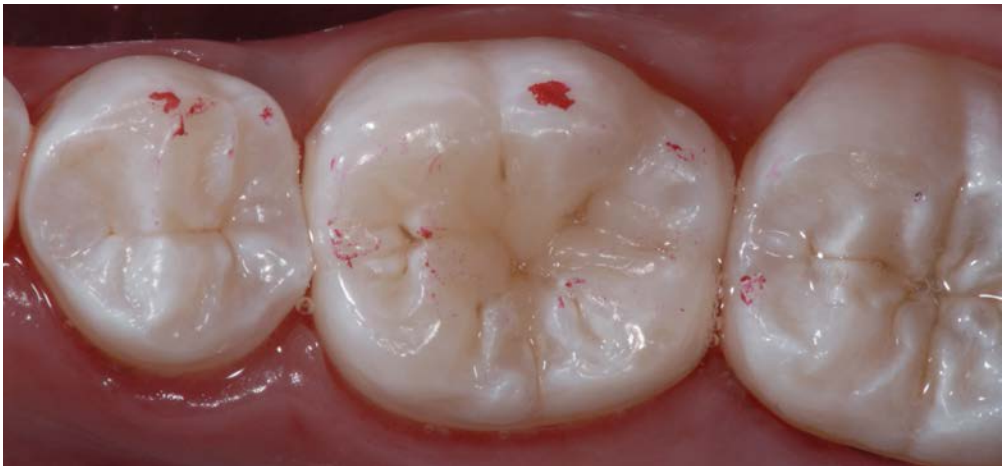

Figure 13: After removal of the rubber dam, the occlusion was checked to ensure the correct contact areas with no interferences.

tinge when light shines on them and a reddish-orange color when light shines through them, exactly like their natural counterparts. Furthermore, the enamel pastes contain fine barium glass fillers (0.4 µ), which provide good polishing properties, high surface sheen, and low susceptibility to wear. Prepolymers are used to increase the strength of the dentin materials and reduce volume shrinkage. Spherical mixed oxide enhances the shine of the material. Ytterbium trifluoride is added to heighten radiopacity and provide fluoride-releasing properties. The material was chosen due to these scientific properties to best achieve greater fidelity to the natural teeth, mimicking them in their most perfect form.

Armed with an understanding of the properties of contemporary bonding materials and experience in the clinical techniques, direct RBC restorations can be effectively performed by clinicians in a single chairside procedure. Direct RBC procedures provide the operator with considerable control over the outcome, and are often a more conservative and economic treatment option in comparison to indirect restorations. Contemporary composites can provide impeccable esthetics and an opportunity for the dental professional to remove the deleterious effects of caries or replace defective fillings with a restoration that provides safety and durability for the patient.

The proper selection of the buildup technique and materials is a perfect duet, and the most important outcomes of their successful combination are the patients' satisfaction and the longevity of the restorations **(Figs 15a & 15b)**.

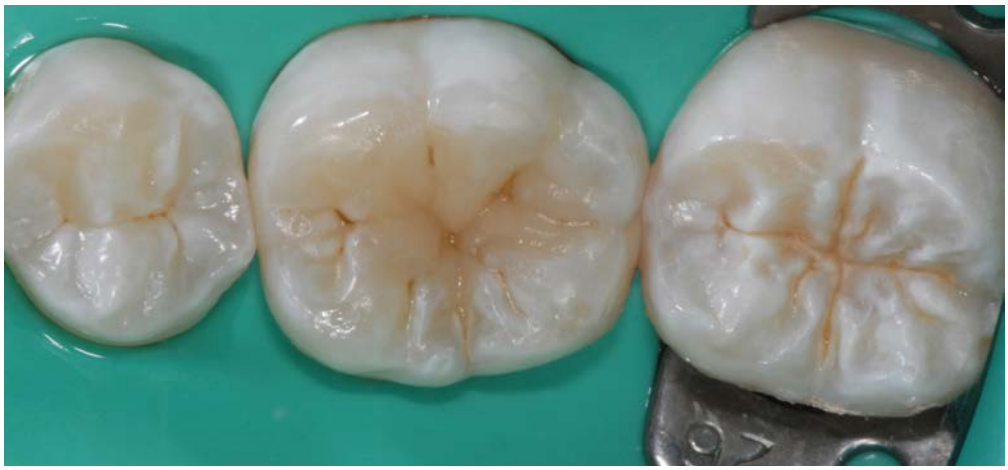

Figure 14a: Case 1: The completed restoration immediately postoperative.

Figure 14b: Case 2: The completed restoration immediately postoperative.

Acknowledgments

The author offers sincere thanks to Dr. Rodrigo Maia of The University of Iowa, in recognition of his help and support in the creation of this article.

Figure 15a: Case 1: One month postoperative.

Figure 15b: Case 2: One month postoperative.

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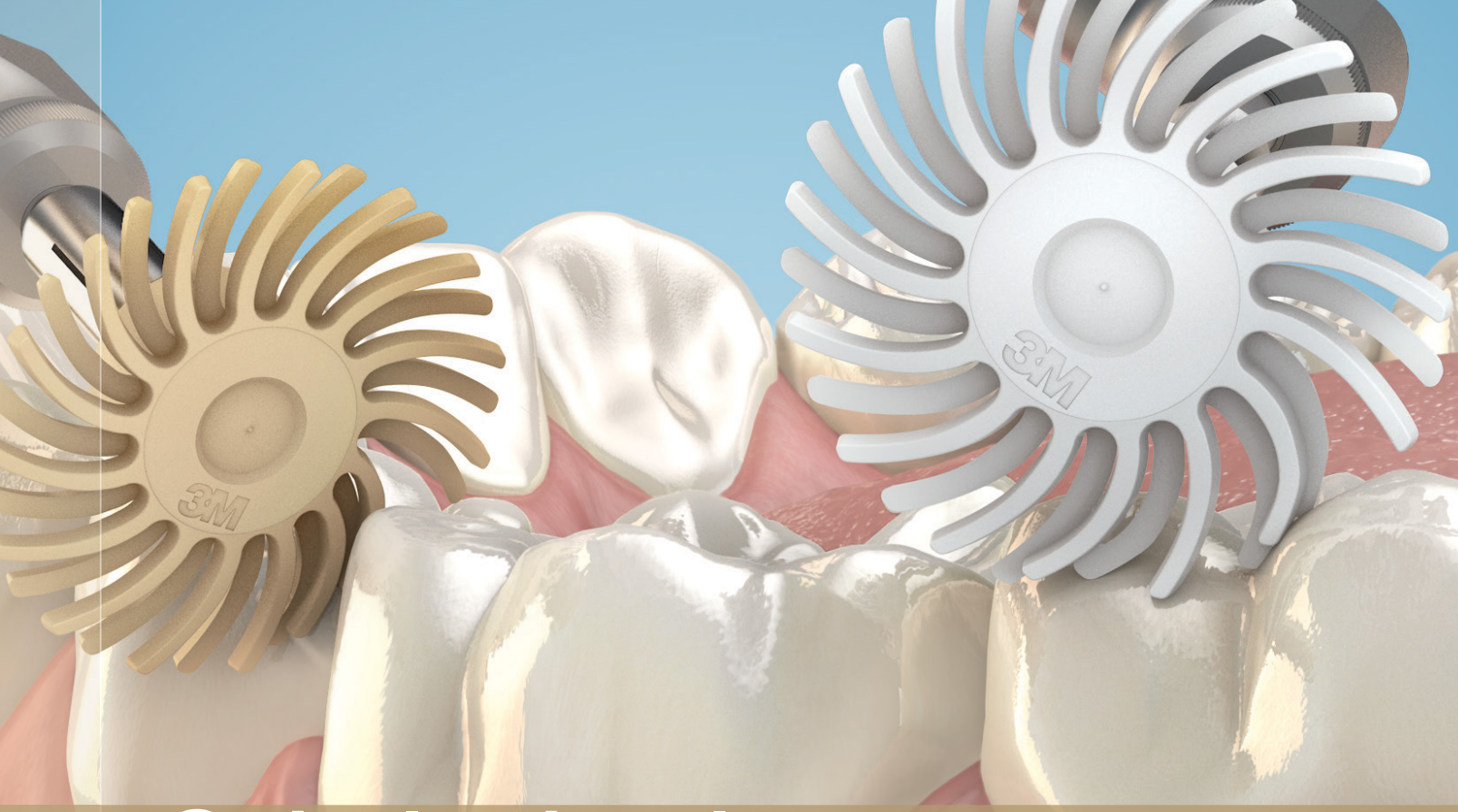

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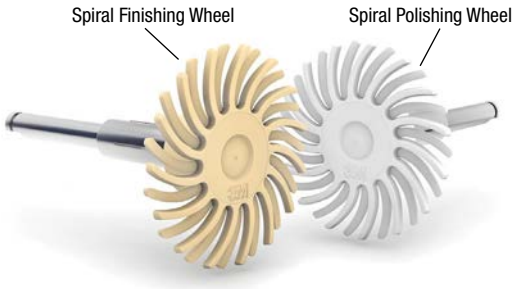

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The dental community is under increasing pressure to keep costs and fees in check.

HOW TO Simplify Implant Restorations

Using Proper Communication between the Surgeon, Restorative Dentist, and Laboratory

Michael W. Johnson, DDS, MS

Key Words: implant restorations, abutments, streamlined process, communication

Introduction

The dental community is under increasing pressure to keep costs and fees in check. To help with this concern, it is important to improve communication between the surgeon, restorative office, and laboratory. This helps to streamline the implant placement and restorative process.

After planning the implant surgery, the sequence shown here will help make your implant restorations more dependable and require less time to completion.

Step 1

At the time of surgery, if initial stability is satisfactory, have the surgeon place a wide diameter healing abutment to begin to mold the soft tissue sulcus **(Figs 1 & 2)**.

If the implant is placed subcrestal, the widest diameter healing abutment may not be usable as it may compress against the alveolus, causing remodeling **(Fig 3)**; a narrower healing abutment may be needed **(Fig 4)**. A minimum of .8 mm of space for soft tissue is needed between the healing abutment and alveolar crest to insulate the bone from the oral environment.[1]

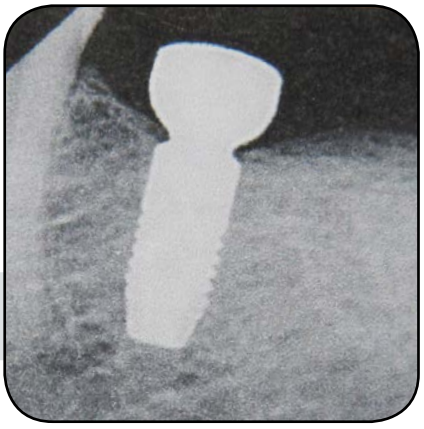

Figure 1: A 6.5-mm healing abutment.

Figure 2: Clinical view.

Figure 3: A 6.5-mm healing abutment impinging on the alveolus.

Figure 4: A 5.5-mm healing abutment allows space for tissue healing.

Step 2
After integration, the soft tissue sulcus has been formed and an impression of the implant and soft tissue contours can be completed per the restorative dentist's protocol. The healing abutment has already started forming the soft tissue profile and this can be picked up in the impression **(Figs 5 & 6)**.

Figure 5: Mature gingival tissue after three months.

Figure 6: Transfer impression coping.

Step 3
The impression is sent to the laboratory of choice and a final cast is fabricated. The laboratory then fabricates a custom abutment using the ATLANTIS™ (DENTSPLY; Mölndal, Sweden) virtual abutment design or similar custom abutment design. The ATLANTIS implant abutment is a computer-designed abutment of titanium, gold-anodized titanium, or zirconium. In the posterior areas titanium or gold-anodized titanium is preferred and is most cost effective. The computer design software has four basic settings:

- No tissue support, which mimics the soft tissue profile without making the abutment any wider than the scanned final cast.
- Supports soft tissue, which adds .2 mm to the width of the soft tissue profile.
- Contour soft tissue, which adds .7 mm of width.
- Full anatomical dimensions, which will mimic the emergence profile of the proposed restoration **(Fig 7)**.

These settings can be modified by the restoring dentist and/or laboratory as needed to fit any specific situation.

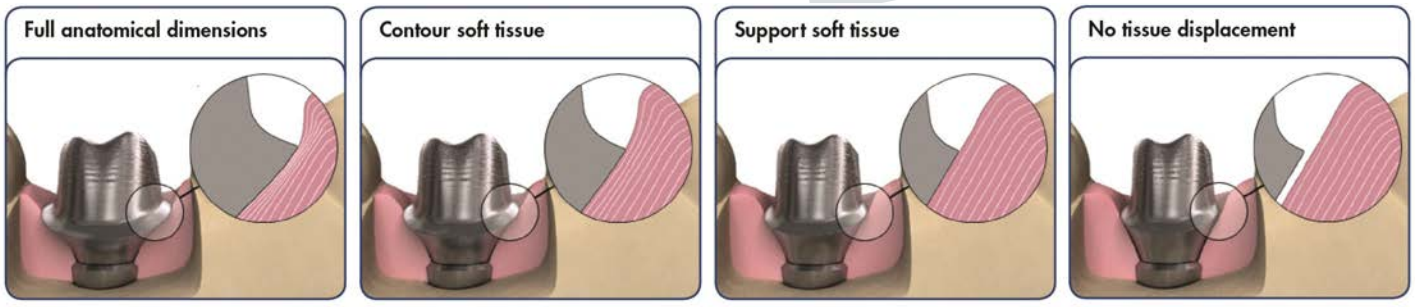

Figure 7: Design options for ATLANTIS abutments. (Figure courtesy of DENTSPLY Implants.)

If the soft tissue sulcus has not been formed by a wider diameter healing abutment, the dimensional change from no soft tissue displacement (tissue profile from cast) to a proper emergence profile of full anatomic dimensions will be extensive and may require a releasing incision or anesthesia to allow seating of the abutment **(Figs 8 & 9)**.

If the soft tissue profile has been mostly formed by the healing abutment, then there is less soft tissue dimensional change from no tissue displacement (sulcus of cast) to full anatomic contours **(Figs 10 & 11)**, causing less discomfort for the patient.

With implant designs that utilize a platform-switching concept, a concave subgingival abutment profile is an ideal way to make sure the abutment does not impinge on the adjacent alveolar bone, which can stimulate remodeling and potential bone loss **(Fig 12)**. This also allows for maximum soft tissue bulk for resistance to apical migration of the free gingival margin due to trauma from excess brushing or other external sources.[2]

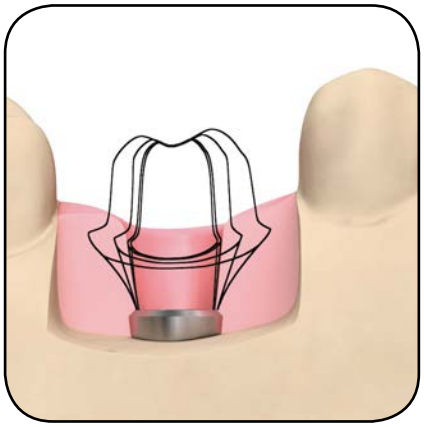

Figure 8: Large variation in abutment diameter between the four basic options when narrow diameter healing abutment is placed. (Figure courtesy of DENTSPLY Implants.)

Figure 9: Extensive blanching of tissue as wider abutment is placed in narrow tissue sulcus.

A minimum of .8 mm of space for soft tissue is needed between the healing abutment and alveolar crest to insulate the bone from the oral environment.

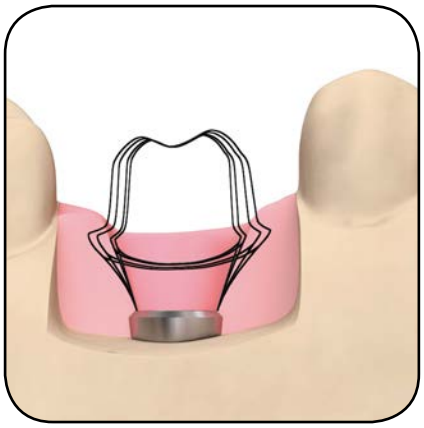

Figure 10: Smaller variation in abutment diameter when larger healing abutment is placed. (Figure courtesy of DENTSPLY Implants.)

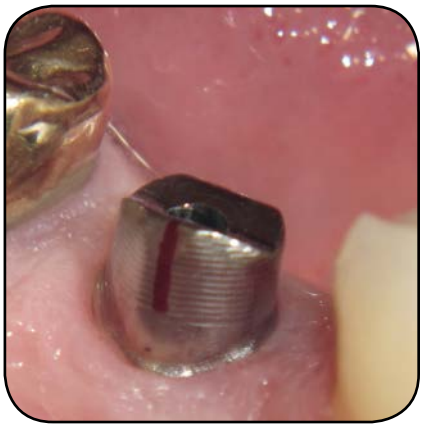

Figure 11: Less tissue displacement and blanching with placement of abutment when larger healing abutment is used.

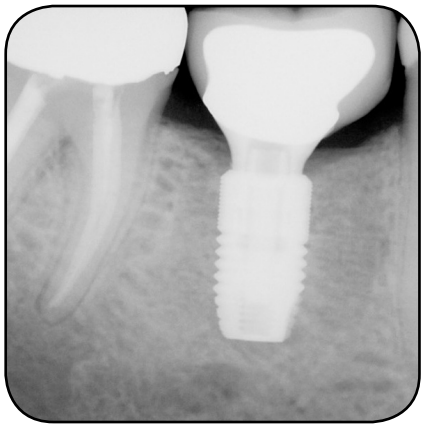

Figure 12: Ideal emergence profile of concave abutment.

Step 4

Once the abutment has been designed and returned to the laboratory, it is a simple matter to have a correctly contoured final restoration fabricated. The abutment and crown are then returned to the restorative dentist and both can easily be seated without anesthesia since the soft tissue has already been formed and the tissue is mature, minimizing discomfort **(Figs 13 & 14)**. The finish line can also be precisely positioned 1 mm or less from the free gingival margin for easy cement removal, since the free gingival margin has already been positioned by the healing abutment.

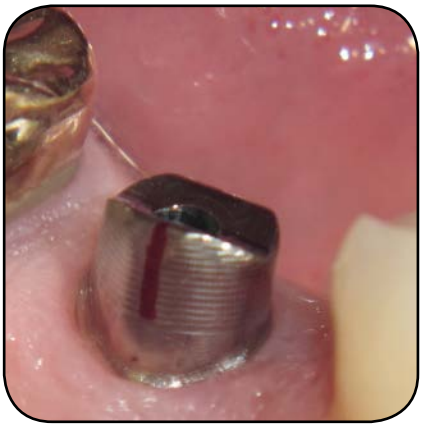

Figure 13: Finish line 1 mm or less from free gingival margin.

Figure 14: Final restoration.

Step 5

This same concept can be used with screw-retained posteriors by following the same protocol as outlined above, using a gold anodized abutment. A full contour lithium disilicate or zirconium crown can be milled to fit the abutment complete with a screw access hole **(Figs 15 & 16)**.

Figure 15: Machined gold-anodized abutments.

Figure 16: Pressed monolithic lithium disilicate crowns.

The abutment and crown are fabricated in two parts for ease of verifying abutment seating to the implant; then the crown is tried on the abutment while it is seated on the implant to verify proximal contacts and occlusion.[3] The abutment is removed from the mouth and cotton is placed in the abutment access chimney to keep cement out of the access; then the crown and abutment are luted together extraorally to ensure the cement is removed completely **(Figs 17-19)**.

The crown abutment complex is then screw-retained to the implant after assembly **(Figs 20 & 21)**; filler such as cotton or plumber's tape[4] covers the screw head and the access is filled with composite. The maximum compressive strength of a machined lithium disilicate crown cemented to a titanium abutment is above the average bite force of a human (it is virtually at the maximum bite force[5,6]), and is sufficiently strong to be used in the posterior region. Monolithic zirconium has an even greater compressive strength[7] and can also withstand the bite forces associated with posterior teeth. With an all-ceramic restoration the composite does not have the metallic shadowing of the access hole as seen with porcelain-fused-to-metal restorations. By fabricating a screw-retained crown in this way the variable cost of alloy to cast a solid screw-retained crown is eliminated. In fact the manufacturing cost is very predictable: just a machined abutment fee and a monolithic machined crown fee. There are no gold costs or "cast to" components to buy.

Figure 17: Cotton in screw access chimney.

Figure 18: Crown cemented to abutment, then cotton is removed from access before cement sets to open chimney.

Figure 19: Final screw-retained restoration luted together after cement removal.

Figure 20: Lateral view of good emergence profile and esthetics of the combined machined abutment/lithium disilicate restoration.

Figure 21: Composite occluding access hole without metal shadowing.

6

Restoring Anterior Implants

Step 6

Good communication and treatment planning are vital when replacing a missing anterior tooth with a dental implant. There are two treatment options with the anterior tooth: immediate implant placement at the time of tooth removal or placement at some time after tooth loss. If the implant is to be placed immediately, then a custom healing abutment can be made at the time of surgery by using a temporary healing abutment and adding Triad (DENTSPLY Prosthetics; York, PA) or another type of light-cured composite to fill the socket and support the soft tissues while the implant integrates **(Figs 22 & 23)**. This allows the tissue to mature while the implant integrates, creating an ideal site for final soft tissue manipulation **(Fig 24)** with a full contour, fully functional provisional crown after six to 12 weeks. At times, if the soft tissue profile is sufficient, the restoring dentist can go to the final restoration without needing further tissue manipulation, a cost saving to the patient. The custom healing abutment can be either a provisional crown left out of occlusion or a custom healing abutment shortened to the tissue level to decrease the risk of function during the integration period. Since there are multiple philosophies on immediate load/provisionalization, treatment options should be discussed beforehand among the surgeon, restorative office, and patient to determine the appropriate treatment protocol.[8-12]

The other option is implant placement in a healed site. With this option, the surgeon should place a small diameter healing abutment to maintain as much soft tissue as possible **(Figs 25-27)**, then the restoring dentist must manipulate the tissue to ideal contours with a full contour provisional restoration **(Figs 28-31)**.

