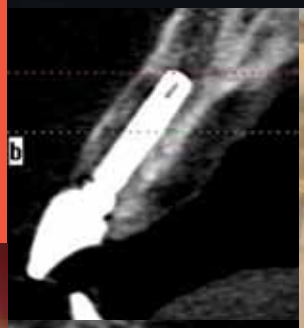
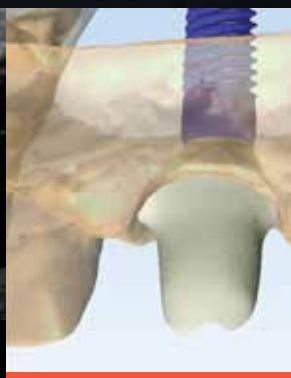
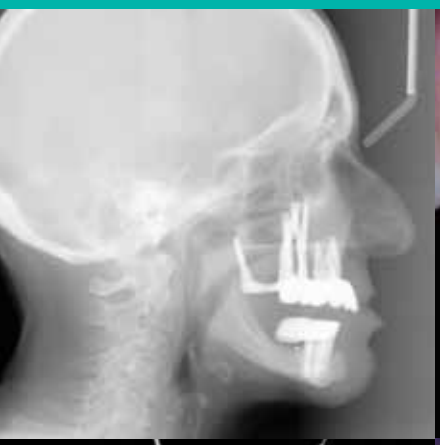
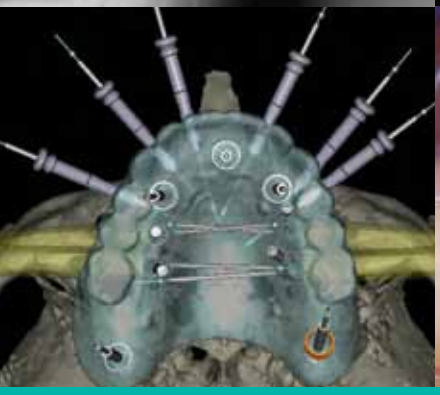
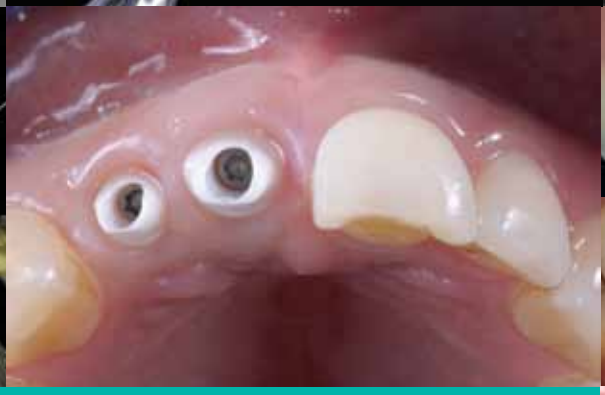
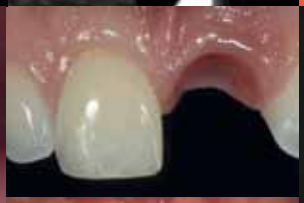
JCD
vol. 28 issue 2
Journal of Cosmetic Dentistry

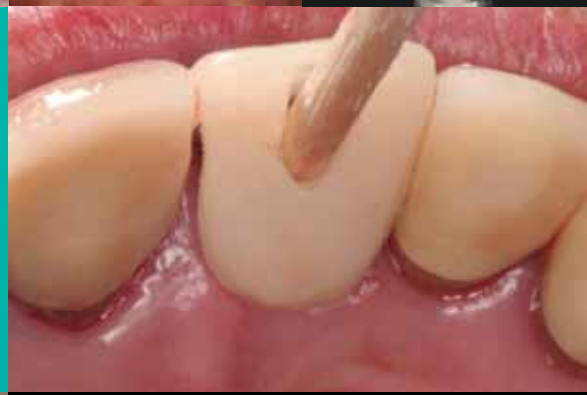


Implants: Past, Present, and Future
Dr. Gerald Niznick

Flapless and Flap Implant Surgery
Drs. Michael A. Pikos and Marius Steigmann

A "No Bone" Solution—3 Hours Free CE
Mr. Stephen F. Balshi and Dr. Thomas J. Balshi



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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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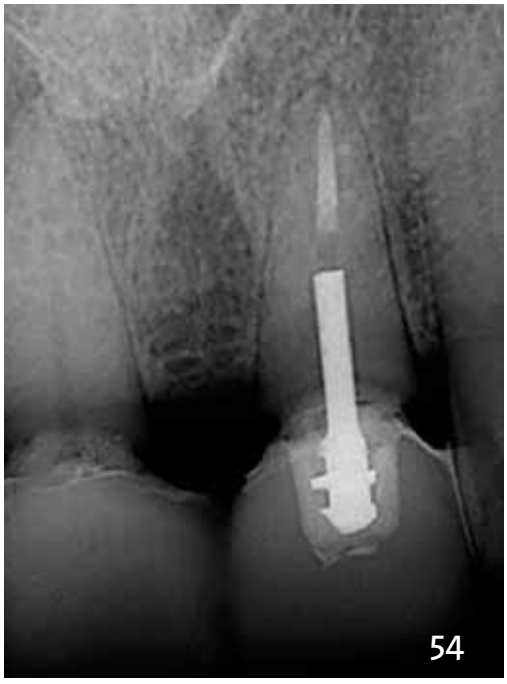
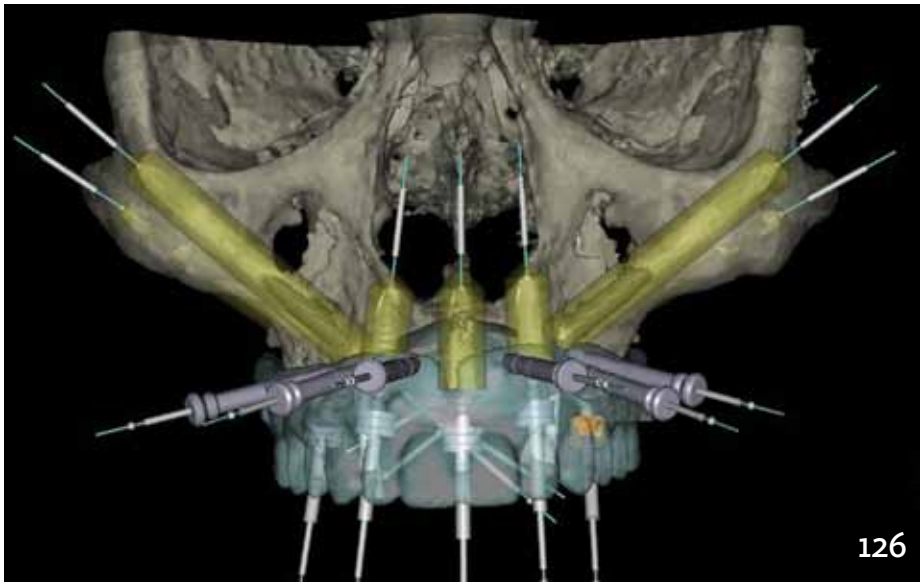
Features





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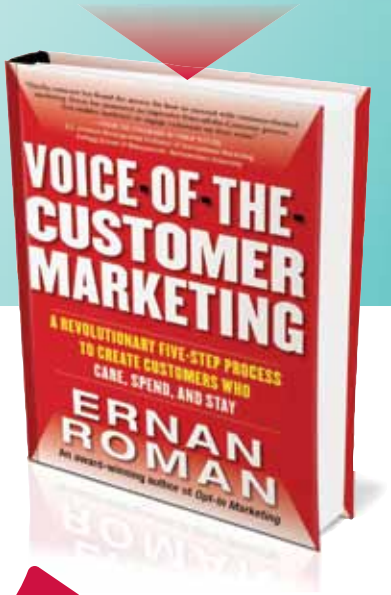

WINNERS! Congratulations to Dr. Frances DuCoin & Dr. Bruce Wilderman whose bids in this year's Give Back A Smile Silent Auction won them each a PNP campaign! We're very proud to support this great cause!