Figure 22: Extraction with immediate implant placement.

Figure 23: Custom healing abutment at time of surgery.

Figure 24: Custom healing abutment after six weeks of healing.

Figure 25: Delayed implant placement with small diameter healing abutment.

Figure 26: Occlusal view of small diameter healing abutment.

Figure 27: Excess bulk of soft tissue with narrow initial implant sulcus.

Figure 28: Screw-retained composite provisional restoration.

Figure 29: Adding composite to develop ideal emergence profile and soft tissue contours.

Figure 30: Contoured provisional inserted; notice tissue blanching and contouring.

Figure 31: Composite provisional placed on #8 and #10 for patient's approval of esthetics.

Step 7

After soft tissue healing, either a conventional pick up or transfer impression coping can be used **(Fig 6)** or a custom impression coping can be fabricated to pick up the shape of the final soft tissue sulcus. There are several technique articles on fabricating a custom impression coping[13-15] so the intaglio aspect of the provisional restoration can be replicated precisely for final cast fabrication **(Figs 32-34)**. It is important to use a pick up (open tray) style of impression coping to make sure the coping is stable within the final impression.

Figure 32: Custom impression coping fabricated from impression of intaglio of implant provisional.

Figure 33: Pick up-style custom impression coping in place.

Figure 34: Impression coping in impression.

8

Step 8
Once the final cast has been fabricated, a zirconium or metallic abutment can be designed and machined. It is important to have the computer not default to the "contour soft tissue" setting but rather, design the abutment to "no soft tissue displacement" since the soft tissue has already been ideally profiled. Any further manipulation with an oversized abutment may move the free gingival margin apically and risk decreasing soft tissue cosmetics.

A quality implant restoration is dependent upon collaboration and communication between the surgeon, restorative office, and laboratory.

Figure 35: Machined zirconium abutment inserted without blanching.

Figure 36: Final all-ceramic restorations after delayed implant placement and after careful manipulation of soft tissue with provisional crown.

Step 9
After the laboratory has finished designing and milling the abutment, a final all-ceramic restoration of choice can be completed and sent back to the restoring office for insertion of the final abutment and cementation of the final restoration with a radio-opaque cement of choice **(Figs 35-38)**. Since the soft tissue has been properly profiled with a provisional restoration, insertion of the abutment and final restoration can be done without anesthesia.

9

Figure 37: Final zirconium abutment without blanching.

Figure 38: Final all-ceramic single central restored after immediate implant placement, custom healing abutment, then provisional crown to finalize tissue contours. Compare esthetics with older PFM #8.

Summary

This article is not intended to go into detail about materials or specific techniques for implant restorations. Rather, it is intended to demonstrate a sequence of steps for the surgeon, restorative office, and laboratory to help create dependable, functional, and cosmetic implant restorations in a timely and predictable manner.

A quality implant restoration is dependent upon collaboration and communication between the surgeon, restorative office, and laboratory. The success of the final restoration and the ease of restoration often begins with the surgeon selecting the correct healing abutment for the tooth being restored.

Proper soft tissue contouring and profiling by the restorative office will provide the laboratory with an ideal soft tissue cast so the machined abutment can be properly designed. In this way ideal emergence profiles can be achieved predictably and expediently.

The laboratory can then quickly, with the help of abutment design software, machine a strong, dependable titanium or zirconium abutment that also cosmetically supports the investing soft tissues and creates a lifelike, esthetic restoration. If using the ATLANTIS system, the software will not allow the computer to design an implant wall that is too thin. The clinician can therefore be confident in knowing the implant abutment is structurally sound. Through simple teamwork among the surgeon, dentist, and laboratory technician, implant restorations can become a very predictable restorative option for your patients.

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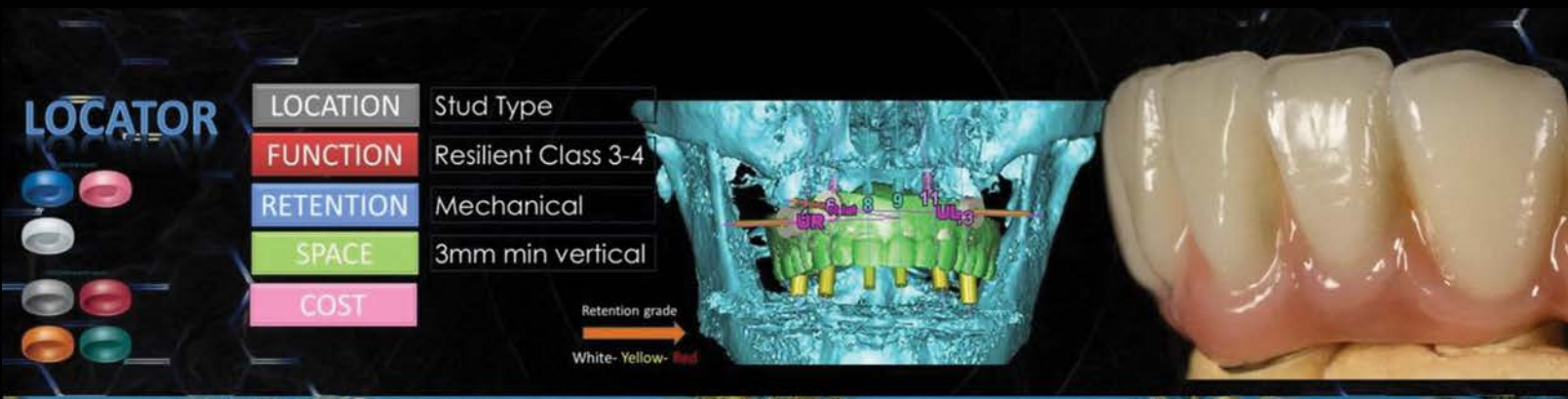

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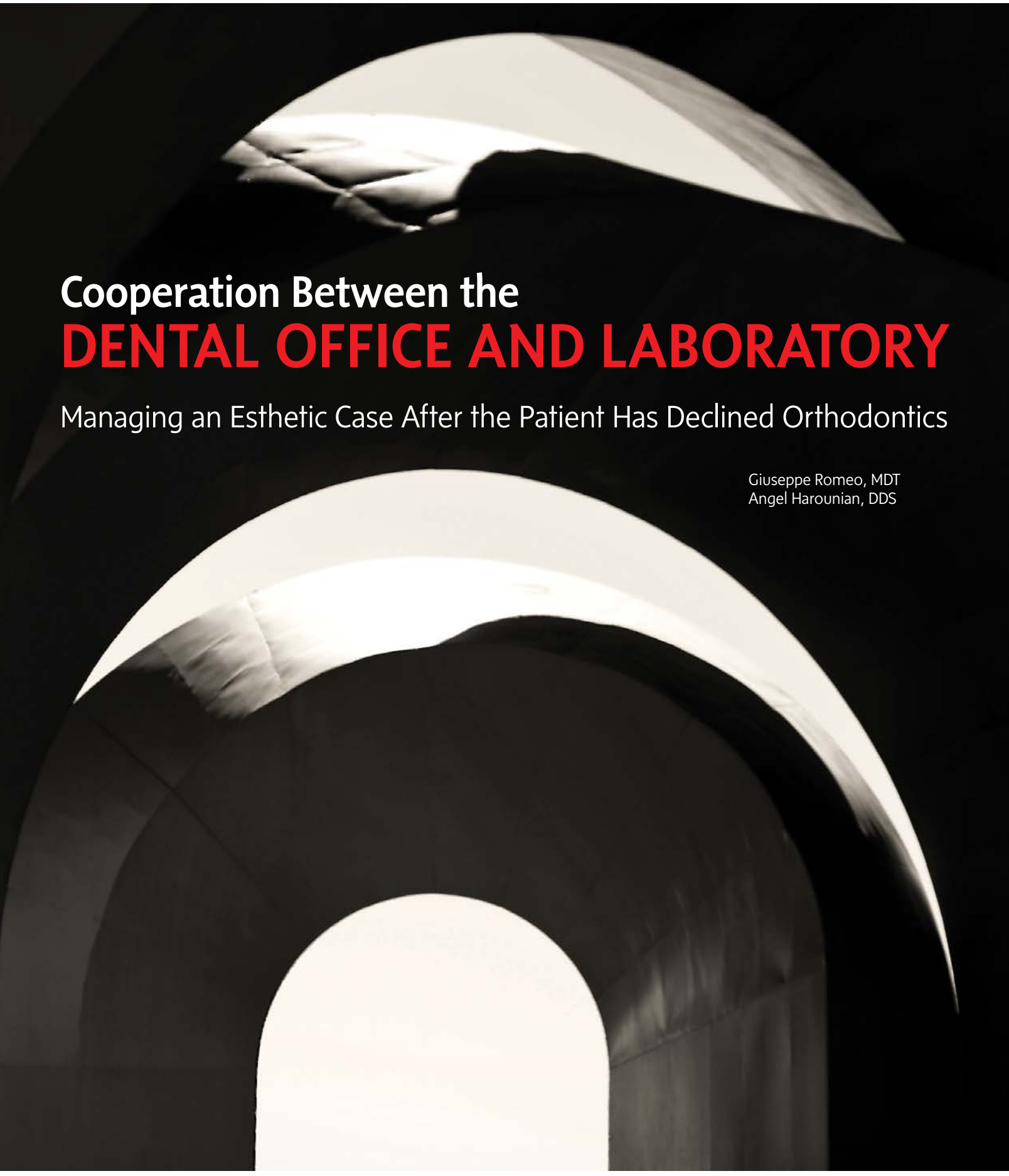

Cooperation Between the DENTAL OFFICE AND LABORATORY

Managing an Esthetic Case After the Patient Has Declined Orthodontics

Giuseppe Romeo, MDT
Angel Harounian, DDS

Esthetic dentistry can satisfy some patients with the same needs by using porcelain veneers as an alternative for orthodontic treatment.

Key Words: diagnostic wax-up, silicone matrix, surgical stent, lab preparation design, technical analysis, clinical modification, ceramic strategy

Figure 1: Preoperative clinical view.

Introduction

Undergoing a lengthy orthodontic procedure is not always the best option for many patients who need orthodontics. Patients often decline this type of treatment due to the cost and time involved. In some cases, patients are also anxious about having metal or even invisible ceramic braces in their mouths. However, esthetic dentistry can satisfy some patients with the same needs by using porcelain veneers as an alternative for orthodontic treatment. This article describes a patient who rejected orthodontic therapy but continued to seek esthetic alternatives. A porcelain veneer and crown was an appropriate alternative in this case. A follow-up several months later revealed that treatment had successfully restored esthetics and function (Fig 1).[1]

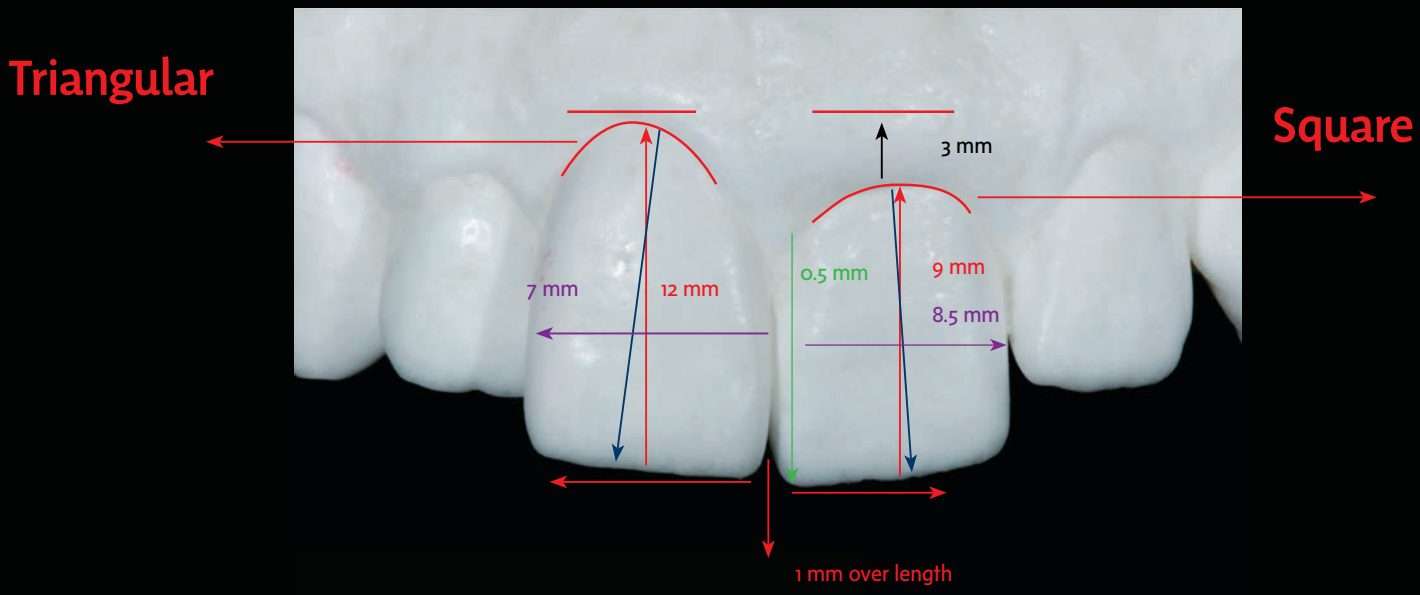

Figure 2: Preoperative case showing the defects in the anterior areas.

Figure 3: Soft tissue evaluation wax-up to create surgical stand for the periodontist.

Figure 4: Soft tissue design after the periodontist's referral and positioning of the surgical stand on the model with occlusal stop on the adjacent #10.

Case Report

The patient, a 35-year-old female, presented with discoloration on tooth #9 and an old metal ceramic crown on tooth #8. Treatment involved realignment of the central incisors.

The patient had refused full orthodontic treatment to realign the teeth in the suitable position, ideal position of the two centrals, and also a possible physiological intrusion of #9 to get the ideal esthetics in the future. She wanted to continue her treatment through esthetics, thus avoiding orthodontic treatment.

The orthodontic treatment was also planned to make a no-prep veneer on #9 to avoid an aggressive preparation on this unit as the dentist did later. Having the teeth properly positioned makes it much easier for the dental technician to create the anatomical esthetics properly.

In the beginning, the additive veneer was placed on the left central incisor, #9, to lengthen the crown; and a full ceramic crown on #8, to simulate the appearance of a right central incisor.[2]

Tooth #8 had triangular characteristics on the cervical area. Its crown (length) had an ovoid-rectangular configuration and the incisal edge was square. The tooth was 12 mm long, 7 mm wide, and the tooth's axis was directed toward the distal. Tooth #9 had a gap in its third cervical height, the cervical shape was square, and the incisal edge was more square-triangular. The clinical crown was 9 mm long, plus 3 mm, which had been covered gingivally, and 8.5 mm wide; therefore, tooth #9 was 1 mm too long (Fig 2).

To start the procedure, a diagnostic wax-up was made on #9 and converted to surgical stands to redesign the soft tissue configuration (Figs 3-5).[3]

The laboratory technician made a replica of the master model and ground #8 on the replica by using sectioned silicone. Then both teeth were waxed up and a shell provisional was created for the central incisors (Figs 6 & 7).[4,5]

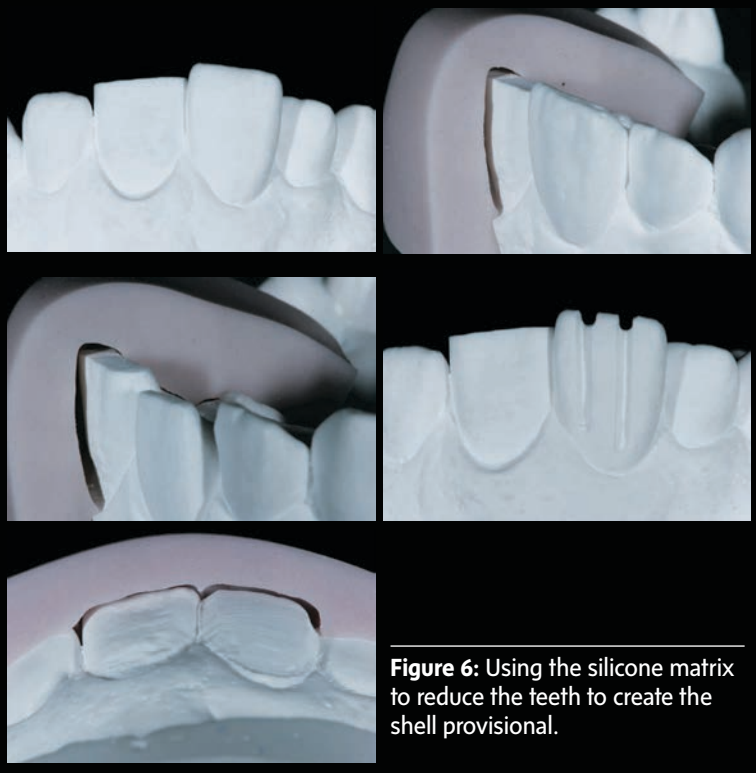

Figure 6: Using the silicone matrix to reduce the teeth to create the shell provisional.

Figure 5: First wax-up.

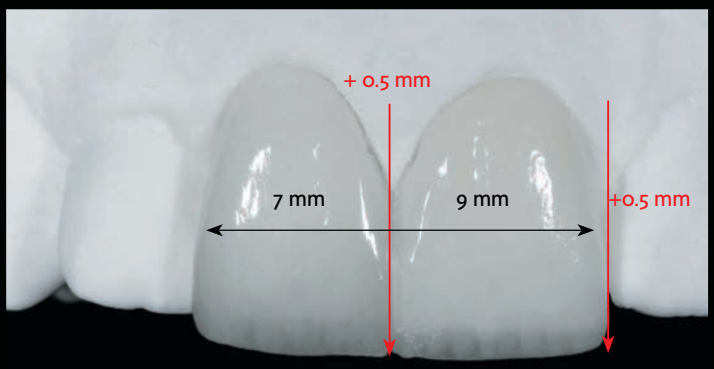

Figure 7: First set of provisionals with overcontours mesially and distally on #9.

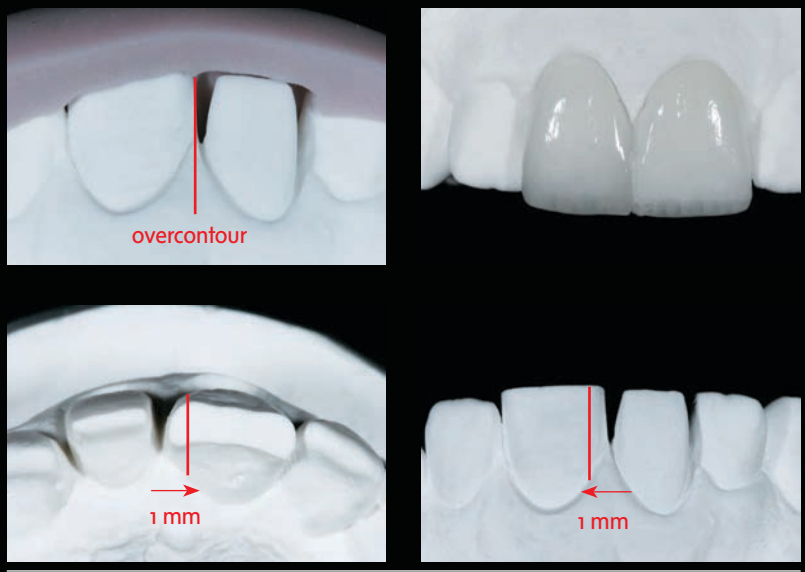

Figure 8: Evaluation of the overcontoured problem and consideration of new preparation.

As a result (because the patient had refused orthodontic treatment), #9 was overcontoured mesially and distally by 0.5 mm on each side. This resulted in different widths for #9 and #8 of 9 mm and 7 mm respectively; this was unacceptable to the patient (Fig 8).[6-9]

The dentist had to evaluate an aggressive preparation cervically on #9, so that it would be possible for the technician to move #8 mesially and create the new balanced proportion between the teeth (Fig 9).[10]

To solve the problem, an alternative clinical and technical treatment had to be undertaken. A space was created between the two central incisors to achieve the suitable proportion.8 To complete the appropriate shape of #9, preparation veneer, not additive, was needed. This was accomplished by grinding the mesio-cervical part of #9 (Fig 10).[6,11-13]

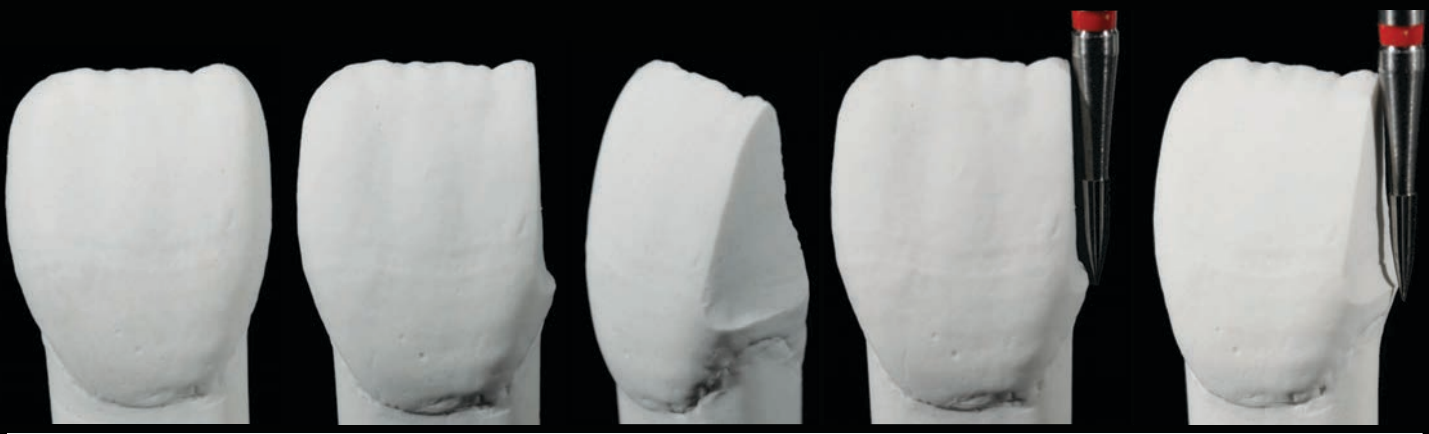

Figure 9: To achieve the suitable shape and proportion of #9, an aggressive cervical reduction of at least 1 mm must be done. In this way the dental technician can better shape the final restoration.

Figure 10: Technician's new preparation.

Figure 11: Second set of wax-ups and esthetic evaluation criteria with the gauge.

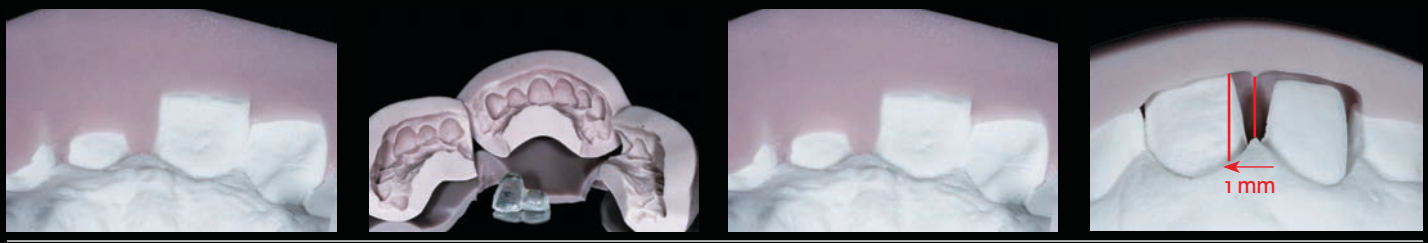

Figure 12: Silicone matrix for clinical support.

Tooth #9 needed aggressive preparation at the mesio-cervical area, and the rest of the tooth in the facial area needed a classic conservative preparation veneer. The laboratory technician waxed up the two teeth again in a different anatomical configuration with appropriate proportions **(Fig 11)**.[3,14-16]

The technician also prepared the silicone preparation key for the clinician to use while making the preparation to replicate the measurement of the one that the technician had prepared **(Fig 12)**.[5,17]

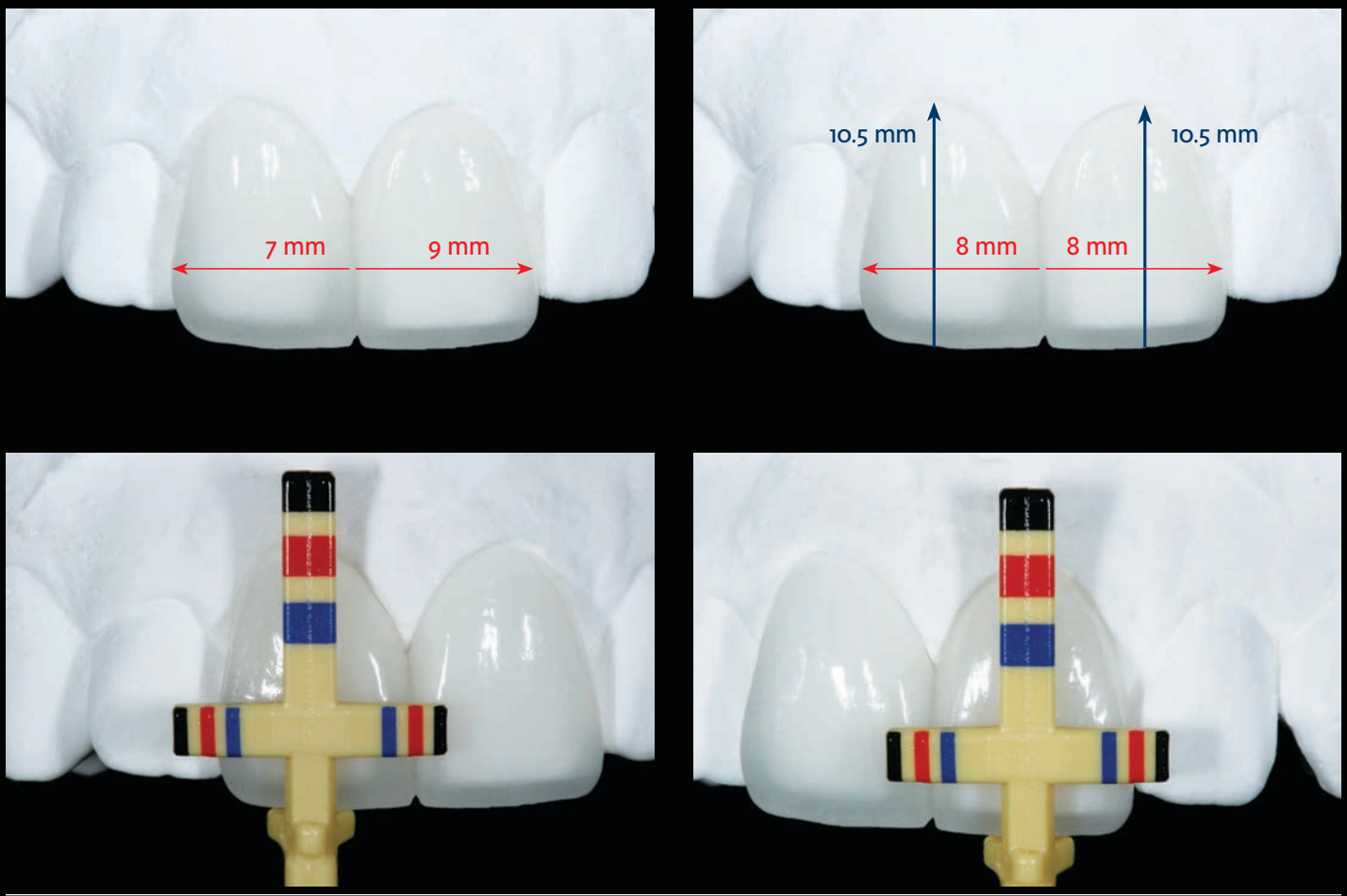

Figure 13: Comparison between first and second set of provisionals based on the previous and new clinical treatment plan.

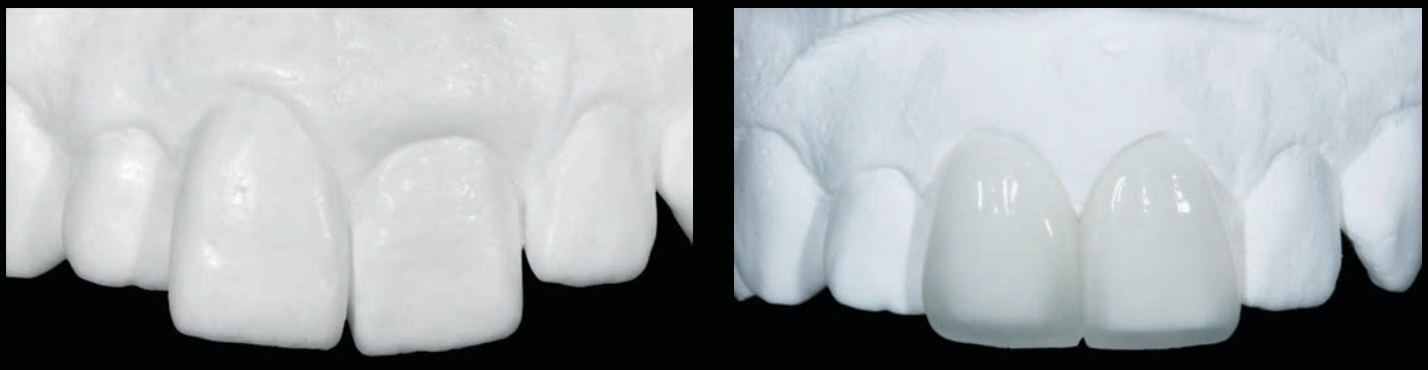

Figure 14: Preoperative case and shell provisional result.

At the laboratory, the technician pressed the acrylic resin on both teeth on the replica model to build up a new shell provisional. Then the two centrals were splinted, achieving the suitable anatomical results **(Figs 13 & 14)**.

Final Ceramic Design

There was one veneer on #9 and a full ceramic crown on #8. Based upon the new wax-up, the laboratory was able to build the shape of the crown coping of the clinical veneer design **(Fig 15)**.[18,19]

This way, it was possible for the lab to layer the ceramic, having the same room in both teeth, and achieve better translucency, value, and chroma. The lab also added stain (Creation Make Up, Jensen Dental; North Haven, CT) facially on #8 to obtain the same characteristics as #9 **(Figs 16-18)**.[20]t

Figure 15: Readapted wax-up on the new ceramic model.

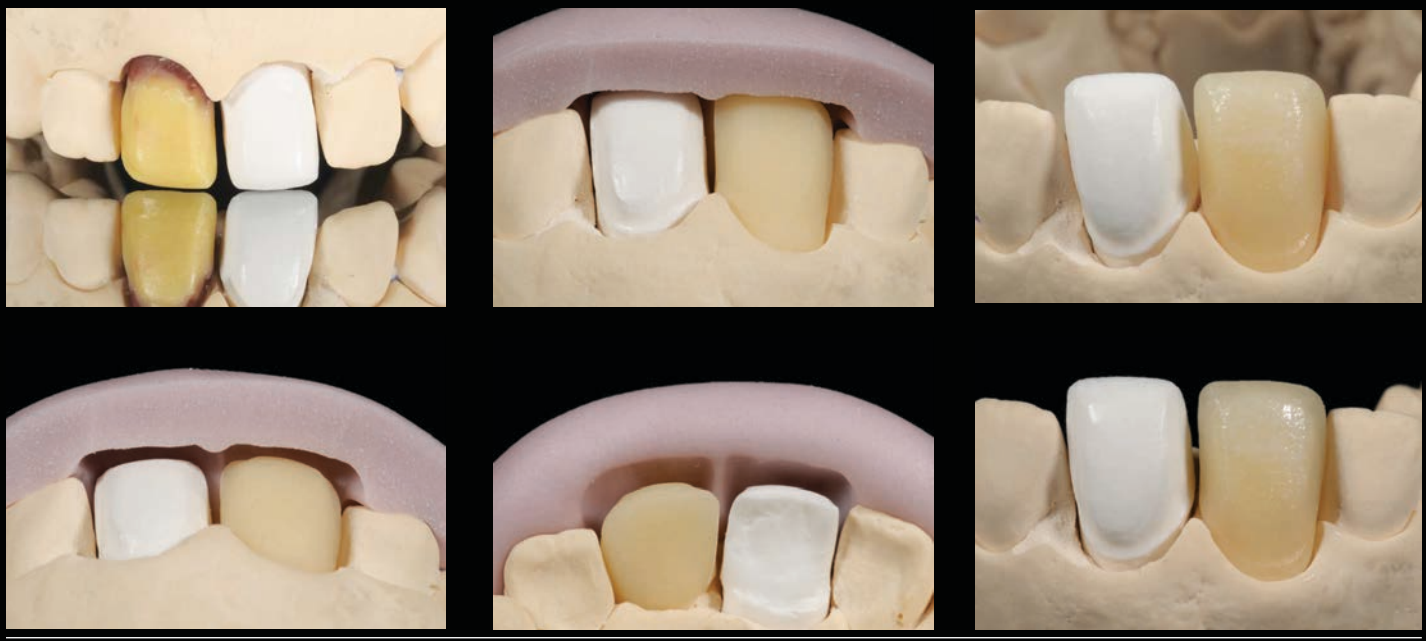

Figure 16: Coping wax design simulating the clinical preparation, the silicone matrix from the adapted wax-up allows the technician to check the space for the future ceramic layering. The wax coping was pressed in ceramic, then stained on top.

Figure 17: Referrals of the natural tooth took into consideration to stain the ceramic pressed core.

Figure 18: Considerations of the translucent, value, and chroma areas.

Figure 19: The fluorescent characteristics of the ceramic masses are useful for the technician in finding the suitable translumination of the tooth.

Figure 20: The final case on the model work: The teeth have the same translucency, value, and chroma.

Figure 21: Preoperative situation and final rehabilitation in the mouth; with the suitable preparation, the patient was satisfied without having orthodontic treatment. Tooth #9 had an aggressive preparation mesially to position the teeth properly.

Figure 22: Full-smile view.

It is important for the technician to know how to attain the exact position of the suitable ceramic masses. He or she also needs to know the degree of fluorescence of each ceramic mass in order to achieve the suitable value, translucency, and chroma **(Fig 19)**.[20]

The final ceramic crown was ready to deliver after using appropriate ceramic layering techniques. The configuration developed by the temporary was replicated in ceramic with new detail modification in the anatomical aspects **(Figs 20 & 21)**.[20,21] A follow-up visit three months later confirmed that esthetics and function had been successfully restored **(Fig 22)**.

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Disclosures: The authors did not report any disclosures.

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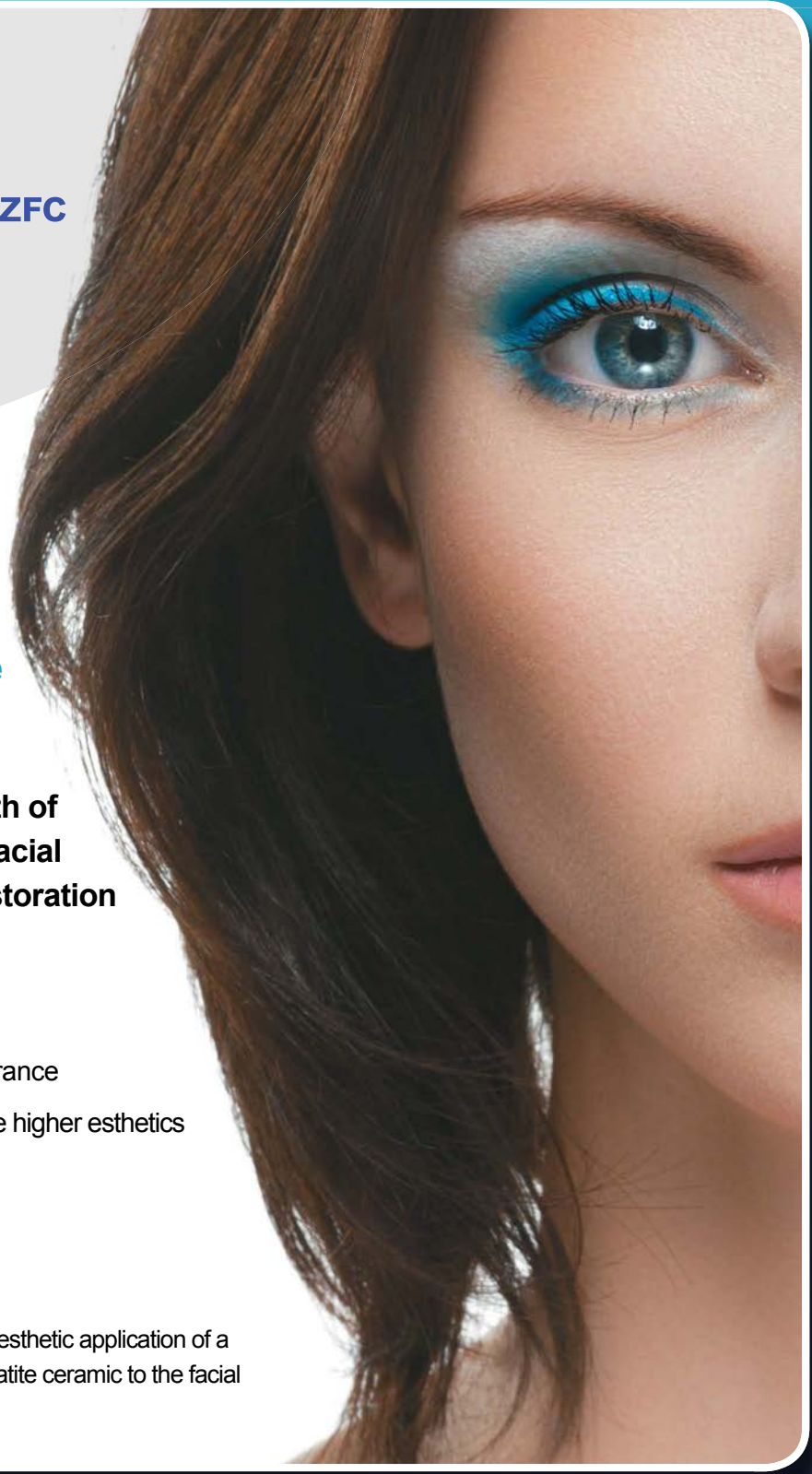

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How Do Patients Value Esthetic Dentistry?

Studying the Worth of Restorative Treatment

Sreenivas Koka, DDS, MS, PhD, MBA
Alan B. Carr, DMD, MS
Thomas J. Salinas, DDS

Abstract

The concept of value in dentistry—specifically in esthetic and cosmetic dentistry, which is predominantly elective care—is discussed through the lenses of patient preference, quality, and cost. How patients perceive the value of the care they receive is dominated by their expectations, aspirations, the cost of care, and the treatment outcome. Whether a patient is ultimately satisfied depends upon the dentist engaging the patient in a manner that promotes a clear understanding of expectations and aspirations before definitive treatment is initiated. Invariably, the technical challenges associated with a treatment outcome are secondary to the primary challenge of elucidating what the patient wants and what they need, and if there is a discrepancy between those elements and what can be provided. Since esthetic and cosmetic dentistry is rarely inexpensive, the issue of achieving a "valued" experience for the patient must introduce the concept of cost of treatment, but not just financially; it also must include other elements such as time, inconvenience, and anxiety. This article attempts to reconcile these different variables to review how patients value their care.

Key Words: value, quality, expectations, cost, outcomes

> *Value* is itself an elusive concept, meaning different things to different people.

Introduction

Clinically meaningful, patient-centered rigorous dental outcomes research remains an elusive target. This elusiveness makes life difficult for dentists and patients as they enter the "ritual dance" of treatment planning, and especially for therapy to improve esthetic/cosmetic appearance. During treatment-planning conversations, dentists are challenged to answer patient questions such as the following:

- *"How long will this treatment last?"*
- *"Is the treatment going to be worth it?"*
- *"What will happen if I do not go ahead with treatment?"*
- *"What are the risks associated with treatment?"*

These questions are substitutes for the main question when considering elective treatment, which is: *"What is the value of what I am getting?"* To the practitioner, the pretreatment and post-treatment comparison can be significant and gratifying **(Figs 1 & 2)**. But does the patient see and value what we see and value?

Value is itself an elusive concept, meaning different things to different people. At Mayo Clinic, we are sensitive to the value of care we provide our patients as healthcare costs rise. We think of value in terms of a simple equation with three components:

Value = Quality / Cost

Cost

Discussing cost within the context of the value equation is best communicated by considering the separate aspects that impact cost, as described below:

Financial Cost

This is often the primary determinant of value to many and is most often ascribed to the price we charge our patients. Yet it also may include other monetary expenditures, such as those spent on traveling to see us and finance charges accrued on loans taken to pay for treatment.

Time

Time is, in the eyes of many, the most precious commodity of all.

Maintenance Costs

These are necessary to promote longevity of restorations.

Complication Costs

These are costs that are associated with unanticipated revisions or replacement.

Figure 1: Patient presenting with erosive lesions and some minor tooth alignment in preparation for restorative therapy of 10 maxillary anterior teeth.

Figure 2: Full-smile view of final restorations.

Opportunity Costs

Some patients discuss opportunity costs, especially when complexity of treatment increases. *"What am I giving up (in terms of time and money) in order to accept this treatment plan?"* or *"What else could I have done with the money and the time?"*

Sunk Costs

These are costs that are already invested by a patient and represent "water over the dam." A general rule is that sunk costs should not influence future economic decisions, yet some patients naturally say, *"I have spent so much money on this tooth that I cannot see spending anymore."* These past (sunk) costs should be irrelevant in forward-looking decisions.