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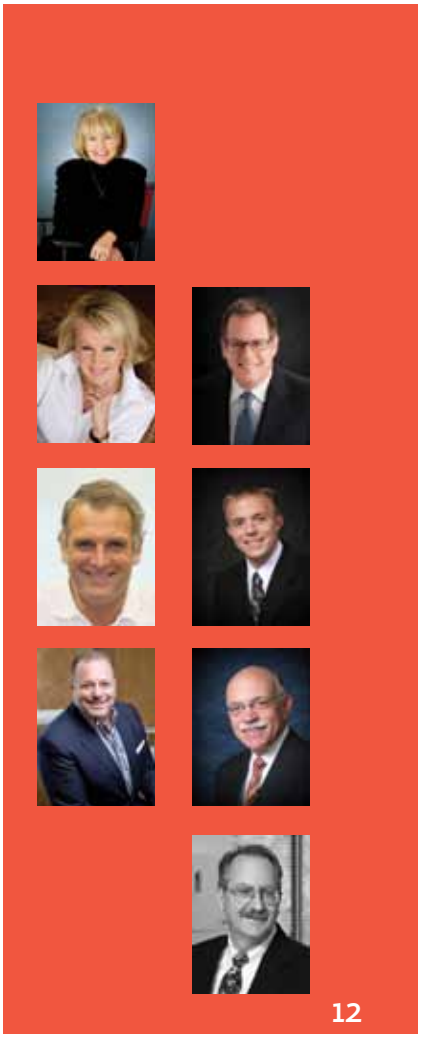

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Adding to Our "Bowl of Knowledge"

We must continually grow as dentists. One of the ways to enrich our knowledge base is to master another skill to add to our dental armamentarium.

At a recent lecture I gave, a couple of new dental school graduates asked how I had acquired my knowledge. They wanted to know what continuing education (CE) courses they needed to take and what subjects they should start with in order to attain my level of clinical skills and judgment. They believed that if they took all the CE courses that I have taken they would "magically" arrive at my level of expertise. If they do this, yes, they will have the same didactic information I possess. What differentiates us, however, is my 26 years of trials and errors (i.e., "mistakes"), clinical experience, and hands-on problem solving—the totality of which I call "enlightenment."

These factors are the same ones that differentiate me from my mentors and coaches, who have close to 50 years of dental experience.

I believe that we all graduate dental school with a small "bowl" and a few "pebbles" that represent the tip of the iceberg in the realm of clinical dentistry. The pebbles are the basic subjects that we have been taught in undergraduate training but have not mastered—such as diagnosis and treatment planning, direct restorations, basic crown and bridge, removable prosthetics, endodontics, oral surgery, periodontics, and orthodontics.

As we progress, we keep adding "pebbles" to our "bowl."

As we progress, we keep adding "pebbles" to our "bowl." For some of us, it may be the occlusion piece. For others it may be the cosmetic dentistry piece or the periodontal surgery piece. As we grow our bowl of knowledge with new pebbles, however, we must not forget the old ones. We must diligently revisit and polish them or they will settle like sand to the bottom of the bowl.

Prior to 2004, I was so preoccupied with sharing my knowledge with others through teaching and lecturing that I did not have much time to add new pebbles to my own bowl. Consequently, I did not grow...and it made me unhappy. I realized I had to enrich my own knowledge, and implant dentistry was one large pebble that I coveted.

Not surprisingly, most of today's CE for general practitioners involves dental implants. Not a day goes by when I do not get an e-mail or brochure from an educational institution enticing me to enroll in a program about implant placement and/or restoration, implant tissue esthetics, bone grafting, or sinus augmentation.

I hope that this issue of the *jCD* inspires you to add the implant dentistry "pebble" to your collection. I promise you that you will need to get a bigger bowl!

Cheers,

Edward Lowe

Edward Lowe, DMD, Editor
AACD Accredited Member

RESTORATIONS BY
LK DENTAL STUDIO
DENTISTRY BY
DR. SAM STRONG

16 year old female. Implant #7 after extraction of deciduous tooth, #10 eMax veneer. #7 replaced with a Nobel Replace 3.5mm diameter RP implant, zirconia abutment, eMax crown.

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Implant Prosthodontics: Past, Present, and Future

Up Front *provides a forum for influential leaders to share their opinions. In this issue , we welcome Dr. Gerald Niznick, whose primary research interest and expertise are in the development of dental implants. The views expressed in* Up Front *reflect the opinion of the author. They do not imply an opinion on the part of the* jCD *or the AACD.*

Gerald Niznick, DMD, MSD

Dr. Niznick graduated from the University of Manitoba Dental School in 1966 and earned a Master's degree in prosthodontics from Indiana University in 1968. He has been awarded 36 U.S. patents and has received honorary doctorates from the University of Manitoba and Tel Aviv University. Dr. Niznick can be reached at drniznick@implantdirect.com.

Disclosure: Dr. Niznick is founder and president of Implant Direct. He developed the Core-Vent system discussed in this editorial.

Research published in 1983 documenting the long-term success of titanium screw implants which, by a process called *osseointegration*, became firmly attached to bone, changed the course of implant dentistry.[1,2] The Brånemark external hex implants used in that study offered a single abutment option for a screw-retained attachment of a hybrid prosthesis for restoring edentulous jaws.

The Core-Vent hollow basket implant had been introduced in 1982.[3] Unlike Brånemark's 0.7-mm short external hex implant, the Core-Vent had an 8-mm deep internal hex for ratcheting insertion and to receive a variety of cemented abutments. This system was the first to document the use of freestanding implants to retain an overdenture, screw-retained bar overdentures, and single tooth replacements with bendable and castable abutments.[4]

In 1986, Core-Vent introduced the Screw-Vent implant, featuring an internal lead-in bevel, hex, and threaded connection.[5] This became the cornerstone of modern implant design and is today referred to as a "conical connection." This advance paved the way for greater use of cemented restorations, which resulted in acceptance by general practitioners of fixed prosthetics on implants, as the procedures more closely paralleled the restoration of natural teeth. The internal connection provided a greater tactile sense when seating an abutment, thus eliminating the need for x-rays to determine whether transfers and abutments were fully seated. It also allowed for smaller-diameter implants with adequate strength to be designed, thereby expanding clinical applications.

The key to proper training was to establish educational courses that focused on case selection and treatment planning.

Implant dentistry is a prosthetic discipline with a surgical component; thus, Core-Vent's system was designed for simplified surgical procedures, allowing general practitioners to learn implant placement. The key to proper training was to establish educational courses that focused on case selection and treatment planning.

In the three decades since the Core-Vent and Brånemark systems were introduced, the number and diversity of implant designs, surface treatments, and abutment options have proliferated. I believe this has been spurred primarily by implant companies, in an attempt to justify price increases. Unfortunately, this has compounded the confusion associated with selecting the implant system that best suits an individual dentist's practice and budget.

In the 30 years I have been involved with the implant industry, my most difficult task has been to overcome the stereotypical thinking that there is a direct relationship between an implant's cost and clinical success. Many implant companies use paid opinion leaders in private practice and academia, along with large sales forces, to perpetuate this myth. Today, however, the Internet has leveled the playing field, making it possible to educate more dentists about the benefits and features of "appropriately priced" products—some with cross-compatibility to the surgical protocols and prosthetic connections with which dentists are familiar. Offering application-specific implants with all-in-one packaging simplifies implant selection, eliminates confusion with ordering ancillary products, and provides unprecedented value, thus allowing more patients to benefit from implant dentistry. Additionally, online education—aided by live surgical videos, lectures, product comparisons, and, especially, online ordering—is changing the implant industry's dynamics.

Today, most patients know about the benefits of implant solutions for their missing teeth, resulting in more restorative dentists making the investment in education to be able to offer these services in their practices.

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Inspirational Advice

In pursuit of its mission, *jCD* remains dedicated to educating and enriching readers by providing quality content from well-respected clinicians. It is a forum in which colleagues and peers can share their clinical experience. This issue highlights talented implant specialists, imparting their knowledge on the subject of implant dentistry. The cover presents a collage of clinical images from the following authors, who also offer some inspiring words.

Paquette & Sheets

Q: *What is one of the most important things you have learned about implant dentistry that can help our readers?*

A: One of the most important things we have learned is the need for proper assessment of the pink element for the final restoration. If that element is not ideal, then a soft/hard tissue augmentation, or plans for a pink porcelain component to the final restoration, will be needed to create the ultimate esthetic outcome.

Van Dooren

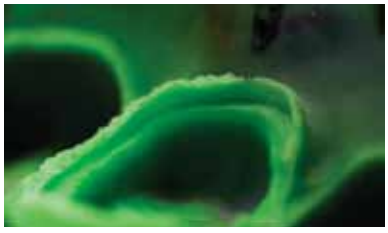
Q: *What is one of the most important things you have learned about implant dentistry that can help our readers?*

A. The most important thing I have learned during the last 30 years working with implants is that, as clinicians, we need to understand the surgical and restorative limitations in implant dentistry in order to minimize the failures.

Petrungaro

Q: *What is one of the most important things you have learned about implant dentistry that can help our readers?*

A: I have learned that implant dentistry—now, more than ever—is not a surgical discipline, nor a restorative or laboratory discipline. It is, rather, a special field blending all three disciplines together at the placement visit, and that this holds true especially when placing implants in the esthetic zone.



Vence

Q: *What are the main contributions or findings that have aided your success in understanding and using implant dentistry?*

A: Gerhardt Iglhaut, DDS, and Peter Whorle, DMD, helped me understand and appreciate the work of David Cochran, DDS, on biologic width around implants and its role in pink esthetics. Jack Ricci, PhD, developed the LaserLok channels to improve connective tissue healing by guiding fibroblast motility. Organized movement of cells creates more organized connective tissue structure around the implant similar to connective tissue around teeth, to deal with biologic width around implants and bone preservation.

Balshi & Balshi

Q: *What is one of the most important things you have learned about implant dentistry that can help our readers?*

A: The use of tilted implants in combination with computer-guided surgery offers expeditious fixed prosthodontic treatment with enhanced biomechanical value for the severely atrophic maxilla. Our "no bone" protocol eliminates morbid bone grafting and costly hospitalization, enabling rapid patient recovery in drastically reduced treatment time.

> "I have learned that implant dentistry—now, more than ever—is not a surgical discipline, nor a restorative or laboratory discipline."

Murphy

Q: *What is one of the most important things you have learned about implant dentistry that can help our readers?*

A: The actual placement of a dental implant is relatively easy; it is the diagnosis and the treatment planning of the case that takes thought and time. With the advent of cone beam computed tomography and digital fabrication of surgical guides, I find that I am investing far more effort in the pretreatment analysis of the implant patient. The benefits are greater accuracy and fewer intraoperative surprises.

Implants: Diagnosis, Planning, and Esthetic Success

An Interview with Drs. Cherilyn Sheets and Jacinthe Paquette

Cherilyn G. Sheets, DDS
Jacinthe M. Paquette, DDS

Cherilyn Sheets, DDS, and Jacinthe Paquette, DDS, will be speaking at the 29th Annual AACD Scientific Session in Seattle, Washington, on April 26, 2013. Their topic will be "Overall Concepts of Interdisciplinary Dentistry." In this interview, the doctors answer questions from the *jCD* Editorial Review Board.

Figure 1: Dr. Jean Wu, partner of Drs. Sheets and Paquette, seated at the clinical microscope showing a relaxed posture, good arm support, and excellent visibility.

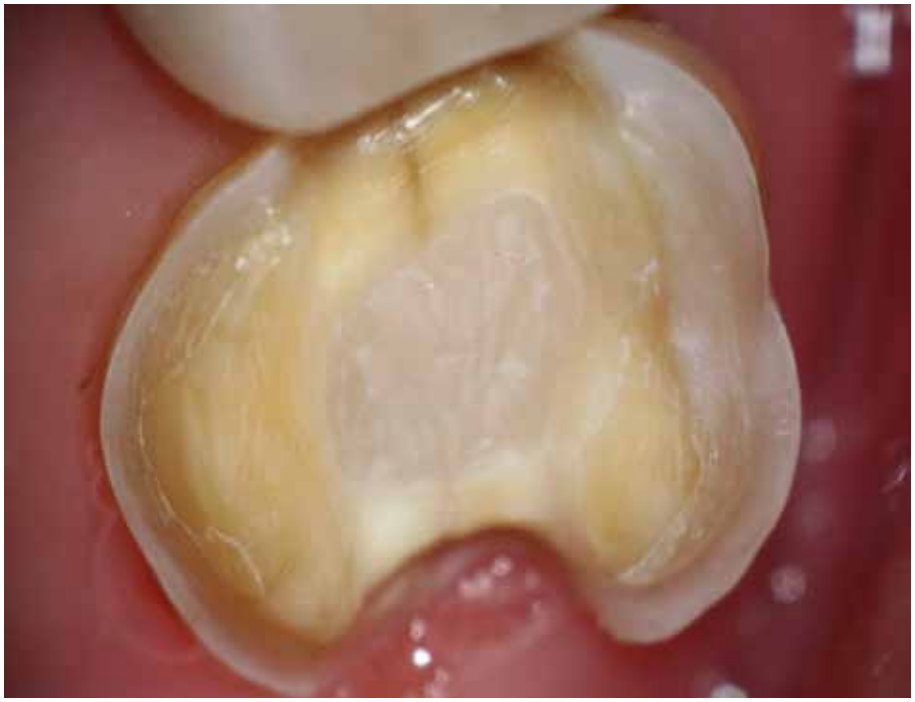


Figure 2: Preparation as viewed at 10x through the clinical microscope. Note the mesial-to-distal fracture that necessitated the endodontic therapy.

Q. Do you think using a microscope clinically provides patients with longer-lasting restorations, and why?

A: Absolutely! We have personally experienced the benefits of enhanced vision through increased lighting and magnification in our own work. We have incorporated the use of the clinical microscope within all aspects of clinical care. This technological aid assists us in the following ways: it makes it easier to achieve more precise restorations or preparations; evaluate impressions for defects; assess the quality of marginal adaptation of new and older restorations; and more effectively diagnose early defects such as decay, crack lines, fractures, open margins, and mobility. All of these benefits translate into better-fitting and therefore longer-lasting restorations. This is not only our opinion. We have taught more than 2,000 dentists in hands-on courses and have seen them raise their own "bars of excellence" with the use of the clinical microscope. Overwhelmingly, they confirmed that the microscope helped them provide restorations that would have the potential for greater longevity due to the increased precision they were able to achieve **(Figs 1-3)**.

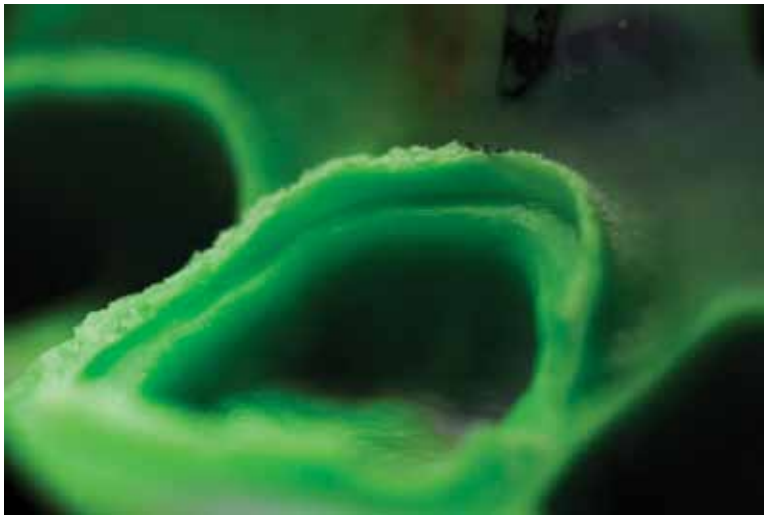


Figure 3: Magnified view of a final impression at 21x to evaluate for the complete capture of the margin and tooth emergence profile.