Cost Over Time

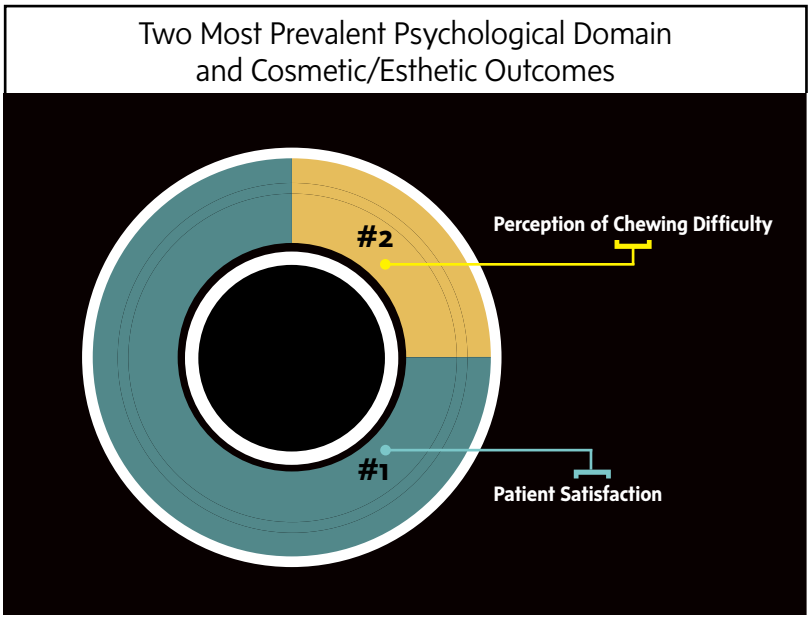
This is an element often overlooked by patients and clinicians. However, the duration of therapeutic benefit lies at the heart of determining both quality and cost—it is a pivotal outcome measure. There are more examples in medicine than in dentistry of time-dependent measures such as cost-benefit analyses or cost-utility analyses, often regarding non-elective treatments. Value, in its purest form, should integrate costs with benefits over time.

Quality

Clinical Outcomes

Quality is best assessed by careful appraisal of clinical outcomes. In dentistry, outcomes are the consequences of treatment decisions made between the patient and the provider regarding their oral health and well-being. Decisions should be made at the individual patient level involving multiple factors of importance to that patient, with interpretation and discussion within the knowledge, experience, and ethical bounds of the clinician. A fundamental principle defining care for conditions that are not life threatening is one of patient election for care. Therefore, intervention must be aligned with tenets of professional ethical behavior (primum non nocere).

The outcome domain under discussion in this article's context of cosmetics (lay definition: superficial measures to make something appear better, more attractive, or more impressive) requires consideration of the patient-centered impact that drives them to seek care. In other words, how we consider this patient-defined impact against the background of what it means to behave ethically and professionally (as evident in the AACD Mission Statement: "Dedicated to advancing excellence in the art and science of comprehensive cosmetic dentistry and encouraging the highest standards of ethical conduct and responsible patient care").



ORONet

The Division of Prosthetic and Esthetic Dentistry at Mayo Clinic is a founding member of the Oral Rehabilitation Outcomes Network (ORONet). ORONet is an international consortium of clinical scientists who review and categorize clinical outcomes research to assist clinicians in treatment planning conversations with patients on best available outcomes research. Along with our ORONet colleagues from the University of California Los Angeles, University of Alberta, University of Iowa, Groningen Medical Center, Turku University, and the University of Torino, we published five articles in the *International Journal of Prosthodontics*.[1-5]

The articles divide clinical outcomes into four broad domains: longevity, psychological outcomes, economic outcomes, and functional outcomes. Acknowledging the importance of the other three domains, we believe discussing the value of cosmetic/esthetic dentistry pertains to the psychological domain.

Psychological Domain and Cosmetic/Esthetic Outcomes

The review revealed 23 different terms used to describe psychological outcomes. The most frequent category, *patient satisfaction*, was three times more prevalent than the second most common category, *perception of chewing difficulty*. Related terms were used across some categories and when grouped revealed *satisfaction* (used in 68 references), *patient* (65 references), *chewing* (30 references), and *comfort* (15 references) as the most common themes. The most frequent outcome, *patient satisfaction*, is a "single dimension" psychological outcome. It is common to focus on a subset of this single dimension, such as *esthetic satisfaction*. Both patient-reported[6] and observer-reported esthetic outcomes[7-9] are felt to be important. However, measurement of esthetic outcomes is difficult and limits addressing the major ethical challenge argued regarding esthetic/cosmetic care (providing care versus conducting business), where care provided must be associated with a demonstrated impact of provider healing.[10]

The focus on patient-related outcomes use in clinical care settings is noteworthy for its individual patient emphasis.[11,12] The rationale stems from recognition that an individual's disease or condition does not exist separate from their personal and social context; therefore,

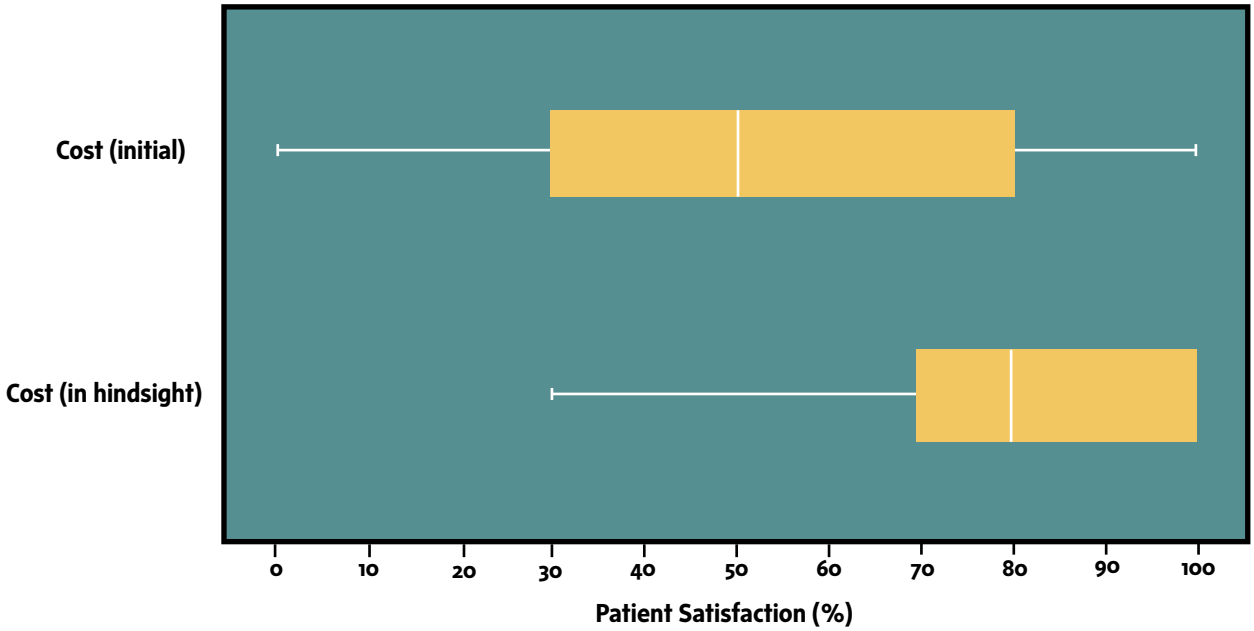


Figure 7: Patient satisfaction with costs (initial) and costs (in hindsight). ***Box Plot Interpretation:*** *Median—central line; interquartile range (IQR)—width of box; outliers 1.5x IQR—circle; whiskers—extreme values not including outliers.* From Walton TR, Layton DM. Cost satisfaction analysis: a novel patient-based approach for economic analysis of the utility of fixed prosthodontics. J Oral Rehabil. 2012 Sep;39(9):692-703. Reproduced with permission of the authors.[16]

understanding this patient-specific context informs various aspects regarding patient management. This information can facilitate focused communication, prioritize patient-perceived problems, identify preferences, and allow monitoring of changes or responses to intervention. Such individualized measures should be designed to detect patient problems in a manner that is more clinically meaningful, allows for shared decision-making discussion, identifies patient priorities for care, and facilitates setting realistic management objectives.[11]

The challenge associated with linking patient clinical variables and psychological characteristics has been discussed for some time. Wilson and Cleary state, "Implicit in the use of psychosocial measures in research or clinical settings is the concept/expectation that interventions can affect physical function, social function, or mental health in a way perceived by the patient."[12] The difficulty with understanding clinical variables and what is embodied in psychological measures is partly due to the differences between the clinical "biomedical" paradigm and the social science quality of life (QOL) paradigm. One seeks answers of causation for guiding diagnosis and treatment, while the latter focuses on function and overall well-being as a means to judge care. A conceptual way to think about potential links involves understanding a continuum of increasing biological, social, and psychological complexity where this continuum runs from single biological measures to complex physical functioning/general health perceptions.[13]

Value

"Nominal" and "Real" Value

Value represents, in its simplest and most powerful form, the sum total of all improvement in quality (of life) divided by the sum total of all the costs (with the exception of sunk costs) incurred to attain the improvement in QOL. Using the language of economics, it could be argued that this form of value is really "nominal value" or the "face value of value." Factoring in the effect of time, which includes the time value of money and the value of duration of therapeutic benefit, however, is more likely to capture true value—what an economist might call "real value." At the end of the day, all outcomes research would ideally be designed to capture "real value" because it accommodates for the effect of time and, specifically, the changes in a patient's perception of quality and cost that take place over time.

> Decisions should be made at the individual patient level involving multiple factors of importance to that patient, with interpretation and discussion within the knowledge, experience, and ethical bounds of the clinician.

Value for the Patient Seeking Cosmetic Improvement

Interesting work published recently reassures the dentist who wonders about the patient questions posed earlier: "*How long will this treatment last?*" and "*Is the treatment going to be worth what I will have to pay?*"

The work of Walton and Layton shows how patients perceive the worth of restorative treatment. The authors report on long-term patient satisfaction in a fixed prosthodontic private practice for treatment provided over 20 years, including the provision of ceramic veneers.[14-16] Some of their key findings are summarized here.

The authors introduce the concept of "cost satisfaction analysis," an especially intriguing concept for the patient seeking esthetic/cosmetic dentistry.[8] They present survey responses from more than 500 patients with a known fixed prosthesis outcome going back from 1 to 20 years. Remembered satisfaction at insertion relative to initial costs and current satisfaction relative to costs in hindsight were recorded. Overall, patients' cost satisfaction among the entire cohort significantly improved, from 53% at insertion to 81% in hindsight **(Fig 7)**. However, particularly interesting is that even those patients who experienced a failure reported improved cost satisfaction with hindsight, as did those who said that they would not undergo the same treatment again, implying that factors other than cost influence a patient's willingness to consider additional treatment or retreatment. Ultimately, although the treatment was reported by patients to be expensive, the perceived value of treatment increased over time.

These findings permit an evidence-based conversation with patients as it relates to their concerns over initial cost and quality and value as well as concerns they might have over regretting treatment.

Summary

The challenge regarding esthetic/cosmetic aspects of our care for patients is to ensure that cosmetic interventions are in the patient's best interest, meaning they are also consistent with overall oral healthcare. The current cosmetic worldview is a challenge for clinicians who have necessary technical competencies yet may be less prepared to apply the intervention within a values-based and/or moral competency context. Generating a meaningful body of clear clinical outcome information delineating the "point-in-time" impact of esthetic/cosmetic care on long-term oral health is an important goal to pursue.

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> "The current cosmetic worldview is a challenge for clinicians who have necessary technical competencies yet may be less prepared to apply the intervention within a values-based and/or moral competency context."

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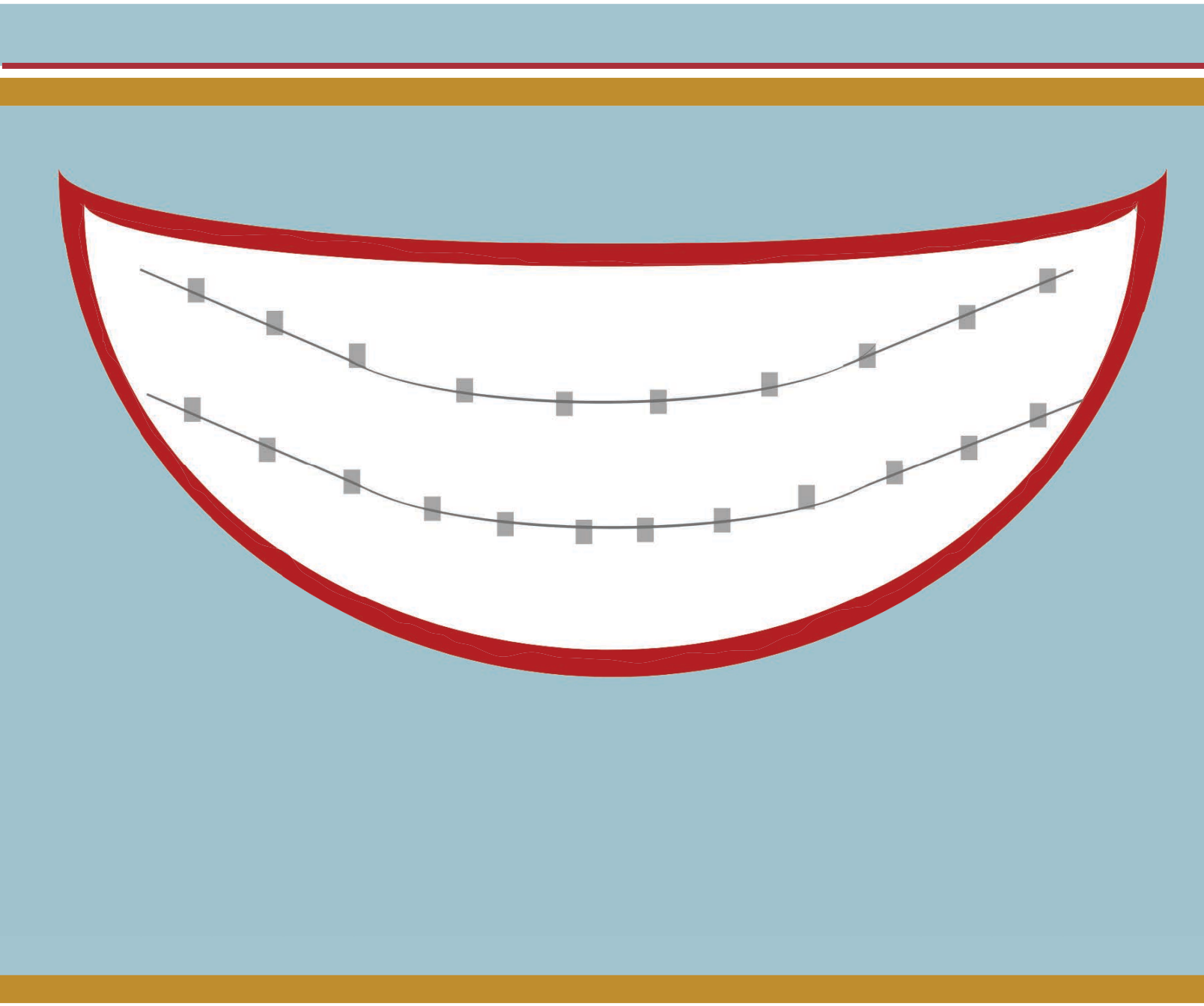


ACHIEVING DRAMATIC *yet* Minimally Invasive Smile Enhancements

Combining Short-Term Orthodontics and Tooth Whitening

Andrew Denny, BDS, MFGDP(UK), MGDS RCS(Eng)

Abstract

With ever more patients wanting to cosmetically enhance their smiles without recourse to irreversible tooth preparation, there is a role for cosmetically minded general dental practitioners to provide minimally invasive smile enhancements by combining safe short-term orthodontic solutions with traditional cosmetic procedures such as tooth whitening.

This article explains the rationale for providing this cosmetically focused treatment and illustrates the possibilities with a clinical case.

Key Words: tooth whitening, short-term orthodontics, cosmetic, minimally invasive, aligners

Individuals with an esthetically pleasing smile are more likely to succeed in the workforce, have higher self-esteem, and improve their perceived social standing.

Introduction

In the age of the educated consumer, more patients understand the benefits of a straight, attractive smile and good oral health. Individuals with an esthetically pleasing smile are more likely to succeed in the workforce, have higher self-esteem, and improve their perceived social standing. As a result, more people are willing to invest in their smiles as a means to improve their appearance. Additionally, individuals presenting good oral hygiene and a straighter smile typically experience better overall health than individuals needing orthodontic assistance, whose health may be compromised due to periodontal issues and/or tooth decay.[1]

Comprehensive Orthodontics

Comprehensive orthodontics is the first-line recommendation to predictably and conservatively correct and enhance the appearance of a patient's smile when they present with severely malpositioned teeth, demonstrated overbite, and extended spacial gaps between teeth.[2] By moving teeth into proportion with the patient's face and stature, improvements to the overall symmetry of the smile can be made.[3] For minimally invasive cosmetic enhancement, orthodontics is the foundation on which predictable restorations can be placed, since properly aligned teeth support strong and durable restorations that are less likely to improperly wear and fracture.[2,3] Braces are significant to esthetic enhancement, often serving as a precursor to other minimally invasive procedures, such as whitening, composites, or no-prep veneers.[4]

Disadvantages

Unfortunately, a large number of adults will not consider traditional braces due to treatment time, unesthetic materials, and discomfort.[5] Additionally, seemingly more convenient and patient-friendly alternatives, such as removable aligners, also require a lengthy treatment time, as well as commitment to a self-disciplined regimen of continue wear, that can yield less-than-satisfactory results.[6] As a result, the nature of traditional braces and other alternatives may prevent many adults and older teens from considering a minimally invasive procedure that, coupled with whitening or composites, could address their primary cosmetic complaints in a non-destructive manner.

Instead, patients may elect to undergo procedures that produce the effects of "instant" orthodontics, creating a straighter-looking smile through the placement of veneers or crowns.[2] In some instances such restorations can be completed with little to no removal of otherwise sound tooth structure. However, depending upon tooth position, degree of misalignment, and material selection, aggressive preparations may be required in order to achieve a harmonious smile design.[7]

It is rational to believe that patients educated about minimally invasive dentistry and new treatment options would choose to enhance their smiles by conserving tooth structure.[8] It therefore appears that for such patients, short-term orthodontics combined with tooth whitening and/or direct composite bonding is a necessary treatment alternative when they decline traditional braces.

Short-Term Orthodontics

Unlike comprehensive orthodontics, short-term orthodontic treatments are not designed for complicated or more invasive orthodontic procedures such as altering Angles Class or correcting skeletal discrepancies. Instead, gentle forces are used to align teeth and achieve occlusal improvements, without increasing a patient's risk for root resorption.[9]

Indications

Short-term orthodontics (e.g., Six Month Smiles [http://www.6monthsmiles.com] or Simply Smiles [http://www.simplysmiles.co.uk]) is a proven and minimally invasive way to enhance a patient's appearance. Indicated for a wide range of tooth movements, including extrusions, rotations, intrusions, and various types of tipping, successful short-term orthodontics treatment is predicated on careful case selection, understanding patient expectations, and knowledge of the modality's capabilities.[10] Based upon advancements in tooth-straightening technology and techniques, short-term braces treatments can achieve a patient's desired cosmetic results in an average of six months.[11]

Benefits

For patients who decline comprehensive orthodontics, short-term orthodontics may be an appealing treatment option for many reasons. First, the clear brackets and tooth-colored wires blend with natural dentition, appearing much less obtrusive than metal braces. Second, whereas comprehensive orthodontic treatment can require braces to be worn for two to three years, short-term orthodontics braces are typically worn for an average of six months. Patients will see significant results within two to three months of treatment and, as a direct result, will be excited and involved in their own dental care.

Additionally, while natural dentition typically is extracted during traditional comprehensive orthodontic treatments, adult short-term orthodontics focuses on cosmetically driven cases. Therefore, the Angles Class of a patient rarely changes and, in most scenarios, few to no natural teeth are removed.

Patients also experience greater comfort during short-term orthodontic treatment. Shape-memory NiTi wires use gentle forces to guide the teeth into position based upon the principles of straight wire orthodontics.[12]

Overall, short-term orthodontics also is both minimally invasive and cost effective for patients desiring a life-changing cosmetic makeover without the expense or invasive procedures of multiple veneers and crowns. If additional but minimal space is required, it can be created through careful interproximal reduction to allow resolution of crowding without resorting to extractions. This benefits both the patient, who desires a minimally invasive procedure, and the general practitioner, who is accustomed to polishing and shaping teeth through restorative procedures.

Integrated Short-Term Orthodontics

For general and cosmetic restorative dentists, an integrated short-term orthodontics system can enable them to efficiently and effectively address a patient's cosmetically driven dental issues related to tooth position discrepancies. Such an integrated approach provides confidence to those dentists with limited orthodontic experience, yet enables them to predictably offer a minimally invasive treatment option to patients who have dismissed comprehensive orthodontics and do not want to pursue a restorative plan.

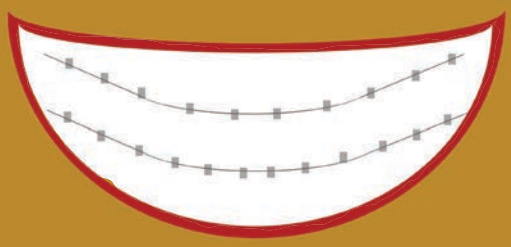
The process of using indirect bracket placement trays that are set up by bracket specialists to precisely position brackets on the teeth makes fitting the braces a straightforward procedure. The tooth-colored, shape memory NiTi wires then do all the work to level and align the teeth.