We have taught more than 2,000 dentists in hands-on courses and have seen them raise their own "bars of excellence" with the use of the clinical microscope.

Figure 4: Zirconia milled abutments provide good optical advantages over cast gold or titanium. Care must be taken to ensure that proper wall thickness is available, or metal must be used.

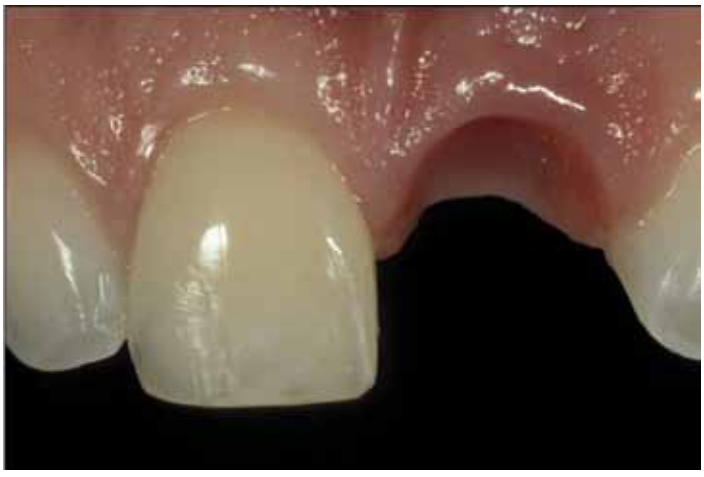


Figure 5: After tissue preservation treatment of extracted left central incisor. Ready for implant restoration.

Q: What do you think the long-term success is for zirconia abutments under function in the anterior?

A: Zirconia abutments in the anterior regions of the mouth have been highly successful in our practice and certainly have been the material of choice when dealing with thin labial tissues. We have been placing them for over a decade with good success. However, it is critical to recognize the structural vulnerabilities if minimum recommended thicknesses of the walls are created between the screw access hole and the external walls of the preparation. If manufacturer guidelines are not followed, and the patient has heavy occlusal and/or parafunctional habit patterns, the risk of fracture is high. If the biomechanics of the abutment dimensions dictate thinner walls, a titanium, gold-plated titanium, or gold abutment should be considered **(Fig 4)**.

Q: There are many different implant systems currently available today for clinicians to use. Is there a particular implant and restorative system you prefer to use in the anterior esthetic zone and if so, why?

A: We have the opportunity to work with many different implant systems in our office. Some are "inherited" with a new patient, and most are treatment planned specifically for the patient to maximize the ultimate result. As a general rule, we prefer a bone-level implant with a conical seal design to eliminate the micro-gap and best preserve the surrounding bone. Our preferred restorative choice is with a custom-milled abutment. This provides us the greatest ability to idealize esthetics, idealize the implant orientation with the presenting bone topography, and provide healthy supported soft tissues. Additionally, the bone-level placement creates the opportunity to transition the shape of the implant fixture into the shape of the emergence profile of the missing tooth. The custom-milled abutment provides a soft tissue scaffold for the gingival tissues and establishes a controlled margin design that follows the undulations of the peri-implant tissues for the resulting restoration. This level of marginal placement allows for easy confirmation of marginal closure and cement removal, both critical for long-term health, biocompatibility, and esthetic longevity. Lastly, the cemented abutment crown eliminates the screw access opening, thereby providing greater optimization of occlusal form and functionality **(Figs 5 & 6)**.

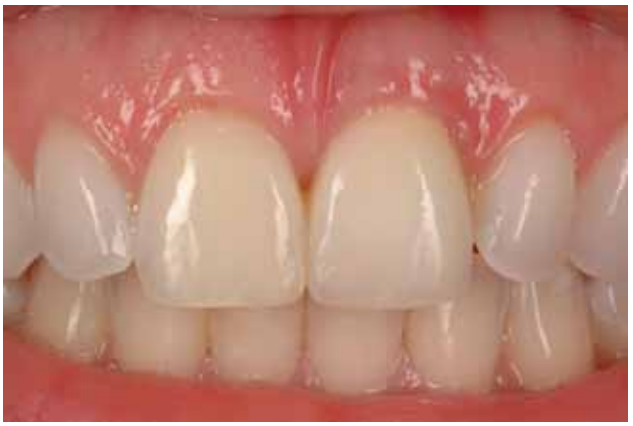


Figure 6: Retracted view of the patient in Figure 5 with final custom-designed implant abutment and PFG crown.

Q: Please describe in detail what diagnostic methods you use in determining the correct size of implant to place in a given restorative situation. Is there a particular implant software program you incorporate in your analysis of radiographic findings that helps to more accurately determine implant size and placement position?

A: Thorough diagnosis and treatment planning is key to creating successful implant treatment outcomes. We prefer to utilize the benefits of three-dimensional CT scans to effectively evaluate the future implant site. The Facilitate Implant Planner Software Program (Dentsply International; York, PA) provides us with the ability to strategically assess the best location and orientation for the future implant, the potential need for additional augmentative procedures that might be necessary prior to or during the implant surgical placement, and the length and diameter of the implant. We can utilize this software for diagnosis only or translate the computer-assisted design/computer-aided manufacturing (CAD/CAM) planning to precise surgical guides from the Materialise System (Dentsply International) for CAD/CAM generated surgical guides in the more complex cases.

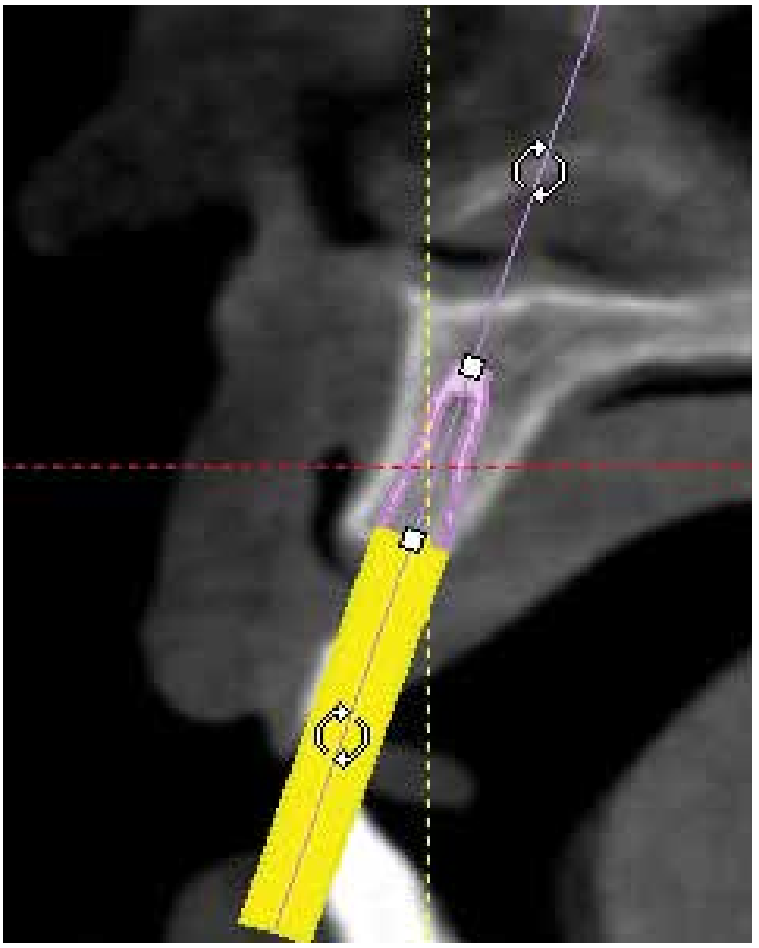


Figure 7: 3D CT scans help to place dental implants in the most ideal position for the patient's anatomical and restorative needs.