An integrated short-term orthodontics system is also a useful tool for enhancing planned minimally invasive cosmetic procedures, such as no-prep veneers or composite bonding, by facilitating pre-alignment prior to bonding or in combination with whitening. Moreover, restorative and/or implant treatment plans through pre-alignment or appropriate space redistribution is simplified for cosmetic restorative dentists.

A literature search to identify short-term orthodontic systems by name did not produce results that would provide guidance to selecting short-term orthodontic alternatives of similar treatment time. However, information about one orthodontic option found on the company's Web site (SureSmile, www.suresmile.com, OraMetrix [Richardson, TX]) states that it cuts treatment time by 30%.

Benefits of Short-Term Orthodontics

1. **Provides an alternative treatment for traditional orthodontic therapy.**
2. **Clear brackets and tooth-colored wires blend with natural dentition.**
3. **Results can be seen within two-three months.**
4. **Typically worn for an average of six months.**
5. **Altering Angles Class and significant midline changes are not a part of the treatment.**
6. **Few to no natural teeth are removed.**
7. **Shape-memory NiTi wires offer greater patient comfort.**
8. **Less time for resorption to occur, since treatment time is short and forces are light.**
9. **Overall, treatment is minimally invasive and cost effective.**



Case Presentation

A 29-year-old woman presented with a Class I molar relationship with right side canines 1/4 unit Class II and left side canines Class I **(Figs 1a-1c, 2 & 3)**. She also exhibited an overjet of 8 mm, overbite of 4 mm, and incomplete anterior open bite **(Figs 4-7)**. The reverse smile line was bowed, with the upper arch illustrating 5 to 6 mm of spacing and lower arch crowding of 4 mm **(Figs 8 & 9)**. The tooth crowding and spacing could be attributed to a history of thumb sucking and removable braces, leading to relapse when the patient was a child. The patient disliked and was unsatisfied with her front teeth sticking out and the resulting gaps. She desired a straighter and whiter smile.

Treatment Recommendations

The patient was referred for comprehensive orthodontic treatment but declined this recommendation due to a previous consultation with an orthodontic specialist who informed her that treatment to correct her misalignment would take 18 to 24 months. Whitening and cosmetic bonding to disguise the gaps but not address the protrusive teeth also was suggested. The patient also declined this option because it did not fully address her cosmetic concerns.

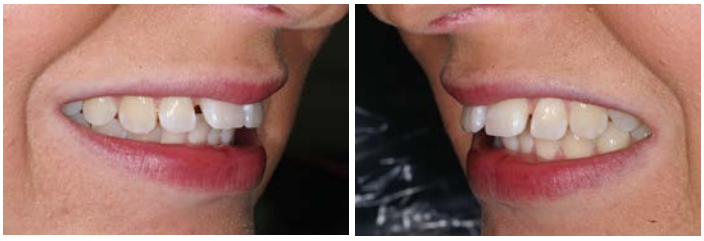
The patient also was told of a comprehensive smile makeover with veneers on teeth ##6-11. Preparations for these restorations would be very aggressive and coincide with pulpal involvement to reduce the overjet. The patient declined this option due to potential complications, damage to healthy dentition, high cost, and because it would not align the lower teeth.

Short-term orthodontics was presented as a treatment option, followed by tooth whitening. This treatment would level and align the upper and lower arches simultaneously, reduce the overjet and overbite, and close the spaces. The estimated treatment time would be between five and eight months. The patient was fully informed that complete correction of her malocclusion would not be possible within this time frame, but that a significant cosmetic improvement could be achieved without any detriment to her long-term oral health **(Fig 10)**.[13,14]

Clear aligner treatment also was suggested. The patient refused this treatment due to the two-year time frame for correcting her issues. Furthermore, clear aligner treatments present difficulty in controlling intrusion and extrusion movement for deep overbite cases.[15]

The last treatment option presented was Inman Aligner therapy, which would address both the upper spacing issues and lower crowding. However, Inman Aligner therapy is not designed to resolve deep overbite cases.[16] In addition, treatment time would be protracted, which was contrary to the patient's wishes.

Figure 1a: Preoperative full-face view of the patient with noticeable diastema between the maxillary central incisors.



Figures 1b & 1c: Preoperative right and left lateral views.

Figure 2: Close-up preoperative view demonstrating the patient's reluctance to smile.

Figure 3: The retracted preoperative view reveals reverse bowing of the smile line.

Figure 4: Retracted right lateral preoperative view displaying the maxillary incisor flaring and spacing.

Figure 5: Retracted left lateral preoperative view displaying the maxillary incisor flaring and spacing.

Figure 6: Retracted right lateral preoperative view emphasizing the patient's Class I molars; upper right tooth #6 is Class II, with an overjet of 8 mm and an overbite of 4 mm (i.e., incomplete anterior open bite).

Figure 7: Retracted left lateral preoperative view emphasizing the patient's Class I molars; upper left tooth #11 is Class I, with an overjet of 8 mm and an overbite of 4 mm (i.e., incomplete anterior open bite).

Figure 8: Preoperative occlusal view of the maxillary arch.

Figure 9: Preoperative occlusal view of the mandibular arch.

Figure 10: The preoperative radiograph identifies asymptomatic impacted third molars.

Treatment Plan

Ultimately, the patient selected short-term orthodontics because it fit her criteria and expectations, and addressed all of her principal cosmetic concerns. The treatment plan involved leveling and aligning both arches. Indirect bonding tray setups would be used for ease of bracket placement, and NiTi coated wires would round out the lower arch, create space for alignment, close the upper space, and reduce the overjet. The full upper arch power chain would allow almost complete resolution of the overjet, and posterior box elastics would help reduce the deep overbite **(Fig 11)**.

Bracket and Wire Placement

To initiate the case, impressions were taken of the patient's upper and lower arches, and the models/impressions were sent for processing. A bracket specialist/technician then set up the case by positioning the clear brackets on models of the patient's teeth and fabricating the custom bonding trays used for precise intraoral bracket placement. These trays were a part of the customized Six Months Smiles patient-specific kit returned to the dentist for treatment.

The indirect bonding trays facilitated the easy and efficient one-step seating process, which also could have been delegated to trained staff. The brackets were precisely positioned within the tray according to where on the patient's teeth they should be located to achieve the desired treatment outcome. To seat the brackets, the patient's teeth were etched, adhesive was applied, and the bonding trays seated intraorally. After confirming the brackets were securely placed, the tooth-colored wires and ties were attached and adjusted.

Short-term orthodontic treatments are not designed for complicated or more invasive orthodontic procedures such as altering Angles Class or correcting skeletal discrepancies.

Follow-Up

The case took five and a half months to complete. The short-term orthodontic wires worked in conjunction with the brackets to guide the teeth to the pre-set and desired position. The patient returned monthly for adjustments and placement of different sized wires, which also were included in the kit.

Minimal and selective interproximal reduction was performed on the upper premolars to allow as much retraction and overjet reduction as possible. Class II elastics, which are often used to further aid correction during the treatment, were also used on the upper premolars. This helped to encourage growth and shape/positional change for better alignment and improve the incisal relationship. Posterior box elastics were used to help finish the case and lock the teeth into centric occlusion/centric relation.

After five months, the lower right tooth #26 needed a minor (0.75 mm) vertical adjustment, which was effected by using "position optimizing pliers" (Six Month Smiles). By five and a half months, #26 was aligned correctly **(Fig 12)**. When the patient's desired changes were achieved, the brackets and wires were removed **(Fig 13)**.

The patient's final occlusion was Class I molars, 1/4 unit Class II canine on the right and Class I canine on the left, as at the initiation of treatment. No compromise in occlusion was observed in this case, since it remained the same. The alignment changes were exclusive to the anterior teeth (i.e., those that would produce the patient's desired cosmetic result). The overjet and deep bite were successfully resolved **(Figs 14-15b)**. Upon braces removal, the patient demonstrated canine guidance on both sides and even protrusive contacts on the central incisors.

Impressions for removable vacuum-formed retainers were taken prior to polishing the teeth, which served as reservoirs for whitening gel.

Figure 11: By month four, the full upper arch power chain allowed almost complete resolution of the overjet. Posterior box elastics locked in the posterior occlusion and facilitated leveling the arch form.

Figure 12: After five and a half months, the lower right tooth #26 was aligned correctly.

Figure 13: The cosmetic braces and brackets were easily removed after five and a half months of treatment, and the teeth were given a final polishing.

Figure 14 Close-up retracted view after polishing.

Figures 15a & 15b: Final right and left lateral views after polishing.


Figures 16a & 16b: Final maxillary and mandibular arch views showing the bonded Six Month Smiles retainers in situ.


Figures 17a & 17b: Postoperative right and left lateral views.

Figure 18: Postoperative full-smile view.

Figure 19: Full-face postoperative view of the patient delighted with treatment results after only five and a half months.

Polishing was completed after impression taking, and the patient completed at-home whitening. Appropriate retention was provided by the indirect setup bonded retainer to ensure fixed retention.

Summary

The literature indicates that successful orthodontic treatment is characterized by full occlusal correction of the malocclusion after treatment, achieving Class I molar and canine relationships, even contact of all teeth in centric occlusion, reduction in the amount of overjet and overbite, absence of spacing, and absence of balancing interferences.[17,18] Although the treatment outcomes may not be perfect by comprehensive orthodontic standards, the patient in this case received a treatment that did not harm her natural tooth structure, delivered the results she anticipated, and produced an enhanced tooth alignment.

Short-term orthodontics is a welcome treatment alternative for dentists whose patients are unwilling to undergo comprehensive orthodontic treatments and are not interested in aggressive restorative dental procedures for enhancing the appearance of their smiles. The patient was delighted with the final results, which were minimally invasive and addressed her primary cosmetic concerns **(Figs 16a-19)**.

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Disclosure: The author is a clinical instructor for Six Month Smiles.

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Opening Vertical Dimension for Esthetic Treatment

Utilizing Direct Posterior Composite Onlays

Sandra Hulac, DDS

Abstract

This article describes a method of opening posterior vertical dimension using direct composite onlays as transitional restorations, allowing a full-mouth rehabilitation to be provided segmentally.

Key Words: composite bonding, comprehensive rehabilitation, crown lengthening, equilibration, malocclusion

Introduction

Restoring anterior wear presents the practitioner with a variety of challenges: A firm diagnosis of the wear etiology must be established to formulate the correct treatment plan. Is this wear the result of parafunction or habits, erosion, or mastication?[1]

In many cases, to create the necessary space to successfully lengthen the anterior segment, additional treatment is required. Orthodontic treatment may be used to intrude anterior teeth and extrude the posterior teeth. Alternatively, restorative dentistry may be utilized to change the posterior vertical dimension of occlusion (VDO).[2-6] This is often difficult for our patients to understand; they are focused on having a nicer smile with longer front teeth and find the additional time and cost to treat their other teeth hard to accept.

Patient History

A 26-year-old female in good health presented in the office as an emergency patient with a fractured composite restoration on #8 **(Fig 1)**.

A brief examination revealed a heavily restored dentition with large composite restorations on most posterior teeth. The disproportionately short centrals were restored with what appeared to be direct composite crowns and the palatal surfaces of #7 and #10 were also covered with directly bonded composite **(Fig 2)**. The patient reported that most of her restorations had been replaced recently. It was agreed to temporarily repair the fractured #8 and reschedule the patient for a comprehensive examination and record taking.

Clinical Examination and Findings

A Panorex, bitewings, several periapical images, and a cephalometric radiograph were taken.

Periodontal

Her oral hygiene was fair and she presented with very slight tissue inflammation. Minimal bone loss around the upper molars was observed on the radiographs and she was classified as an AAP Type II patient.[7]

Biomedical

Decay was observed on #5, #6, #11, and #29. Defective restorations were noted on #3, #14, and #31. Nearly all other posterior teeth were classified as having questionable restorations and #3, ##7-10, #13, #14, #19, #30, and #31 were classified as structurally compromised due to size of existing intracoronal restorations or root canal treatments.[7,8] Tooth #8 had previously been prepared for a direct composite crown, with insufficient preparation height and taper.[9] Acceptable root canal treatments were present in #7, #8, and #14, while an unacceptable root canal treatment was noted in #3, which was asymptomatic. Erosion was clearly evident on ##3-6, #11, #19, and #30. The presence of erosion on other teeth could not be ruled out, because they had been covered with composite. In her dental history the patient reported a previous habit of sucking lemons **(Figs 3 & 4)**.

Functional

It was noted that the patient's central incisors were disproportionately short, although the exact etiology was difficult to establish due to the presence of large composite restorations. The gingival tissue heights on the central incisors were substantially lower than the height on the laterals and cuspids, which was suggestive of compensatory overeruption of the central incisors **(Fig 5)**. Posterior wear patterns were not visible on the posterior teeth due to the quite recent placement of large bonded restorations.

Figure 1: Full smile at initial appointment; #8 is fractured.

Figure 2: Palatal view of upper anterior before treatment; palatal surfaces are covered with composite resin.

The patient stated in her dental history that she felt her front teeth had worn more in the past five years and reported episodes of clenching and muscular pain. She remarked that her bite was "not secure" and did not feel comfortable. She had to squeeze her teeth to make them fit together. These comments indicated unacceptable function and presence of either occlusal dysfunction or a constricted chewing pattern. The fact that the restoration on #8 had repeatedly fractured was further evidence of an underlying functional problem.[7,10]

Muscle palpation revealed tender masseter and temporalis muscles. Joint examination revealed no sounds, opening and lateral movements were normal, joint load and immobilization tests were negative. A slight fremitus was observed, but when shimstock foil (Almore Int.; Beaverton, OR) was inserted between the front teeth it could be pulled through. To further examine her functional movements, a constriction test was performed by sitting the patient upright and having her carry out normal chewing movements with a 200-µ thick articulating paper (Horseshoe, Bausch; Nashua, NH) inserted

Figure 3: Upper arch before treatment.

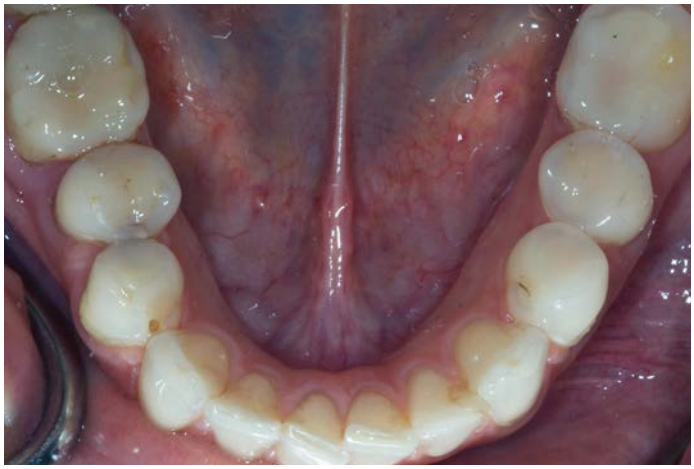

Figure 4: Lower arch before treatment.

between the teeth.[11] No streaks were observed on the lingual aspects of the maxillary incisors, which ruled out a diagnosis of chewing constriction. It is the author's opinion that given the patient's history of anterior wear and the presence of a slight fremitus, she might have been in a constricted chewing pattern before and had "worn through" that pattern, and now had an occlusal dysfunction.[12]

To confirm a diagnosis of occlusal dysfunction, the patient was fitted with a Kois deprogrammer[13] to be able to analyze her bite in centric relation (CR).

After wearing the appliance for two weeks she was scheduled once more to confirm deprogramming **(Fig 6)**. The patient stated that every time she removed her deprogrammer, her teeth consistently touched prematurely in the left bicuspid area. A bite registration was taken and models were mounted on an articulator (Panadent; Colton, CA), confirming a premature contact on #12. This established a firm diagnosis of dysfunction. Analysis of the patient's cephalometric radiograph revealed a mild Class III skeletal relationship with reduced lower facial height **(Fig 7)**.

Dentofacial

The patient was extremely unhappy with the appearance of her smile. She particularly noted the wear on her central incisors, the discoloration of the existing bonded restorations, and the cracks on her lateral incisors. The height-to-width proportions and tissue heights of #8 and #9 were incorrect **(Figs 8-10)**. She displayed very little tooth with her lip in resting position **(Fig 11)**. As both her lip mobility and lip length were average, the lack of display was not age-appropriate.[14] She also stated that she wanted to change the appearance of the rotated #11, as she felt it was "sticking out." Her lip dynamics were normal to low in the anterior segment, not revealing the gingival margins of ##7-9 **(Fig 1)**.

Figure 5: Upper anteriors before treatment; tissue profile is indicative of overeruption of centrals.

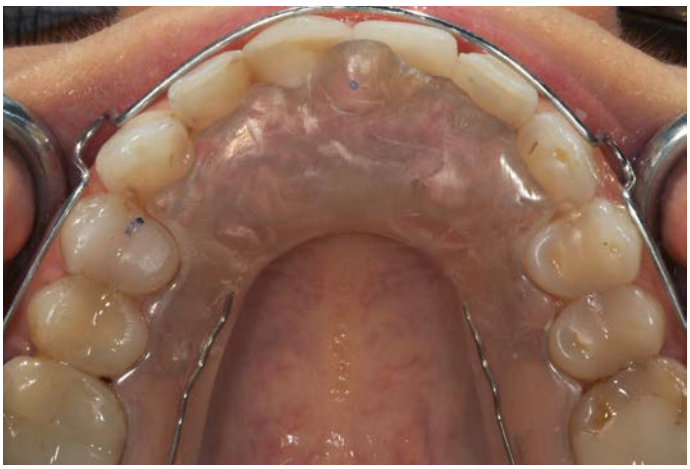

Figure 6: Kois deprogrammer at review appointment.

Figure 7: Cephalometric radiograph.

Figure 8: Full-face smile before treatment.

Figure 9: Preoperative right smile.

Figure 10: Preoperative left smile

Figure 11: Lips in repose before treatment. Display not appropriate for patient in her twenties.

Treatment Plan

Periodontal

Periodontal therapy was provided, which consisted of scaling and polishing with a focus on increased home care and six monthly recare intervals.

Biomedical

Treatment of decay and structurally compromised posterior teeth with onlays or crowns and an endodontic retreatment of #3 were indicated. The treatment choices for ##7-10 were lithium disilicate crowns (IPS e.max, Ivoclar Vivadent; Schaan, Liechtenstein) with a cutback and layered incisal edge. The decision was made to place full crowns instead of veneers because the facial surfaces of these teeth had insufficient enamel for an adhesively retained restoration. In addition, the palatal surfaces required more durable restorative protection and it was extremely important to completely control the design of the palatal surfaces for function.[10] Lithium disilicate was chosen based upon its strength.[15] Due to the insufficient retention form on #8 and #9 it was also decided to crown lengthen those teeth.

Functional

When the models were mounted in CR, the first contact on #12 resulted in an increase in the VDO that was sufficient to accommodate the desired length of the anteriors. Equilibration into centric occlusion by subtractive means was not considered as the approach would have been likely to decrease the vertical dimension, thereby limiting the room for anterior lengthening. It would also risk putting the patient into a constricted chewing pattern. Furthermore, the patient's cephalometric radiograph showed reduced vertical proportions, confirming that vertical reduction was contraindicated. It was therefore decided to add to the posterior teeth, achieving CR positioning and vertical opening simultaneously.

As many posterior teeth were already structurally compromised, minimally prepared porcelain onlays on all posterior teeth were proposed to the patient, which would provide a long-lasting and stable means of increasing the VDO.[16,17] In addition to lowering the functional risk, the structurally compromised teeth would be protected from fracture, thereby lowering the biomechanical risk.[7,8] This treatment option was rejected due to cost. Orthodontic treatment was also discussed and rejected due to cost and inconvenience. It is the author's opinion that erupting the posterior teeth to open the VDO would not have eliminated the long-term need to treat them for biomechanical reasons. Changing the tissue profile of the anteriors by orthodontic intrusion would not have eliminated the ferrule issues and orthodontic extrusions to achieve better ferrule would have compromised the esthetic outcome.

> "In many cases, to create the necessary space to successfully lengthen the anterior segment, additional treatment is required."

It was therefore agreed to treat the patient with direct composite onlays made chairside to open the vertical. The patient understood that these direct restorations were a long-term provisional solution that would allow her to sequentially restore her back teeth when she had the financial means to do so.

Some authors propose similar methods of increasing VDO with additive composite as a medium- to long-term solution.[18]

Dentofacial

Surgical crown lengthening of #8 and #9 to achieve better tooth proportions and tissue heights was indicated; this would also increase the ferrule on these teeth.[19] After three months, permanent restorations could be placed. The rotation of #11 would be solved by adding direct composite to the mesial aspect of the tooth and aligning it better into the arch.

Treatment

Periodontal Therapy and Crown Lengthening

Periodontal therapy, consisting of scaling and root planing, was completed prior to surgical crown lengthening, which was performed in one session. The tissues of #8 and #9 were cut to ideal height with a double-sided fine surgical blade. Then a small flap was raised and the crestal bone recontoured with a Wedelstadt bone chisel (Stoma; Emmingen, Germany), as gingival levels can be predictably altered only if crestal bone levels are addressed.[20]

Biomedical and Functional

After the centric mounted models had been evaluated to determine how much vertical opening would be required to achieve adequate clearance for anterior teeth of appropriate length, a diagnostic wax-up was created. Matrices of the wax-up were fabricated with a clear silicone material (RSVP, Cosmedent; Chicago, IL) **(Figs 12-14)**.