If manufacturer guidelines are not followed, and the patient has heavy occlusal and/or parafunctional habit patterns, the risk of fracture is high.

Q: What type of implant stent do you use to help determine the correct position for the placement of the implant(s) and why?

A: Our preference is to take advantage of a surgical guide whenever possible—the more precise the surgical placement, the more controlled and predictable the outcome. We utilize predominantly three forms of surgical guides. In situations where the implant position may be easily recognized through its orientation with adjacent teeth, a vaccu-form simple guide is sufficient for initial orientation. When more restrictive guidance is necessary, a laboratory-processed hard acrylic guide is employed for the initial placement. And lastly, as mentioned above, the CAD/CAM coordinated guides, which direct the entire drilling process to final placement of the implant, are utilized for the more complex cases.

Q: With the extensive backgrounds you both have in esthetic dentistry, prosthodontics, and implant dentistry, what do you see as the greatest challenge for dentists restoring implants in the esthetic zone?

A: Esthetic success with dental implants requires a more sophisticated approach to care, which includes a thorough diagnosis, well-coordinated treatment planning and sequencing, and sound knowledge in the surgical elements to esthetic implant treatment. Unlike the esthetic challenges of strictly restorative esthetic treatment, the biological aspect of implant dentistry is one that requires the clinician to understand the challenges at hand, the potential pitfalls if healing does not go as planned, and an ability to communicate and manage the esthetic expectations of the patient.

Replicating nature with implants in the esthetic zone can be a challenging goal. The greatest challenge for dentists restoring implants is coordination with co-specialists who are able to visualize the desired ideal result prior to starting any procedures and to implement the appropriate restorative/biological plan to help the patient achieve those results **(Figs 7-9). jCD**

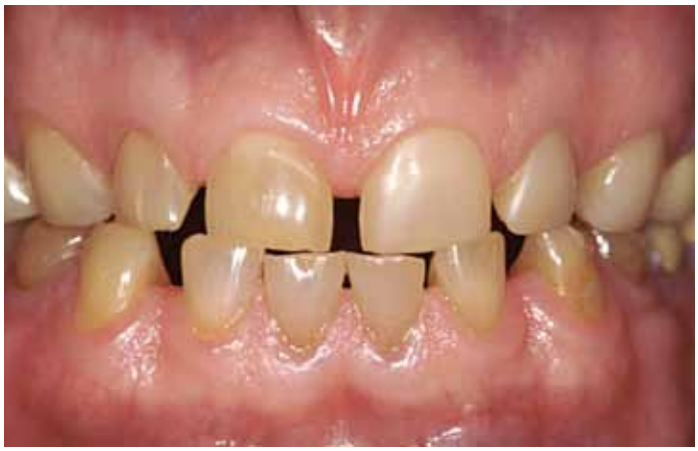


Figure 8: Pretreatment image of male patient who desired a more attractive appearance. Tooth size discrepancy, severe wear, dark color, and loss of occlusal vertical dimension dictated a comprehensive treatment approach.

Figure 9: Retracted view of the same patient in protrusive. Occlusal balance and optimal function have been established.

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The Laboratory Technician's Role in Interdisciplinary Care

Tooth Replacement in the Esthetic Zone

Todd L. Cochran, AAACD

> "Utilizing an interdisciplinary approach, a consultation with the oral surgeon deemed the prognosis of the luxated primary tooth to be hopeless."

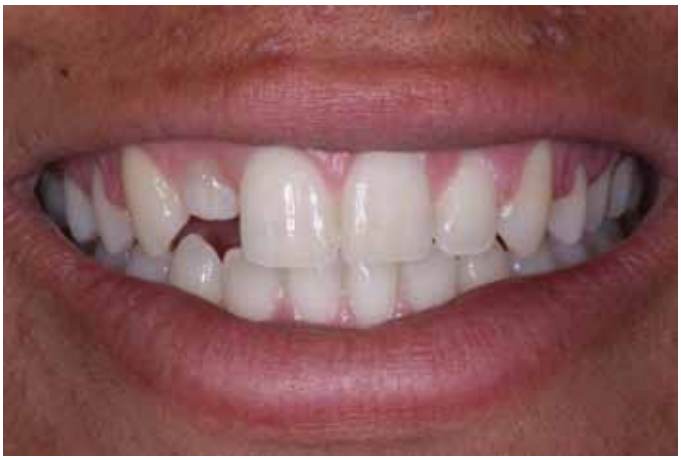

Figure 1: Preoperative frontal image prior to extraction of tooth D.

Introduction

As implant dentistry becomes more prevalent, we are faced with multiple clinical options. When creating a plan for tooth replacement in the esthetic zone, our primary challenge is the management of the soft tissue architecture while replacing the missing tooth structure so that it blends invisibly into the surrounding dentition. In the case discussed here, it was determined that an implant would be the best long-term clinical solution. Collaboration between the oral surgeon, restorative dentist, and laboratory technician (the author) was essential to a successful outcome.

History and Clinical Examination

The patient, a 17-year-old male, had a (congenitally) missing tooth #7 with primary tooth D present. Tooth D had very short root structure and a deficient width-to-length ratio **(Fig 1)**. The primary tooth had been luxated in a sports-related injury, which resulted in pathologic hyper-mobility. The patient's self-confidence was affected by his appearance.

Treatment Plan

Utilizing an interdisciplinary approach, a consultation with the oral surgeon deemed the prognosis of the luxated primary tooth to be hopeless. The recommendation was the removal of the primary tooth and the immediate placement of an implant **(Figs 2-4)**.

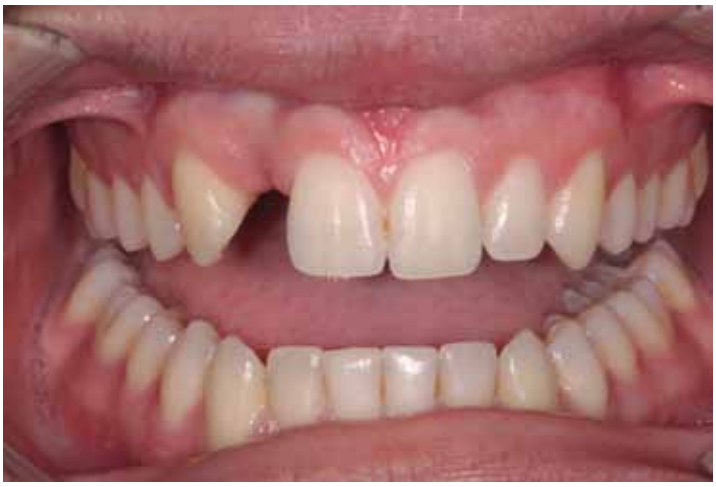

Figure 2: Preoperative frontal image, 1:2 view.