The posterior teeth were minimally prepared in quadrants. After the existing composite restorations and decay were removed, the teeth required only a slight amount of further preparation to provide enough room for composite thickness requirements.[21]

Figure 12: Articulated upper model.

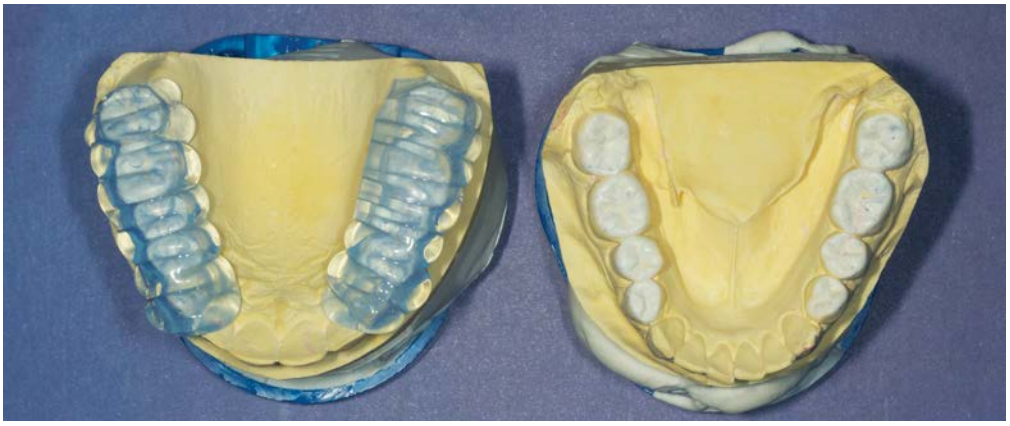

Figure 13: Posterior occlusion waxed up in CR.

Figure 14: Clear silicone matrices of wax-up.

The preparations were then isolated with a glycerin gel and the clear matrices loaded with a microhybrid composite (Four Seasons, Ivoclar Vivadent). Prior to loading the matrix, the composite was placed in a composite warmer (Calset, AdDent; Danbury, CT) and heated to 130 °F to decrease the viscosity and improve adaptation into the matrix. Warming composites also increases monomer conversion, thereby decreasing curing time and shrinkage.[21,22] The loaded matrices were applied to the isolated teeth and the composite was fully cured. Once cured the direct composite onlays could be easily removed from the teeth and separated **(Fig 15)**.

The prepared teeth were then isolated with a rubber dam, treated with air abrasion, and cleaned with phosphoric acid. Silane and bond was applied and the onlays were loaded with a flowable composite (StarFlow, Danville Materials; San Ramon, CA) and individually cemented **(Fig 16)**.[23] A microhybrid was used to improve wear resistance.[24] The onlays were cemented to maximize marginal integrity by reducing curing stresses.[25]

Teeth ##7-10 were prepared and the patient was fitted with provisionals. The anteriors were recoupled and the anterior guidance was tested in the newly opened vertical position. Composite was added to the tip of #6 and the rotated #11 to recouple the cuspids for canine guidance[10] in an incremental layering technique utilizing a microhybrid (Four Seasons) in the load-bearing areas[21] and a microfill (Renamel, Cosmedent) on the facial for optimum polish.[26]

The patient was instructed to wear her Kois deprogrammer again and was scheduled for an occlusal equilibration one week later. Deprogramming was confirmed and equilibration was carried out using football-shaped diamonds and brownie points.[13] The patient was very comfortable with her new vertical dimension and remarked that her muscles were not tense anymore and her bite felt like her "teeth were finally fitting together properly."

Dentofacial

Impressions were taken for final crowns on ##7-10. The impressions and multiple photographs for shade documentation were sent to the dental laboratory. At the delivery appointment, once the patient had approved the esthetics of the crowns, 00 cord (Ultradent Products; South Jordan, UT) was gently packed into the sulcus to ensure that no crevicular liquid contamination occurred during the cementation. The teeth were cleaned using air abrasion with 27-µ aluminum oxide at low pressure (40 psi).[27] The crowns were loaded with RelyX Unicem cement in shade translu-

Figure 15: Chairside-fabricated composite onlays.

Figure 16: Seating of onlays after air abrasion and conditioning of surfaces.

Figure 17: Full smile after treatment; teeth proportions are correct, and smile esthetics are much improved.

Figure 18: Upper arch after treatment; improved alignment of left cuspid.

Figure 19: Lower arch after treatment.

cent (3M ESPE; Hong Kong) and seated. Most excess cement was immediately wiped away using microbrushes. After about 30 seconds, the time needed for the self-etching action of the cement to take place, the crowns were "tacked" into place with an initial cure of the cement, allowing for easier removal of the residual cement.[28]

Glycerin gel was applied to all margins for oxygen inhibition to ensure full cure of the marginal cement layer and avoid later margin breakdown due to cement wash-out.[29,30] Final curing was carried out for 40 seconds on all surfaces. Retraction cords were removed and final cement removal was accomplished using 12B scalpel blades, a hand scaler, and waxed floss. Margins were carefully polished using a brownie point.

Occlusion was carefully checked using the constriction test described previously and any streaks on the lingual aspects of ##7-10 were removed with a fine football-shaped diamond and polished with a brownie point and a felt disc using Porcelize (Cosmedent).[10]

The patient returned for postoperative images a couple of days after the fit appointment. These illustrated that the tissue would have to heal for a longer period of time before a decision could be made to carry out a slight tissue correction on #8, should the patient wish **(Figs 17-23)**.

Summary

Dentistry to restore or create beautiful smiles is often more complex and costly than our patients can afford. Even if the treatment is covered by insurance, most insurance plans have an annual maximum limit, which does not begin to cover the cost of the entire rehabilitation. We must provide our patients with an approach that allows the needed care to be provided in manage-

Figure 20: Lips in repose after treatment; display is age-appropriate.

"Dentistry to restore or create beautiful smiles is often more complex and costly than our patients can afford."

> We must provide our patients with an approach that allows the needed care to be provided in manageable segments to address the realities of patients' financial or time constraints.

Figure 21: Upper anteriors after treatment; tissue profile has been improved, and more healing time is required.

Figure 22: Postoperative right smile.

Figure 23: Postoperative left smile.

Figure 24: Close-up smile after treatment.

Figure 25: Full-face smile after treatment.

able segments to address the realities of patients' financial or time constraints. Transitional bondings are an excellent way to achieve this: They require less time and cost than porcelain and can function well for a long time,[31-33] allowing patients to "switch" to more durable porcelain restorations over a period of years. In this case, an indirect/direct composite onlay technique was utilized to allow permanent treatment of the front teeth, combined with long-term provisional treatment of the back teeth. This patient was extremely pleased with the treatment outcome and is now able to sequence the final treatment of her back teeth into manageable sections **(Figs 24 & 25)**.

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Dr. Hulac is a part owner of Tam, Hulac and Partners Ltd., Hong Kong. She is a mentor at the Kois Center, Seattle, Washington.

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Analysis and Discussion

Opening Vertical Dimension for Esthetic Treatment

This analysis and discussion is regarding the article, *"Opening Vertical Dimension for Esthetic Treatment: Utilizing Direct Posterior Composite Onlays,"* by Sandra Hulac, DDS.

Gary Alex, DMD, AAACD

In her article "Opening Vertical Dimension for Esthetic Treatment," Dr. Hulac demonstrates how the science of occlusion and comprehensive dentistry can actually be applied to clinical dentistry. She uses a logical and systematic methodology that addresses both the functional and esthetic issues and concerns of her patient. A mistake that dentists commonly make in treating a patient like the one in Dr. Hulac's case is that they fail to recognize, diagnose, and treat the occlusal issues before addressing the patient's esthetic concerns. It should be recognized that it is one thing to be able to create beautiful teeth, and an entirely different thing to create beautiful teeth that actually last and function in harmony with the rest of the masticatory system. An acceptable cosmetic result, without regard for function and/or parafunction, will often result in premature case failure. What today's truly successful clinician requires is a logical and systematic methodology in approaching cosmetic/restorative cases that will lead to a reasonably predictable and durable end result. Dr. Hulac has described just that in her article.

It is probably safe to say that the great majority of dentists use maximum intercuspation (MIP) as a starting and ending point when developing an occlusal scheme. The reason for this is likely because it requires the least thought, time, knowledge, and effort. The dentist simply works with the occlusal relationship as it exists. The problem is that in many cases the patient's existing MIP and occlusal scheme is far from ideal. In fact, it may be a destructive relationship, causing a problem, or problems, somewhere in the masticatory system. This appeared to be the case with Dr. Hulac's patient.

Dr. Hulac's decision was to use a centric relation (CR)-based occlusion based upon long-accepted occlusal principles as taught by Dawson and others[1-3] to first develop a stable and non-destructive occlusal scheme prior to placing definitive restorations. She describes the use of a "Kois deprogrammer" to help determine the patient's CR position. Anterior programmers of one type or another (Kois deprogrammer, Lucia jig, Pankey deprogrammer, NTI, etc.) are often used in some capacity to help determine CR.

Dr. Hulac recognized the need to treat her patient in a comprehensive fashion to achieve the most predictable end result. A primary tenet of comprehensive dentistry is that all of the components of the masticatory system (teeth, soft tissues, skeletal structures, muscles, and joints) are intimately related and dependent upon one another for ideal function. Comprehensive dentistry is really about seeing, understanding, and treating the "big picture." This is a far different approach from the "see the hole, fill the hole" mentality often employed in restorative dentistry.

Dr. Hulac is to be applauded for her approach and thoroughness in making this case the success it appears to be.

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> It should be recognized that it is one thing to be able to create beautiful teeth, and an entirely different thing to create beautiful teeth that actually last and function in harmony with the rest of the masticatory system.

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ANTERIOR EXTRACTION & Implant Placement in a Severely Deficient Site

Multidisciplinary Enhancement of Hard & Soft Tissue Profiles: Prosthetic Considerations, Part II

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Editor's Note: The digital version of this article features a direct link to Part I of this article.

Abstract

A proper diagnosis is of paramount importance in creating a "roadmap" for the multiple treatment options we can offer our patients. The more advanced the problem is, decisions regarding treatment can be fairly simple or quite complicated. The incorporation of numerous techniques often requires the knowledge and ability of several specialists, including the general dentist.

Interdisciplinary communication and management from the onset of problems has enhanced treatment outcomes for the clinical dilemmas we routinely face in dentistry. On complex cases the decision taken can have favorable or adverse results with an impact that is evident from a health perspective in the supporting bone, surrounding soft tissues, prosthetic design, function, and esthetics. While the short-term objectives and results of such treatment must reflect an improved clinical situation, we strive for a positive and optimal long-term outcome with all patients.

Key Words: risk management, teamwork, long-term results, soft tissue contouring, computer-designed prosthetics

Figure 1: Preoperative view showing advanced gum recession of 9 mm with loss of the labial bone. No attached gingivae, with the surrounding tissue extremely inflamed and exhibiting bleeding upon probing.

Recreating the history of any given problem can, in some instances, help establish some guidelines for future treatment.

Introduction

The positive evidence of orthodontic forced eruption altering bone and its surrounding soft tissues around hopeless teeth prior to their extraction was proven[1-7] and described in Part I of this article (*jCD*, Winter 2012, Vol. 27 Number 4).[8]

Recreating the history of any given problem can, in some instances, help establish some guidelines for future treatment. Periodontal problems can have a devastating impact upon individual or numerous teeth, the causes being multifactorial. From a mild reversible soft tissue problem to a moderate or advanced predicament involving bone loss, the solution(s) for the affected tooth or teeth will be dictated by the level of the disease. Furthermore, the type of periodontal defect can determine the predictability that the anticipated treatment may provide.

Clinical Case

As described in Part I of this article,[8] a 57-year-old female presented with a non-contributory medical history except for oral bisphosphonate therapy over a five-year period. The bisphosphonate therapy was discontinued just prior to seeking a dental consultation. The patient's chief complaint at her first appointment was a significant concern about the existing right central incisor, particularly related to the considerable recession, exposed root, and associated cosmetic deformity **(Fig 1)**.

Oral examination recorded generalized (+) mobility levels across her entire dentition except for the maxillary right central incisor, which exhibited a Class II+ mobility. All posterior teeth presented with a balanced occlusion, a slight localized recession, and a history of mild bone loss but were otherwise periodontally stable. The upper right lateral and central incisor had undergone endodontic therapy several years earlier, with the upper central incisor requiring a subsequent apicoectomy.

In conjunction with the gingival recession and apicoectomy, the majority of the osseous labial plate of the right central incisor had resorbed. While the defect on the labial of #8 was significant, it was also localized. Important influencing considerations were the anatomy of the soft tissue defect, having a triangular shape, as well as the lack of any attached gingivae.

The more advanced the problem is, treatment may be equally complicated, and in some instances may fall short of the expected results, even when multiple procedures are implemented **(Figs 2 & 3)**. The diagnosis will be essential to identify all possible reasons that created such problems, hence the need to address them during the treatment-planning phase. Even with the most current techniques and materials, the final result can find shortcomings, as regeneration of the lost periodontal ligament creates a quandary on the surrounding hard and soft tissues.

Considering all available options to solve any given clinical problem, the most conservative one should always be initially considered, since all other options can be implemented at a later time. Therefore, the abutment was modified on its buccal emergence profile **(Figs 4a & 4b)**; by reducing its profile, the aim was to allow for the gingival tissue to reposition itself in a more incisal direction **(Figs 5a & 5b)**.

Relevant Diagnostic Influences

Relevant diagnostic influences were as follows:

- high patient expectations
- high lip line
- gingival recession resulting in uneven gingival margins
- lack of attached gingivae, #8
- lack of labial plate of bone, #8
- lack of cosmetic smile parameters of balance, harmony, and continuity of form
- lack of shade match, #7.

Upon clinical evaluation, the lingual aspect of the crown showed severe adjustment on the porcelain and the metal substructure **(Fig 6)**.

Discussion

As the bone sets the architecture to support the soft tissue height, the soft tissue will shield the underlying abutment, follow, and conform to the new environment. Important aspects to consider for long-term stability are the characteristics of the existing soft tissue biotype and whether there is a need or advantage for a

Figure 2: Tissue biotype around implant-supported provisional on the upper right central incisor appears to be thin and unstable, despite the excellent results achieved with the previously provided treatment.

Figure 3: Incisal view showing healing after uncovering the implant and fabricating the provisional. There is a concern with the irregular palatal tissue contour.

Figures 4a & 4b: Figure 4a shows the lateral view of the provisional and TiDesign abutment (Dentsply Implants; Waltham, MA). Figure 4b shows a modified abutment with a concave buccal contour to allow for the tissue to migrate in an incisal direction.

Figure 5a: Titanium abutment and provisional modified in a concave direction to allow for gingival tissue to fill in.

Figure 5b: Buccal view showing the exposed gingival margin of the titanium abutment and the modified provisional. Gingival contours are slightly wider, attempting to provide support for papillae.

Figure 6: There was a history of aggressive occlusal adjustment on the #8 crown.

connective tissue graft to improve the long-term stability for the treatment to be implemented.[9,10]

With the concern about possible exposure of the implant threads on the palatal side, and the thin and irregular buccal soft tissue, an additional procedure was done. This utilized the tissue from the palate, to attempt to improve the clinical environment around the implant, even though such defect in this location can be extremely difficult to correct in a predictable manner.

While the original defect was eliminated, the buccal tissue appeared unstable. The initial objective was to create the best long-term healthy environment around the treated teeth and implant, thus converting the thin soft tissue biotype into a thicker, denser, stippled tissue that would better protect the implant during function **(Figs 7a & 7b)**.

The provisional had an undercontoured gingival anatomy. There was an attempt for the gingival tissues to fill in around the abutment and adjacent teeth while still providing support for the interproximal papillae. In addition to the initial somewhat acceptable, but less than ideal results, it was critical to give the tissue undisturbed healing time to allow it to mature before taking a final impression.

Once the tissues surrounding the implant healed, even though the gingival contour had flattened out **(Fig 7c)**, a final impression was taken to create an accurate model that would be utilized for the creation of a computer-generated custom abutment for the implant.

Such technology has proven invaluable in creating excellent esthetic results with titanium,[11-18] gold-shaded titanium,[19] and zirconia abutments[20,21] in addition to accuracy of fabrication[22,23] with optimal fit between the implant and the abutment.[24,25]

Among the goals when designing a computer-generated abutment are the creation of ideal subgingival contours to support the soft tissues, ideal taper, and length for maximum retention of the final restoration. Clear communication between the restorative dentist and abutment designer is extremely important **(Figs 8a-8c)**.

Computer-designed zirconia copings enable us to create excellent-fitting restorations for the natural tooth and to the abutment **(Fig 9)**.

With the completed crown on the upper lateral incisor permanently cemented, the zirconia abutment was screwed in, torque tightened to 25 Ncm, and a cotton pellet placed covering the abutment screw and closed with a temporary cement **(Fig 10)**.

The final restoration(s) must at least meet the original goals, foremost from a health and function perspective. It is especially critical for the anterior teeth to deliver the anticipated esthetic results **(Figs 11 & 12)**.

Figure 7a: Buccal view of the initial healing three weeks after the connective tissue graft, reflecting that more healing time is needed.

Figure 7b: Buccal gingival volume and interproximal papillae had not filled in as originally expected.

Figure 7c: Buccal view of the provisional and surrounding tissue prior to taking a final impression. While the tissue is irregular, it is healthy and is expected to fill in further with time.

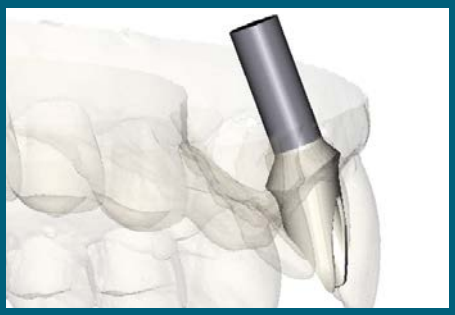

Figure 8a: Lateral view of computer planning of the zirconia abutment.

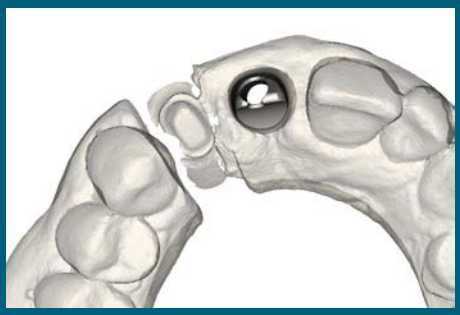

Figure 8b: Occlusal view of computer planning of the zirconia abutment.

Figure 8c: Buccal view of the Atlantis (Dentsply Implants) zirconia abutment showing the customized emergence profile and proper length of the abutment.

Figure 9: Zirconia copings for the natural tooth and implant.

Figure 10: Buccal view of the Atlantis zirconia abutment on the right central incisor.

Figure 11: Palatal view of final restorations cemented.

Figure 12: Buccal view of final restorations cemented.

It is essential to reevaluate initial goals and make the necessary adjustments during treatment, especially when managing a complex case or when a setback occurs.

The final crowns were permanently cemented, ensuring there was no residual subgingival cement, which could lead to periodontal and peri-implant soft tissue inflammation.

Note the final result as compared to the pre-treatment image **(Figs 13-15)**.

The positive visual clinical results are equally important to a radiographic evaluation, reflecting the existing bone level around teeth and the implant. Long-term bone preservation should be monitored radiographically and compared to the radiograph taken at the time of delivering the final restoration **(Fig 16)**.

Summary

Astute treatment planning and objectives must be well defined once a diagnosis has been established. It is essential to reevaluate initial goals and make the necessary adjustments during treatment, especially when managing a complex case or when a setback occurs. Utilization of modern technology in addition to proper judgment during all phases of treatment will lead to the best possible results a patient and practitioner can expect. Features of implant design and fit of the prosthetic components that reduce micro-movement, in addition to the fit of the final restoration, can help determine the preservation of bone and the surrounding soft tissue levels.

Acknowledgment

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Figures 13-15: The lateral view reflects the initial defect on the central incisor and shows the correction of the defect with the gingivae healed.