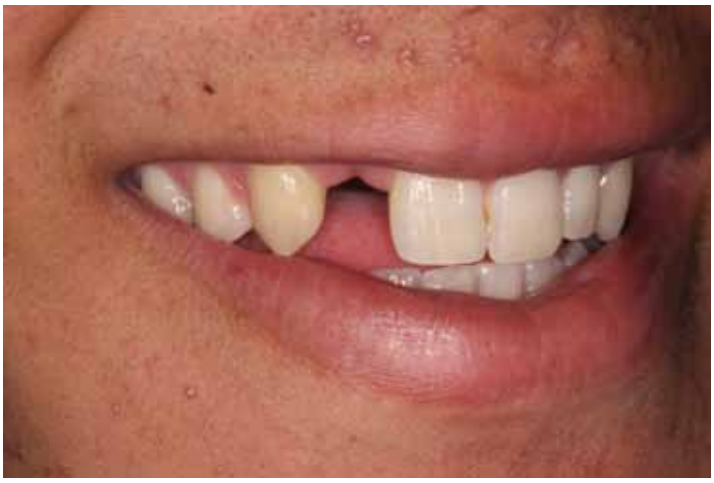

Figure 3: Preoperative right lateral image, 1:2 view.

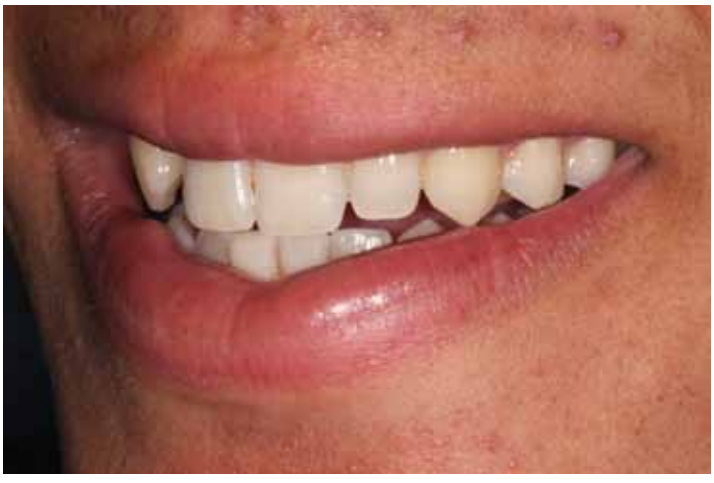

Figure 4: Preoperative left lateral image, 1:2 view.

Implant Placement and Provisionalization

Primary tooth D was extracted and an immediate implant (bone level 3.3 NC SLActive 12 mm, Straumann; Andover, MA) was placed.[1] The patient was provided with an Essix retainer with a composite replacement tooth in the area of #7 as an esthetic solution for the missing tooth.[2] After a three-month period to allow for osteointegration **(Fig 5)**, a tan polyetheretherketone (PEEK) NC temporary abutment (Straumann) was used for temporization and a provisional crown was fabricated (Protemp A2, 3M ESPE; St. Paul, MN). This was cemented with GC Temp Advantage (GC America; Alsip, IL) **(Figs 6 & 7)**. The purpose of the provisional was the development of predictable tissue contours prior to the final restoration of #7.[3] The final fixture level and opposing impressions were captured along with bite records several weeks later and sent to the laboratory. The author also had the opportunity to clinically evaluate the shade in preparation of the final restoration.[4]

Laboratory Procedure

Model Fabrication

To fabricate the soft tissue model, a wash impression material (Imprint3, 3M ESPE) was applied using a fine-tip syringe to cover the implant analog in the final closed-tray impression by approximately 1 mm. The proximal areas of the cured material were trimmed with a knife to allow clean removal and placement to trim the soft tissue. After pouring the master impression with die stone, the model was removed from the impression material and prepared for processing **(Fig 8)**. Measurements were recorded using a Boley gauge of the adjacent lateral to create proper emergence from the tissue **(Fig 9)**. In the author's experience, utilization of the impression material as a reference for the soft tissue makes trimming of the simulated soft tissue easy and clean. In this case, the models were hand-articulated to allow for freedom of excursive movements, without restriction, to verify the occlusal parameters.

Implant Abutment Fabrication

The implant used in this case was a Bone Level Regular CrossFit (Straumann). A custom Lava (3M ESPE) implant abutment was fabricated from a UCLA-type platform. The plastic sleeve of the abutment was removed and the retention grooves were slightly smoothed using a diamond-impregnated silicone wheel (Axis Dental; Coppell, TX) to allow the wax pattern to be separated with ease from the titanium base. Sticky wax was placed over the screw hole and two coats of die spacer to cover the wax to create a barrier so the wax from the screw hole and the wax of the custom abutment did not fuse. A thin coat of Pico Sep (Renfert USA; St. Charles, IL) separator was applied.

The abutment was waxed to mimic a lateral preparation, taking care to keep the final crown margin 1 to 1.5 mm below the tissue level. It is important to not place the margin too far below the tissue level to aid in cleanup upon final cementation by the clinician. The wax pattern was then removed from the titanium platform and cleaned to remove the separator. It was then placed back on the platform, packaged, and sent to a certified Lava Milling Center.

There are alternatives to using this two-piece technique. If it had been a tissue-level implant or if the tissue was very thin on the facial, this technique would not be ideal as there is risk of the titanium interface showing through in the tissue area. In that instance, either a stock zirconia abutment or a custom-milled zirconia abutment would have been utilized. Care must be taken when choosing which technique to use, as the bondable surfaces of most UCLA-type custom platforms are quite short; this can result in failure for longer clinical crowns such as central incisors or canines. For longer restorations, it may be necessary to modify a stock titanium abutment as the platform. Then the wax-up for the custom zirconia to increase the bonded surface would be performed, and the steps to bond the two pieces together as described above would be followed.

The milling center removed the wax pattern, scanned the platform, then replaced the wax pattern on the platform and performed a double scan. The scan was batched, milled, and sintered as with any zirconia unit. Once the two separate parts were received back at the laboratory, the soft tissue was removed from the model to ensure proper seating of the platform into the analog on the model. To control position, it was important that cementation be completed by the technician who would be fabricating the final restoration (the author). The orientation of the components was indexed on the facial of the zirconia and the titanium platform, and then removed from the model.

Next, the components of the abutment were luted together using RelyX Unicem (3M ESPE) as per the manufacturer's recommendations. Wax was placed over the screw hole to prevent excess cement from occluding the access. A small bead of cement was placed along the bottom of the platform, and the inside of the zirconia was carefully lined with cement without too much excess, to minimize cleanup. A flash cure with a curing light aided in cleanup of the excess cement from the inside of the cylinder before the final self-polymerizing cure. A final light-cure of 20 seconds per surface was completed and the cemented components were allowed to auto-polymerize for five

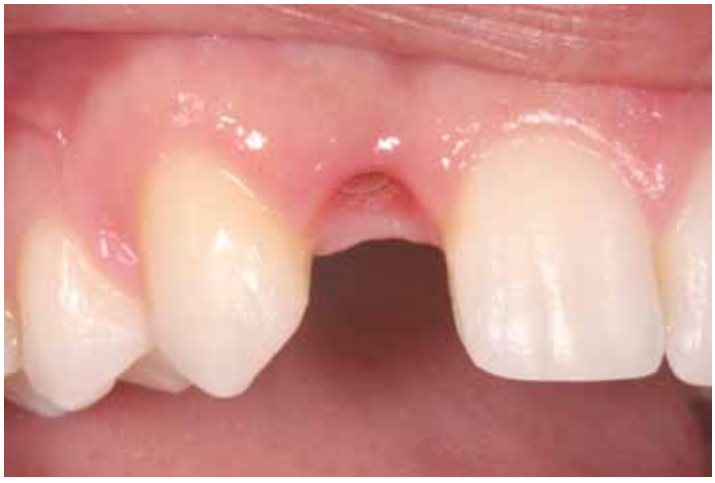

Figure 5: Surgical site after three-month healing period.

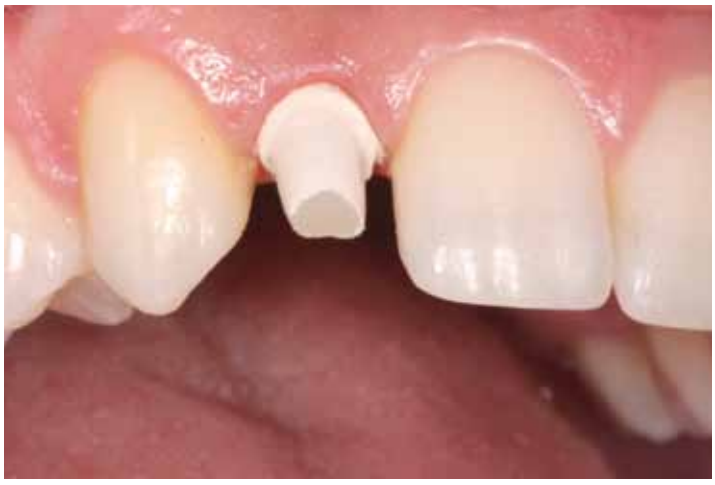

Figure 6: Temporary abutment placed; note soft tissue adaptation.

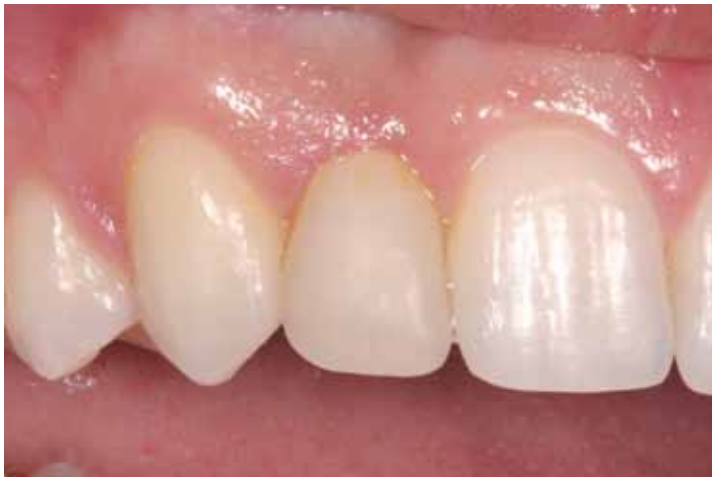

Figure 7: Right lateral view of temporary implant abutment and crown in place.

minutes. The wax was then removed from the screw hole and inspected under a microscope. It is important to ensure that the screw can be freely removed. A rubber wheel was used to smooth the outer zirconia-to-titanium juncture **(Fig 10)**.

Coping Design and Porcelain Buildup

The material chosen for the coronal restoration was e.max (Ivoclar Vivadent; Amherst, NY) due to its well-documented parameters of esthetics and strength.[5] The design would involve a lithium disilicate crown with a full cutback for layering with a nano-fluorapatite ceramic. All pressing parameters were followed as suggested by the manufacturer.

Two coats of die spacer were applied to the zirconia abutment and then the final restoration was waxed to full contour to balance with the contralateral tooth. A full cutback was completed on the facial surface **(Fig 11)**. Margins were checked under a microscope and the wax was cleaned and an eight-gauge sprue was used to attach to the ring former. Ingot value 3 was selected based upon the provided photography and in-laboratory custom shading. It was then invested with PressVest Speed (Ivoclar Vivadent) and bench-set for 30 minutes. The ring was placed in a preheated burnout for one hour.

Once pressed and devested, the reaction layer was removed and steam-cleaned. The restoration was then returned to the master model and all margins and occlusion were double-checked under magnification **(Fig 12)**. The cut-back lithium disilicate frame was then veneered with the nano-fluorapatite layering ceramic. An initial wash firing was completed with TI-1 and Transpa clear (Ivoclar Vivadent). Internal characterization was achieved with mamelon light and mamelon salmon mixed with glaze liquid (Ivoclar Vivadent) and placed in the wet enamel porcelain prior to being fired.[6] The restoration was cooled and lightly sandblasted to prepare the surface to receive another layer of ceramic.

A second bake was done using enamels. Transpa blue was placed on the mesial and distal corners. A segmental layering scheme was used in the middle incisal using Transpa enamel 1, Transpa clear, and Transpa blue. The middle third was built to full contour using Transpa enamel 1. A slight halo was placed using incisal edge.

The restoration was cooled and repositioned on the master model where contact, contour, and occlusal adjustments were made. The restoration was sandblasted and a final correction bake was completed **(Fig 13)**. Final contour and surface texture were im-

Figure 8: Master models articulated.

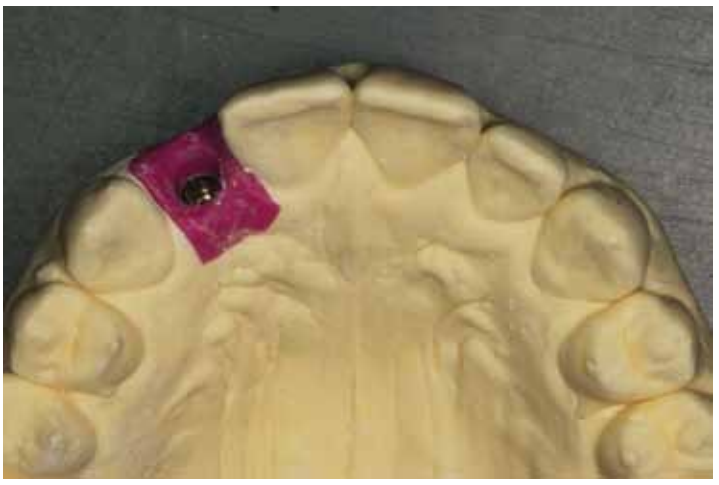

Figure 9: Occlusal view of master model with soft tissue adjusted.

Figure 10: Facial view of Lava custom abutment placed in master model.

Figure 11: Working model with pressed e.max coping placed.

Figure 12: Final buildup to full contour.

Figure 13: Bisque bake.

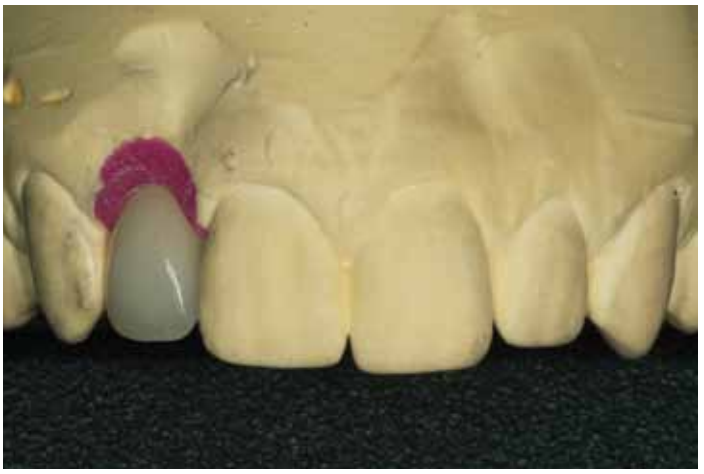

Figure 14: Final restoration glazed and polished.

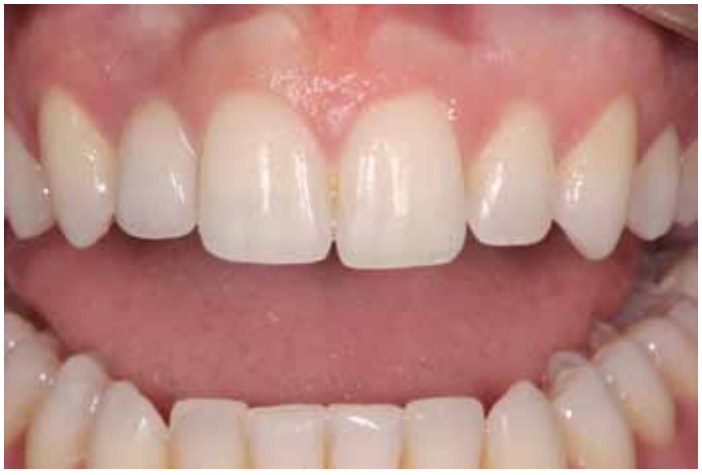

Figure 15: Postoperative frontal image, 1:2 retracted view.