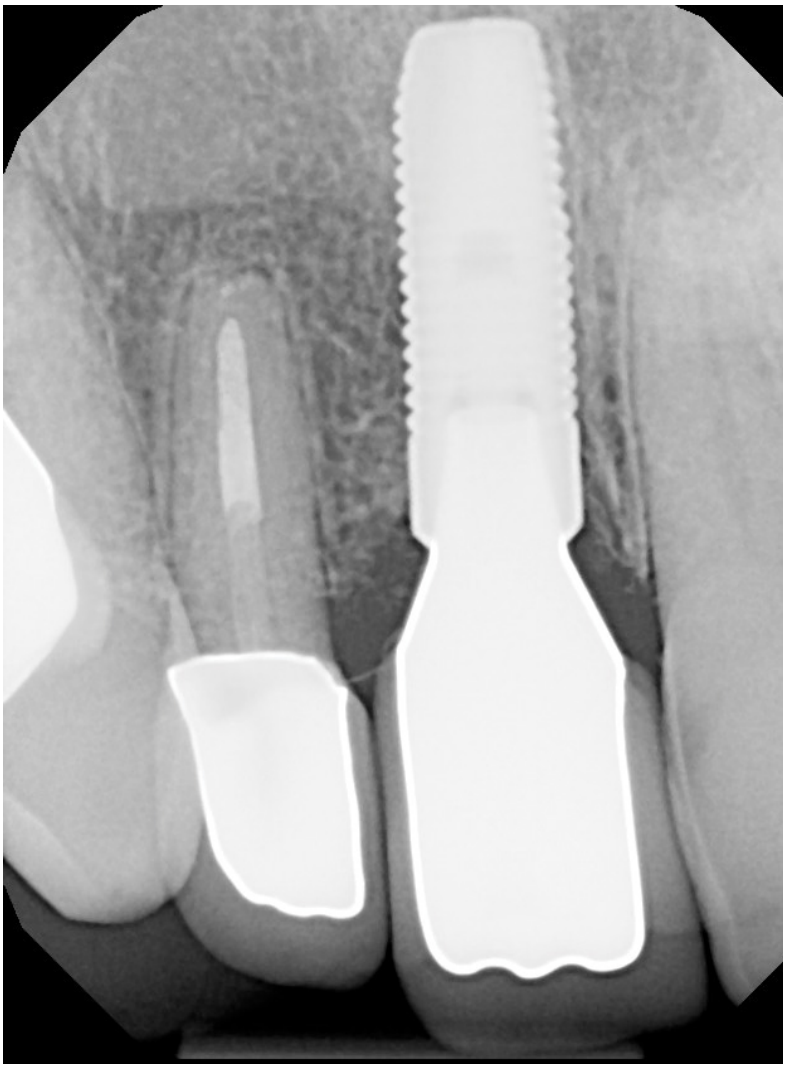

Figure 16: Radiograph of the final restorations.

Features of implant design and fit of the prosthetic components that reduce micro-movement, in addition to the fit of the final restoration, can help determine the preservation of bone and the surrounding soft tissue levels.

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From Dentures to an *Esthetic Implant Restoration*

Fixed Implant-Supported Bridge for the Maxilla and Mandible

Stephen Travis, BDS(HONS), MDSC
Massimiliano Zuppardi, MDT

Key Words: fixed implant-supported restorations, CAD/CAM, bridge, zirconia

Abstract

This clinical case presents a patient who wished to go from full dentures to esthetic fixed implant-supported restorations. There had been mild to moderate hard and soft tissue loss. Treatment was carried out using a combination of classic prosthodontic techniques and CAD/CAM technology. The process presented here is a step-by-step technique.

> “Zirconia frameworks now provide the ability to create ceramic restorations that mimic the natural dentition in nearly all aspects.”

Introduction

Many people are unhappy wearing dentures. Often it is difficult for people to accept a denture as a restoration. Particularly for younger people, it can be psychologically distressing that this is their restoration for life, and reduced function and esthetics can cause loss of confidence and self-esteem. Dentures can be very aging, both physiologically and psychologically.

Fortunately, with current implant technology, fixed restorations can be provided. Zirconia frameworks now provide the ability to create ceramic restorations that mimic the natural dentition in nearly all aspects.

Case Report

The patient presented **(Fig 1)** with an existing implant bridge in the lower arch and wanted to replace her full upper denture with an implant-supported bridge. She had worn a full denture for many years, having it remade every five years or so to keep as good an appearance as possible. Her primary esthetic concerns were that her upper lip did not sit properly, the teeth were very "full," and her lower lip did not sit symmetrically **(Figs 2 & 3)**.

Full clinical, esthetic, and radiographic analysis was carried out. The upper ridge was not heavily resorbed, but flattened **(Fig 4)**. The existing denture had an irregular occlusal plane, the buccal corridors were filled, and the upper incisors were too far forward **(Fig 2)**. The decision was made to provide a six-implant supported upper zirconia bridge with buildup, with pink replacement due to the flattened ridge. At the same time, the lower implant bridge would be remodeled to align the occlusal planes, open the vertical dimension, and coordinate the upper and lower lip support.

> "As the patient had worn a full denture for so long, it was difficult to determine the ideal incisor tooth size, shape, and position."

Figure 1: Patient at presentation.

Figure 2: Old denture with wrong occlusal plane.

Figure 3: Full view of upper denture and lower implant bridge.

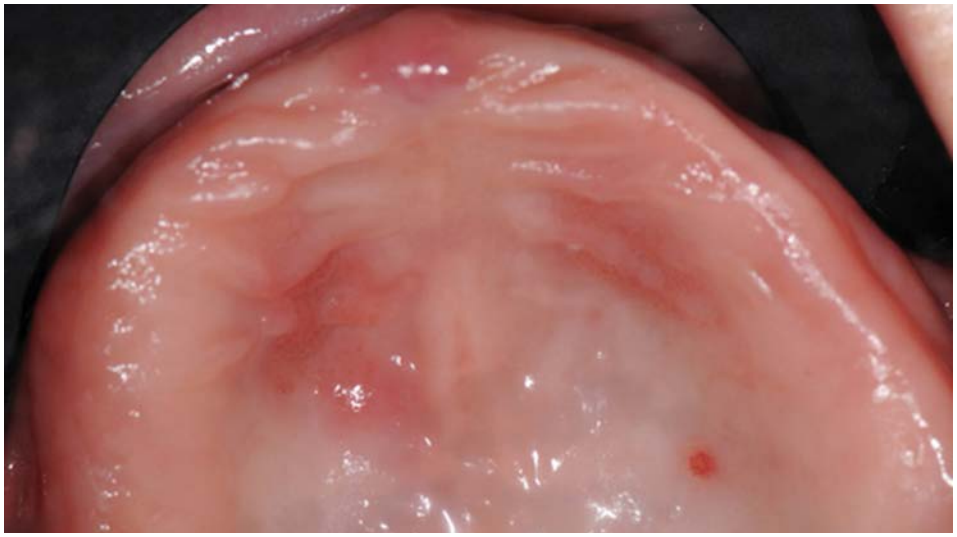

Figure 4: Upper ridge, flattened and edentulous.

Treatment Planning and Treatment

The treatment plan was to replace the lower bridge with new acrylic teeth. Due to the patient's high esthetic expectations, ceramics would be used to restore the upper arch.

The implants were placed avoiding the upper incisor region. This tooth position would not then be negatively influenced by the implant position.

As the patient had worn a full denture for so long, it was difficult to determine the ideal incisor tooth size, shape, and position. Initially the upper denture was remade, to attempt correction of some of the presenting problems **(Fig 5)**. The implants were placed using a surgical guide based upon this denture as it was thought that the final tooth size would be similar to the denture teeth and that pink replacement would be necessary.

At this stage, neither we nor the patient were happy with the appearance. The lip still appeared too full, with the arch width too wide so there were no buccal corridors. We asked the patient to bring in a photograph of her natural teeth. This showed a larger central incisor, narrower upper arch form, and incisor edges sitting just inside the lower lip **(Fig 6)**.

A master cast was obtained and a diagnostic setup was done direct to fixture level.

Several diagnostic setups were carried out, first in wax **(Figs 7 & 8)** and then acrylic until all parties were happy with the appearance of the smile, lip support, and facial height **(Figs 9 & 10)**. The tooth sizes and arch form were now very similar to the appearance before tooth loss.

Figure 5: Facial image with denture.

Figure 6: Old photograph provided by the patient.

Figure 7: First diagnostic wax-up.

Figure 8: Second diagnostic wax-up.

Figure 9: Acrylic bridge on the model.

Figure 10: Acrylic bridge in the mouth with front and right profile.

The Problem—Fixture Alignment

What was evident now was that no pink replacement was necessary. However, when the setup was transferred to the master cast and duplicated in wax, the emergence of the screws through the occlusal was not ideal and the emergence at the gingival was not right in the center of the tooth **(Figs 11 & 12)**. This would create problems with contouring and cleaning. Also, the canine implants were not deep enough to allow for angulated abutments and the screw access was through the incisal edge **(Fig 12)**.

The Solution

The solution was to alter the tooth dimensions for the posterior teeth, and to place angled abutments at the #14, #15, #24, and #25 positions to allow exact emergence from the implants.[1] On each side there would be one rather than two premolar teeth. At the canine implants, custom abutments were designed and milled. Galvano copings would be used to allow passive fit of the zirconia framework.[2] There would be screw retention posteriorly, idealized by the angled abutments through the middle of the occlusal surfaces, cemented to the custom abutments with provisional cement at the #13 and #23 abutments.

Finalization of Restorations

Now that the upper arch abutments **(Fig 13)** and tooth position had been finalized, the lower bridge was completed and a provisional acrylic bridge placed in the upper to confirm the new positions. Pontic forms could also be developed at the ##12-22 positions **(Fig 13)**. A new master cast was formed **(Fig 14)**.

The lower bridge was completed in acrylic to avoid ceramic-to-ceramic occlusal contact. Otherwise all traditional prosthodontic principles for function, esthetics, and cleansibility were fulfilled. All tissue-fitting surfaces were convex and highly polished **(Fig 15)**, there was access adjacent to each implant for cleaning, and there was minimal thickness of the bridge so that tongue function would not be compromised. The gingival esthetics were idealized using pink acrylics.

The final wax-up was tested on the abutments in acrylic as a final check and to confirm patient approval of tooth size, shape and position, lip support, and occlusion **(Fig 16)**.

Once this acrylic had been checked clinically it was cut back from the buccal and occlusal/incisal **(Figs 17 & 18)**. One side at a time was prepared to ensure correct cutback thickness.[3] This was essential to ensure the best properties of the layering ceramic.[4]

The acrylic framework was scanned and the milling center proceeded to reproduce this precisely in zirconia. Before sintering, the framework design was

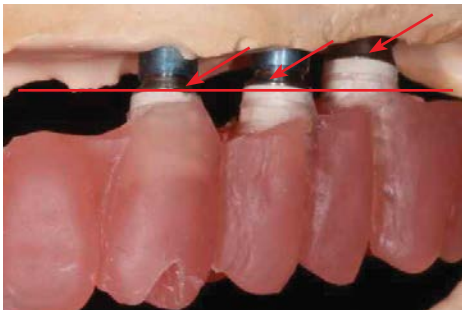

Figure 11: Implant not in the same depth.

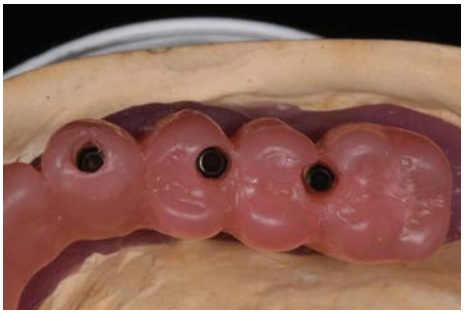

Figure 12: Screw access.

Figure 13: Angulated abutments in the mouth.

Figure 14: New model with the abutments.

Figure 15: Lower implant bridge with new teeth replaced.

Figure 16: Try in of the lower and upper bridges.

Figure 17: Cutback, buccal view.

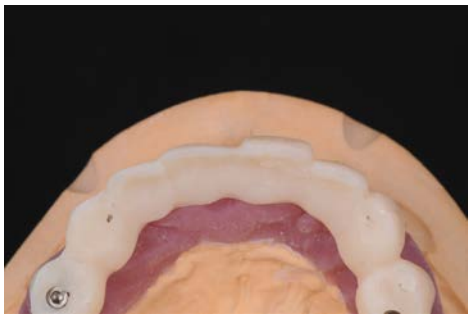

Figure 18: Cutback, occlusal view.

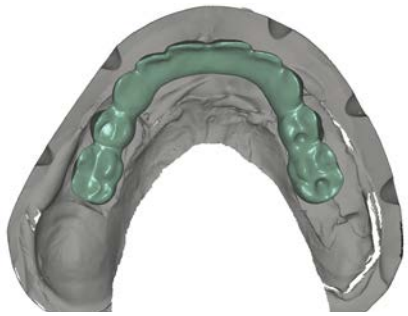

Figure 19: Virtual framework before sintering.

checked with us via e-mail **(Fig 19)**. The framework was then milled, sintered, and delivered back to the laboratory **(Fig 20)**.

The layering commenced with dentin buildup to full contour **(Fig 21)**, dentin cutback **(Fig 22)**, and enamel stratification **(Fig 23)**.

For the first firing, the bridge was heated very slowly. This ensured that the framework was evenly heated; otherwise, the porcelain would not be homogeneous and well fired. We set the temperature at 810 °C, 10 degrees higher than recommended by the manufacturer. After firing, the bridge was tried in the mouth to check the shape, length, and color **(Figs 24-27)**. At this stage minimal modifications were required.

A second firing completed the shape **(Fig 28)**. The texture was designed with a pencil, showing areas to trim and shape to give the

Figure 20: Zirconia framework.

Figure 21: Dentin buildup.

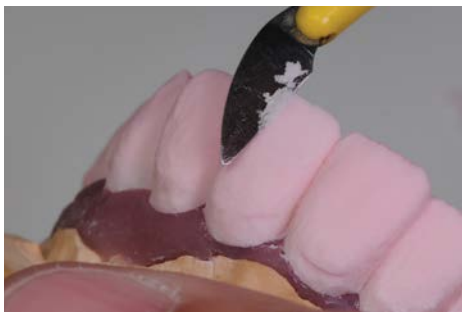

Figure 22: Dentin cutback.

Figure 23: Enamel stratification.

> A truly beautiful esthetic result was achieved. The upper and lower lip support, tooth sizes, and arch form have recaptured the appearance of the natural teeth.

Figure 24: First firing, right profile.

Figure 25: First firing, left profile.

Figure 26: First firing, buccal view.

Figure 27 First firing, detailed stratification.

restoration life and personality **(Fig 29)**. The aim was to provide a non-homogenous surface that lets light reflect at many different angles, as well as translucence at the incisal edge **(Fig 30)**. The surface then needed to be polished smoothly to attain the desired effect—a tooth-like reflective surface **(Fig 31)**.

Completion of the Upper Bridge

Figures 32, 33, and 34 show how the thickness of the layering porce-

Figure 28: Second firing.

Figure 29: Simple texture design.

Figure 30: Surface with texture.

Figure 31: Surface polished.

Figure 32: Zirconia framework, step one.

Figure 33: Zirconia framework, step two, with dentin.

Figure 34: Zirconia framework, step three, finished.

lain onto the zirconia framework was managed.[5,6]

Time was taken to refine, smooth, and polish the bridge. This was particularly important so that the fitting surface had good adaptation to the soft tissues **(Figs 35 & 36)**.[7-9] The ovate pontic needed just the right pressure to create the emergence profile and to avoid food impaction **(Figs 37 & 38)**.[10]

The next three images show the evolution of the restoration. At presentation with the old denture, the

Figure 35: Galvano and titanium cylinder, cemented.

Figure 36: Bridge, polished profile view.

Figure 37: Bridge on the model.

Figure 38: Upper and lower bridge in the mouth.

> This case highlights the importance of a careful diagnostic provisional phase even when implants are already in place.

Figure 39: Patient at presentation.

Figure 40: Patient with temporary.

Figure 41: Patient with final restoration.

upper and lower lips are distorted and pushed forward, there are no buccal corridors, and the vertical dimension is overclosed **(Fig 39)**. With the provisional acrylic restoration, the lips are symmetrical, the facial height is restored, and the arch form is more harmonious **(Fig 40)**. The final image in the series **(Fig 41)** shows how carefully the provisional restoration has been mimicked in the final bridge. The maxilla occlusal plane follows the lower lip contour and incisal edges sit at the wet-dry line **(Fig 42)**.

Figure 42: Restoration in harmony with lips.

Figure 43: Final smile, right side.

Figure 44: Final smile, left side.

Results

A truly beautiful esthetic result was achieved. The upper and lower lip support, tooth sizes, and arch form have recaptured the appearance of the natural teeth.

Maintenance was made easier by natural tooth pontic form and direct emergence from the implants without any overhanging flanges. The acrylic-to-ceramic occlusal scheme reduced the risk of ceramic fracture. The zirconia framework was the ideal dimension to support the minimal build-up of ceramic **(Figs 43-48)**.

This case highlights the importance of a careful diagnostic provisional phase even when implants are already in place. This allows for patient approval and refinement of esthetics, but most importantly with zirconia, the idealization of the framework design. All future risks will be managed as well as possible.

Figure 45: Lips, inanimate.

Figure 46: Lips in animation.

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Figure 47: Patient with the restoration.

Figure 48: Harmony.

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Massimiliano Zuppardi is a member of Oral Design International Foundation and is a dental technician in New South Wales, Australia.

Disclosures: The authors did not report any disclosures.





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ADVANTAGES of Composite: Direct and New Semi-Direct Techniques

Morphological Correction and Improving Esthetics of Anterior Diastemas

Antonio Cerutti, MD, DDS, PhD
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Prof. Dino Re, MD, DDS

CE CREDIT

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

1. Understand management of anterior diastemas utilizing non-invasive techniques.

2. Know the indications for direct or semi-direct closure of diastemas.

3. Have an appreciation for using composite versus porcelain in closing anterior diastemas.

> "Diastemata exist for various reasons, including disproportion between the tooth size and the maxillary or mandibular arch width, tooth angulation, and tooth rotation."

Abstract

Diastemata are a common esthetic problem in mixed and early permanent dentitions at the time of eruption of the maxillary incisors. Different materials such as composite resin and ceramics are commonly used with indirect techniques, yet the recent major improvements in composite resin properties suggest a more conservative approach.

Direct bonding in diastema closure cases allows clinical control in definition of the interproximal layer, even with multiple dental treatments. It is crucial to have an efficient and stable guide for the layering of each material. In the case of anterior multiple diastemas, a semi-direct technique may improve the precision of the restoration. Laboratory-fabricated composite layers, adapted with cyanoacrylate glue on the rigid silicone template, are bonded on the palatal surface of each tooth.

Both techniques allow us to improve dental morphology and enhance the esthetics of a smile, using composite restorations with a minimally invasive approach. It ensures that any future dental interventions can remain minimally invasive in their scope. The positive response of periodontal tissues confirm a perfect integration of the restorations.

Morphological corrections with direct and semi-direct techniques allow us to realize an intervention that would further improve esthetics while minimizing the biologic cost.

Key Words: diastema, composite, esthetics, direct and semi-direct restorations

> "Since the prevalence of diastemata involves young patients, an invasive approach should be avoided."

Introduction

The esthetic resolution of anterior single or multiple diastemas is a complex procedure. A maxillary diastema can be defined as a gap or space between two or more teeth. A diastema can compromise dental harmony, resulting in a displeasing smile. This is a common esthetic problem in mixed and early permanent dentitions at the time of eruption of the maxillary incisors.

Diastemata exist for various reasons, including disproportion between the tooth size and the maxillary or mandibular arch width, tooth angulation, and tooth rotation. The space can occur either as a transient malocclusion or can be created by developmental, pathologic, or iatrogenic factors. Some causes of incisor diastema are congenital microdontia, missing or peg-shaped lateral incisors, supernumerary teeth, pathologies, or habits.[1,2]

Different materials such as composite resin and ceramics are commonly used with indirect techniques (full-crown restorations, ceramic or composite veneers), yet recent major improvements in composite resin properties suggest a more conservative approach[3] of using direct or semi-direct techniques.[4] In addiction, since most diastemata affect young patients, an invasive approach should be avoided.

This procedure is commonly used in cases of a single diastema, but in anterior multiple diastemas it may become a time-consuming and demanding process, requiring great expertise to solve the associated esthetic problems. In particular, a correct tooth morphology should be created by closing the so-called black triangles in the interproximal areas, establishing appropriate tooth dimensions, and striking a balance among the anterior teeth in the opposing anterior arches to develop a pleasant appearance. Furthermore, the restorations should be well integrated with the surrounding periodontal tissues and should have the same features as the natural teeth (i.e., natural stratification with opaque and translucent shades, creation of surface micro and macro texture).

Diagnosis/Treatment Plan

Esthetic rehabilitation in complex diastema closure cases is guided by the principles of proportion. Achievement of this proper balance dictates treatment. The width-to-length ratio of the central incisors must be pleasing, determining the following:

- amount of distal proximal reduction
- number of teeth to be treated
- decision to completely veneer the incisors or only augment the interproximal areas
- placement and location of naturally occurring prominences and concavities to create the illusion of a narrower tooth.

The proper consideration of these four topics permits the maintenance or restoration of acceptable dimensions and shape of the central incisors.[5,6] If they are made to appear harmonious, then the principle of "golden proportion" (1.6:1:0.6) can be achieved among the central and lateral incisors and canines. The parameters for restorative approaches must respect the dental structure and morphology to gain maximum esthetic results.[2]

Direct Technique

Clinical Case

A mock-up was done prior to treatment so that the patient, a 16-year-old male, would understand and accept the treatment plan and allow the clinician to forecast the esthetic result. This was done to obtain esthetically harmonious reconstructions, maintaining minimally invasive dentistry.

There was almost no need for tooth preparation, enabling the clinician to preserve the original tooth structure using a noninvasive technique. Direct bonding in diastema closure cases allows complete clinical control in smile creation, even with multiple dental treatments. This modality is challenging but ultimately rewarding for both patient and the dentist. It enables the restoration of shape, color, surface texture, and function as a realistic alternative to more invasive procedures that are not indicated in young patients or for morphologic corrections **(Figs 1a-1c)**.

The first step, after a preliminary silicone full-mouth impression, is to model a diagnostic wax-up on extra-hard stone casts. It is crucial to have an efficient and stable guide for the layering of each material; for this purpose, a laboratory-made rigid silicone template, obtained from the diagnostic wax-ups, should be used to create the perfect shape of the definitive restorations **(Fig 2)**.

After the isolation (with a rubber dam) and cleaning of unprepared teeth, the phases of etching with orthophosphoric acid (36% for 30 seconds) and adhesive application (two-step etch-and-rinse dentin bonding agent) on enamel surface were conventionally carried out, followed by light-curing (at an intensity of 800 mW/cm2 for 120 seconds).[7,8] A transparent matrix, which is a useful aid when creating interproximal anatomy with a wooden wedge, made the composite layer highly adaptable to palatal dental morphologies by interposing a thin flowable layer **(Figs 3a & 3b)**.

Figure 1a: Frontal preoperative view of the anterior teeth.

Figure 1b: Right lateral preoperative view of the anterior teeth.

Figure 1c: Left lateral preoperative view of the anterior teeth.

Figure 2: Frontal view of the diagnostic wax-up.

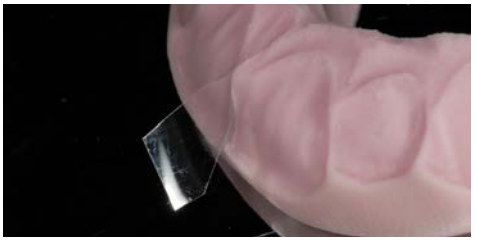

Figure 3a: Lateral view of the silicone template with a transparent matrix.

Figure 3b: Frontal view of the silicone template adapted to the teeth.

Figure 4a: Frontal view of the restored teeth.

Figure 4b: Right lateral view of the restored teeth.

Figure 4c: Left lateral view of the restored teeth.

Once the interproximal layer was well defined, it was possible to focus on building up the internal body with the combined application of chromatic materials, such as low-saturation dentin (A2) and enamel (A1) composites, followed by light-curing (at an intensity of 800 mW/cm2 for 120 seconds).

Color selection should be done on clean teeth and with the natural humidity of the oral cavity. This is necessary because water plays a fundamental role in the final color outcome; in fact, enamel dehydration reduces its translucency by 82%. Reproduction of enamel should be done with a resin that presents transparent characteristics.

Dentin reproduction should be done with a resin that presents opaque characteristics. In natural teeth, there is a progressive decrease in chrome from the cervical to the incisal area, as well as from the most internal toward the surface of the tooth. When reproducing the artificial dentin localized in the inner part of the restoration and directed to the cervical third, the chrome should be increased.

Enamel composite masses can be managed even in a single step, depending upon the required thickness, thus optimizing both operative time and the definitive morphology **(Figs 4a-4c)**.

Semi-Direct Technique

Clinical Cases

In the case of anterior multiple diastemas, a semi-direct technique may improve the precision and the quality of the restoration. This technique provides micro incremental layering, while the first composite layer is modeled and cured outside the mouth. This compensates for the shrinkage of material, improves its strength and wear resistance, and facilitates modeling the composite easily in the proper shape. It was then bonded to the tooth of a 15-year-old female patient **(Figs 5a-5c)**.

With this type of rehabilitation, a key aspect is to evaluate the space dedicated for each material; haphazard application is a waste of chair time when performing multiple restorations. For this purpose, a diagnostic wax-up on extra-hard stone casts was modeled and composite layers were adapted with cyanoacrylate glue on the rigid silicone template **(Figs 6a & 6b)**.

Figure 5a: Frontal preoperative view of the anterior teeth.

Figure 5b: Right lateral preoperative view of the anterior teeth.

Figure 5c: Left lateral preoperative view of the anterior teeth.

Figure 6a: Frontal view of the diagnostic wax-up.

Figure 6b: Composite layers adapted with cyanoacrylate glue on the rigid silicone template.

Figure 7a: Silicone template cut for individual teeth.

Figure 7b: Silicone template cut for individual teeth.

Slightly excessive or insufficient application can result in esthetic failure and the need to repeat the restorations. This innovative procedure saves time and creates the correct morphology and tooth dimension as well as a symmetric appearance in the opposing anterior arches. The silicone template was cut along interproximal areas to allow the operator to restore teeth one by one **(Figs 7a & 7b)**.

The clinical procedures provide the same isolation, etching, and adhesive application techniques described above.[8] Then, through the silicone template and wood wedge application, the composite layers were adapted on the palatal surface of each tooth and light-cured (at an intensity of 800 mW/cm2 for 120 seconds) **(Figs 8 & 9)**.

After performing this procedure, when the operator was sure of the interproximal accuracy, the clinician made the buildup of restorations, applying composite increments progressively **(Figs 10a-10c)**.

Figures 11a and 11b show another clinical case (of a 15-year-old male) treated with a semi-direct technique. The palatal layers of composite were applied, through the silicone template, on one tooth at a time **(Figs 12a & 12b)**.

After polymerizing this composite shell, chromatic masses were modeled to build up the internal body **(Figs 13a-13d)**.

> "The restorations should be well integrated with the surrounding periodontal tissues and should have the same features as the natural teeth."

Conclusion

Morphological corrections with direct and semi-direct techniques allow us to realize an intervention that can further improve esthetics with minimally invasive dentistry. Composite restorations would provide the optimal therapeutic result in terms of function and esthetics.

Securing longevity and durability of the chosen restorative approach, while simultaneously minimizing biologic cost to the hard dental tissues, remains a major focus in adhesively driven dentistry. Adopting such a conservative restorative approach ensures that any future dental interventions, if required, can remain minimally invasive in scope.

In fact, both techniques allow us to improve dental morphology and enhance the esthetics of a smile, using composite restorations with a minimally invasive approach. The material may actually be bonded directly on the tooth with no preparation (prepless approach). Bonding procedures are well known and reliable, especially when the composite is bonded to enamel. In addition, the semi-direct technique allows us to obtain a high-precision interproximal contact, ensuring a correct tooth morphology and an excellent polymerization of the composite layers made in the laboratory.[9,10] It also reduces the chairtime of each tooth's restoration, resulting in an overall saving of time.

For these reasons, composite resin can be considered the first choice for clinical situations that usually require complex and demanding procedures.

The positive response of periodontal tissues elicits a perfect integration with the restorations, suggesting that this technique should be considered whenever possible.

Figures 8 & 9: Composite layers adapted to the tooth surfaces.

Figure 10a: Frontal view of the restored teeth.

Figure 10b: Right lateral view of the restored teeth.

Figure 10c: Left lateral view of the restored teeth.

Figure 11a: Frontal preoperative view of the smile.

Figure 11b: Frontal preoperative view of the anterior teeth.

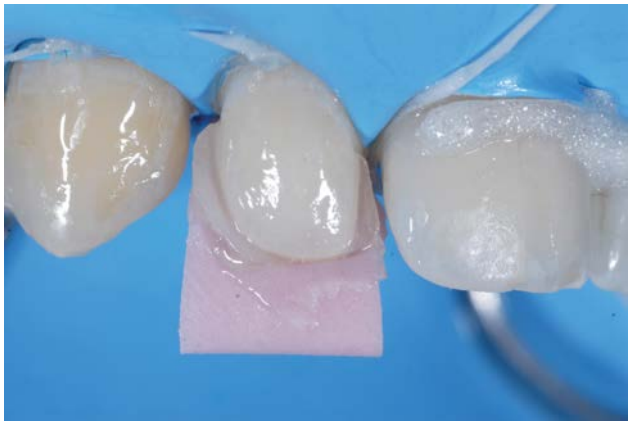

Figure 12a: Silicone template adapted to a single tooth.

Figure 12b: Composite layers adapted to the tooth surfaces.

Figures 13a & 13b: Frontal views of the restored teeth.

Figure 13c: Right lateral view of the restored teeth.

Figure 13d: Left lateral view of the restored teeth.

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> "Adopting such a conservative restorative approach ensures that any future dental interventions, if required, can remain minimally invasive in scope."

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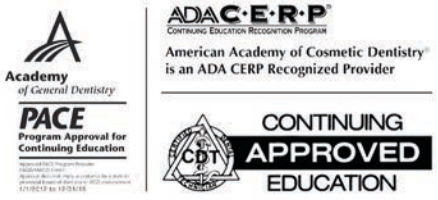

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(CE) Exercise No. jCD13

Anterior Composite Restorations (Operative Dent) AGD: Subject Code: 254

The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article, *"Advantages of Composite: Direct and New Semi-Direct Techniques,"* by Antonio Cerutti, MD, DDS, PhD; Andrea Zubani, DMD; Erica Nembrini, DMD; Prof. Massimo Amato, MD, DDS; and Prof. Dino Re, MD, DDS. This article appears on pages 128-137.

The examination is free of charge and available to AACD members only. AACD members must log onto www.aacd.com to take the exam. **Note: Only Questions 1 through 5 appear in the printed and digital versions of the *jCD*; they are for readers' information only.** The complete, official self-instruction exam is available online only—completed exams submitted any other way will not be accepted or processed. A current web browser is necessary to complete the exam; no special software is needed. The AACD is a recognized credit provider for the Academy of General Dentistry, American Dental Association, and National Association of Dental Laboratories. For any questions regarding this self-instruction exam, call the AACD at 800.543.9220 or 608.222.8583.

1. A maxillary diastema

a. is a common esthetic problem in mixed and developed dentitions.
b. can occur as a transient malocclusion.
c. cannot be created by developmental pathologic or iatrogenic factors.
d. is rarely associated with cases of congenital microdontia.

2. When treating anterior diastemas, this article advocates

a. a moderately invasive approach using porcelain restorations.
b. indirect techniques using laboratory-fabricated composite veneers.
c. conservative indirect or semi-direct techniques.
d. closing spaces using orthodontics.

3. Correct tooth morphology should be created

a. even if this leaves small black triangles at the gingival crest.
b. to close spaces using appropriate tooth dimensions.
c. without regard to balance among the anterior sextant.
d. within the maxillary arch, without consideration of the lower arch.

4. Restorations for closing diastemas

a. should be well integrated with the surrounding soft tissue.
b. can only have the same features as natural teeth when fabricated indirectly in a laboratory.
c. attempt to disregard arch size and tooth size discrepancies.
d. take into consideration the biologic cost when using porcelain veneers.

5. The esthetic rehabilitation of multiple diastema closure cases can be

a. guided by the principle of balance.
b. best restored by the bonding of laboratory-fabricated restorations.
c. best treated orthdontically without regard to height-to-width ratios.
d. easily restored without the use of a diagnostic wax-up.

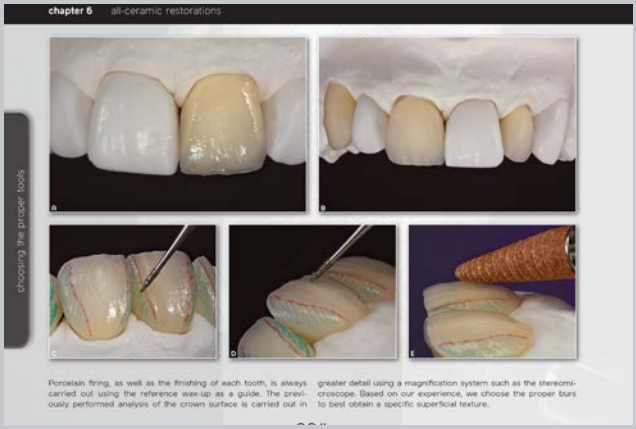
To see and take the complete exam, log onto www.aacd.com.

jCD Book Review

> **"At 416 pages, including nearly 1,500 illustrations, it is a very substantial work, formatted in 'landscape' view."**

The *Journal of Cosmetic Dentistry's* Book Review is an opinion piece by *jCD* reviewers. It highlights works that are currently available from publishers in the dental industry.

Title: *Atlas of Dental Rehabilitation Techniques*
Authors: Romeo Pascetta & Davide Dainese
Publisher: Quintessence Publishing



Atlas of Dental Rehabilitation Techniques is a highly visual presentation of fixed restorations that encompasses choices for single teeth, metal bridges, implants, and full-mouth reconstructions, to modern CAD-supported and full-ceramic milled crowns. Written by two dental ceramists, it is intended for use as a reference work of treatment choices for the restorative team. The publication is image-focused, with text playing a lesser role. At 416 pages, including nearly 1,500 illustrations, it is a very substantial work, formatted in "landscape" view. The authors' intent for the layout is to present an array of restorative techniques in a lecture-style format.

The beautiful photography speaks for itself in large images on every page. There is helpful documentation of metal techniques including full gold, cast-bridge, and Captek, which capture steps for sound design, along with "pearls" for successful construction. There is much valuable information in the technique photography and captions. The authors cover a wide variety of fixed procedures with appreciable detail and accuracy throughout.

More attention given to ceramic materials would have been helpful, as would have additional "how to" details in the captions. A significant number of pages are dedicated to metallic restorations, the use of which has diminished in many practices. While the photography and text provide useful technical instruction, information that seems critical—especially if the reader wishes to duplicate the results as depicted—sometimes is not included (e.g., specific products and material names are not mentioned). Also, a more robust binding would have been helpful, as the pages are a thick stock and present the material beautifully. Upon a second review of this book, readers will have the immense satisfaction of discovering even more informational "gems."

A Special Gift to *jCD* Readers:

Take advantage of a special offer from Quintessence Publishing! As an AACD member, you can receive a preview download of *Atlas of Dental Rehabilitation Techniques* and 25% off the regular price. Simply enter promo code JCD2013 at checkout. To take advantage of this discount, visit: http://www.quintpub.com/jcd/

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Clinical Considerations for Cementing Indirect Restorations

Cement Product Evaluations

Sabiha S. Bunek, DDS

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

Introduction

The practice of fixed prosthodontics has changed significantly with the rapid development of esthetic restorative materials and the adhesive systems that allow these materials to bond to tooth structure. There are a number of new resin cements on the market, some of which combine convenience and simplify procedures, and some that have entirely new chemistry. However, we have yet to see a true universal cement for all indications. The goal of this article is to provide a brief understanding of the classifications and properties of permanent cements to enhance the dentist's ability to select the best cement for each situation, taking into account strength, esthetics, and longevity.

Permanent Cement Options

Luting Cements

Luting cements (zinc phosphate, polycarboxylate, conventional glass ionomer, and resin-modified glass ionomer) were developed primarily for the cementation of metal and metal-ceramic restorations.[1] Resin-modified glass ionomers (RMGI) are most commonly used in this category because they offer slightly better strength and adhesion, easy cleanup, and lower solubility.[2] While RMGIs offer better properties than other luting cements, they are not intended for use with low-strength ceramic materials.

Resin Cements

With the advent of all-ceramic restorations, resin cements have gained popularity mainly because they address the shortcomings of luting cements. They exhibit high bond strength to tooth structure, esthetics, and the lowest solubility of the available cements.[3] Currently, resin cements can be classified into three categories. **Figure 1** highlights the differences among each class of resin cement.[4]

Selecting the Best Cement

There are many types of cement to choose from and often there is more than one viable option. An easy place to start in the decision-making process is by looking at the strength of the ceramic, as well as taking into account the retentiveness of the preparation.

Generally, when esthetics is of high concern, low- to medium-strength ceramics (feldspathic, leucite-reinforced, lithium disilicate) are selected. A benefit of using a high-strength cement (adhesive resin or esthetic resin) is that it will add strength to the restoration.[5] When cementing a veneer; esthetic resin cements provide a variety of shades, translucencies, and try-in pastes. Light-cured resin cements are less likely to change color when cured and are recommended for veneers.

Guidelines for cement selection based upon the strength of the ceramic and the retentiveness of preparation are highlighted in **Figure 2**.

> We have yet to see a true universal cement for all indications.

Self-Adhesive Resin Cements
(no separate etching or primer of teeth)

- self-etching—no phosphoric acid or special primer needed
- easy one step
- easy cleanup
- dual-cured
- fluoride-releasing
- usually available in universal, translucent, and opaque shades.
- (RelyX Unicem II [3M ESPE; St. Paul, MN], Maxcem Elite [Kerr; Orange, CA], Panavia SA [Kuraray Dental; New York])

Adhesive Resin Cements
(bonding based on self-etching primers)

- bonding agent required for adhesion to enamel and dentin; may not require separate primer for adhesion to metallic or ceramic restorations
- dual-cured
- usually available in universal, translucent, and opaque shades
- higher strength than self-adhesive resin cements
- (adhesive resin (NX3 XTR [Kerr], Multilink Automix [Ivoclar Vivadent; Amherst, NY], RelyX Ultimate, Duo-Link; Schaumburg, IL])

Esthetic Resin Cements
(bonding based on total-etch adhesives)

- etch and bonding agent required for adhesion to enamel and dentin; separate primers are required for adhesion to ceramic restorations
- mostly light-cured
- available in esthetic shades
- higher strength than self-adhesive resin cements
- (esthetic resin (RelyX Veneer, Variolink II [Ivoclar Vivadent], Variolink Veneer, Mojo Veneer [Pentron Clinical; Wallingford, CT], Calibra [Dentsply; York, PA])

Figure 1: Characteristics of resin cements.

Ceramic Strength	Preparation	Resin-Modified Glass Ionomer	Self-Adhesive Resin	Adhesive Resin	Esthetic Resin
LOW (feldspathic, leucite-reinforced)	*Retentive*			✔	✔
	Non-retentive			✔	✔
MEDIUM (lithium disilicate)	*Retentive*		✔	✔	✔
	Non-retentive			✔	✔
HIGH (zirconia)	*Retentive*	✔	✔		
	Non-retentive			✔	✔

Figure 2: Guidelines for cement selection based upon strength of ceramic and retentiveness of preparation.

Table 1: Comparison of Flexural Strengths of Ceramics.

Feldspathic	Leucite-Reinforced	Lithium Disilicate	Zirconia
low	low	medium	high

Table 2: Comparison of Bond Strengths of Cements to Tooth Structure.

RMGI	Self-Adhesive Resin	Adhesive Resin	Esthetic Resin
low	low-medium	medium-high	high

When using a high-strength ceramic, such as zirconia, with a retentive preparation, low-strength cement such as a self-adhesive resin cement or RMGI can be used because it is not necessary to rely on the cement for additional strength.[6] **Table 1** compares the strength of all-ceramic restorations and **Table 2** compares the bond strengths of different classes of cements.

The following product reviews reflect findings of *THE DENTAL ADVISOR*.

Product Reviews

GC FujiCEM 2 +++++ (GC America)
GC FujiCEM 2 is a resin-modified glass ionomer luting cement. Compared to original GC FujiCEM, it has increased bond strength to tooth structure and restorative materials. GC FujiCEM 2 is indicated for permanent cementation of all types of metal-, resin-, alumina-, and zirconia-based inlays, onlays, crowns, bridges, and endodontic posts. Working time is two minutes and 15 seconds, and intraoral setting time is four minutes and 30 seconds. It is available in a light yellow shade and comes packaged with one 13.3g GC Paste Pak cartridge, 20 mixing tips, and one GC FujiCEM 2 dispenser. GC FujiCEM 2 was evaluated by 33 consultants over a two-month period. This product received a 96% clinical rating.

Panavia SA Cement +++++ (Kuraray Dental)
Panavia SA Cement is a self-etching, self-adhesive, dual-cured resin cement with fluoride release. It is based on the Panavia and Clearfil SE Bond adhesive technology and is indicated for cementation of crowns and bridges made of metal or ceramic as well as inlays/onlays and metal and fiber posts. It is packaged in 4.6 mL syringes in Universal (A2) and White shades. Most consultants found that the snap-set took longer light-curing (8-10 seconds) than the time recommended by the manufacturer (2-3 seconds). After the initial cure, the excess cement easily peels off, mostly in one piece. Thirty consultants used Panavia SA Cement for luting more than 570 clinical restorations made of various materials. This product received a 96% clinical rating.

RelyX Ultimate Adhesive Resin Cement +++++ (3M ESPE)
RelyX Ultimate is a versatile adhesive resin cement system compatible with all restorative materials. The kit contains everything the clinician needs to complete a cementation procedure. Having a system that uses one liquid to treat dentin, enamel, and all restorative materials greatly simplifies the clinical procedure. The viscosity of the cement was rated as "excellent," allowing complete seating of restorations

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without being too runny. The four cement shades were considered adequate for most cases. Excess cement can be removed during the gel phase of self-curing. Alternatively, tack curing for 1-2 seconds allows immediate removal of excess cement. Once fully hardened, removal of excess is difficult. RelyX Ultimate was evaluated by 36 consultants in 962 uses. It received a 96% clinical rating.

Variolink II +++++ (Ivoclar Vivadent)
Variolink II is a dual-cured, light-cured resin cement for luting indirect ceramic and composite restorations. It has excellent physical properties and is ideal for the cementation of esthetic restorations. The cement consists of separate syringes of base and catalyst pastes. The base paste is light-curable and can be used alone to lute thin or translucent restorations like veneers. The catalyst paste allows the cement to dual-cure under thick or opaque restorations. The Variolink II kit contains six syringes of base (in six shades) and four syringes of catalyst (in high/low viscosity, ExciTE F DSC, Liquid Strip, and Monobond Plus). Try-in pastes are available separately. Twenty consultants used Variolink II over a six-month period to lute more than 300 restorations. It received a 97% clinical rating.

Summary

A great deal of the emphasis in prosthodontics is placed on the comprehensive treatment plan for a patient, including occlusion, esthetics, and total function. Many times, consideration of the important properties materials need to have restorations in place is lacking. There are a number of new materials on the market, and each cement type has different physical and mechanical properties, making no one cement alone sufficient for every application. To achieve success, clinicians need to be aware of the characteristics of each type of cement and use them appropriately.

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