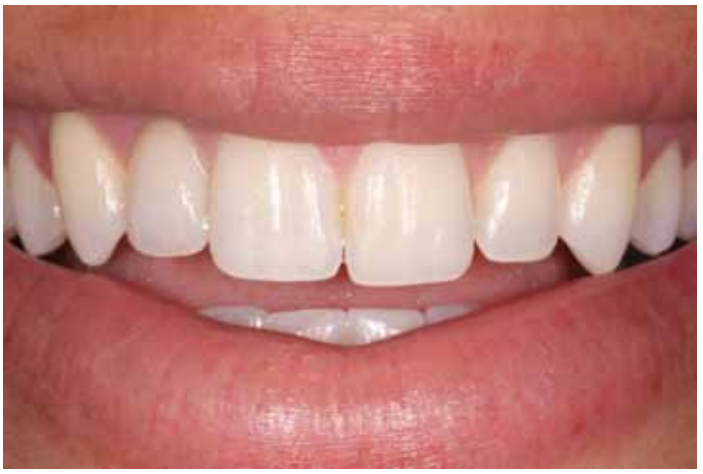

Figure 16: Postoperative smile, frontal view.

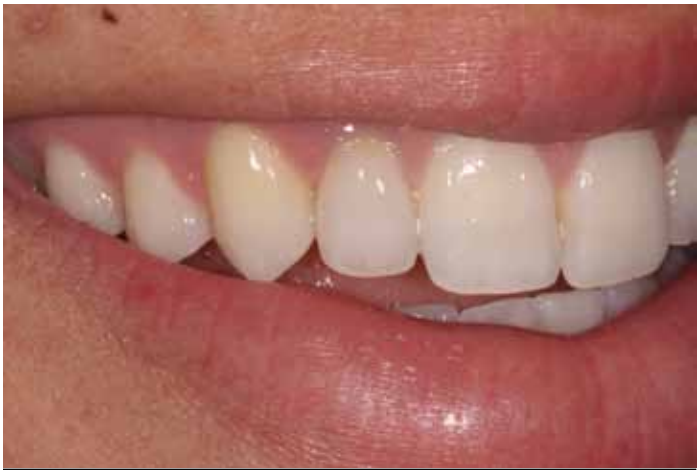

Figure 17: Postoperative smile, right lateral view.

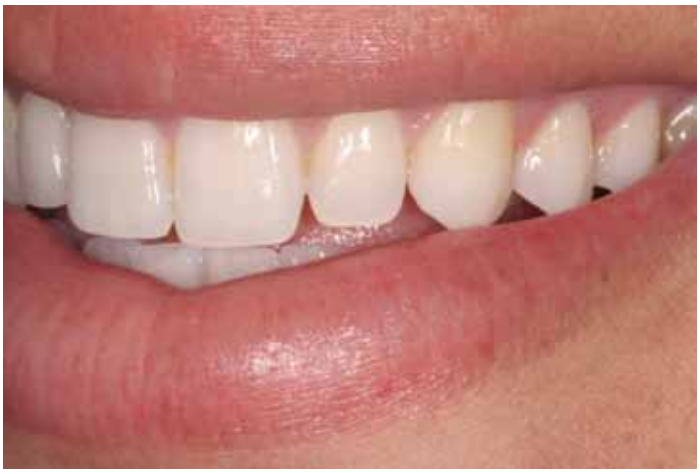

Figure 18: Postoperative smile, left lateral view.

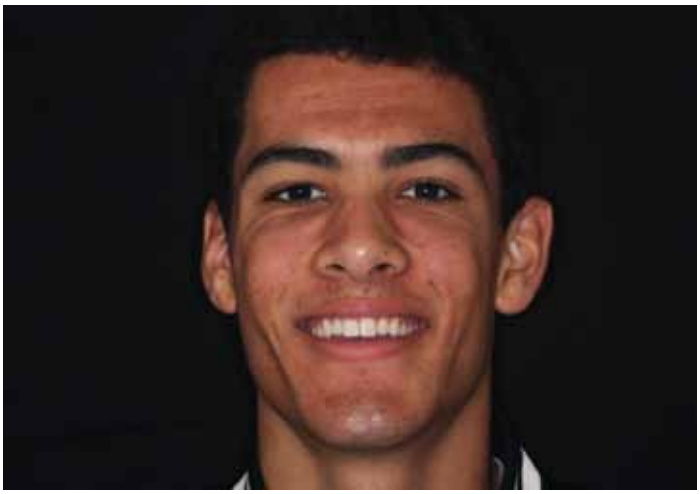

Figure 19: Postoperative portrait.

parted, margins were checked and verified under magnification, and the case was lightly sandblasted and placed in an ultrasonic device for cleaning.

The glaze firing was done at a lower temperature without glaze paste and then polished using a silicone wheel. Final polish was achieved with Metalor polishing paste (Henry Schein; Melville, NY). The restoration was returned to the master die model and critiqued in the laboratory by the author to evaluate fit, marginal integrity, and occlusion **(Fig 14)**. The internal surface of the crown and the bonded portion of the implant abutment were lightly sandblasted using aluminum oxide at two bars pressure and cleaned in an ultrasonic device. The subgingival aspect of the titanium implant platform and the zirconia abutment were rubber-wheeled and polished with diamond polishing paste and placed in the ultrasonic for final cleaning.[7]

The restoration was dried completely using compressed air, and IPS Ceramic etch gel (Ivoclar Vivadent) was used to etch the internal of the crown. The etch was rinsed after 20 seconds and the restoration was again placed in the ultrasonic to be cleaned. The crown and implant were placed in a sealed crown box and the case was packaged and delivered to the dental office for seating.

Delivery and Seating

The case was received in the dental office and prepared for seating. The implant abutment was removed from the model and disinfected along with the crown. Removal of the temporary crown and abutment was completed and the final implant abutment was placed. After a clinical evaluation and patient approval, the implant abutment was verified and torqued to 35 Ncm. The definitive restoration was seated using implant resin cement (Premier Dental Products;

Plymouth Meeting, PA). Care was taken to remove all residual cement and verify the occlusion **(Fig 15)**.[8]

Conclusion

The doctor, patient, and patient's mother were pleased with the final result. The patient's confidence was restored. The synergy of careful planning and detailed execution of the treatment by the implant surgeon, restoring doctor, and laboratory technician ensured this successful result **(Figs 16-18)**. The initial challenges of maintaining balanced tissue architecture and replacing the missing tooth were well managed **(Fig 19)**.

Acknowledgments

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Disclosure: The author did not report any disclosures.

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Examiners' Observations

Key Insights for Accreditation Case Type III

James H. Peyton, DDS, FAACD
Illustrations by Dave Mazerski

Figure 1: Contralateral teeth should display balance and harmony. In particular, the central incisors should mirror each other.

Accreditation Case Type III tests the candidate's clinical and interdisciplinary skills in creating a natural-looking maxillary anterior bridge or maxillary anterior implant. Case selection is critical in ensuring a successful result.

Often associated with the loss of an anterior tooth is the residual defect of the missing supporting periodontal architecture.[1] It is this principal challenge upon which the examiners are most focused. The defect must be managed with balance and symmetry **(Fig 1)** to create the natural emergence of a pontic or an implant from the edentulous area. If a bridge is chosen, an ovate pontic design[2] is crucial **(Figs 2a & 2b)** in creating this illusion. When utilizing either modality in tooth replacement, any deficiencies in the periodontal ridge, both in a horizontal and vertical component, must be addressed.[3] For most candidates, this typically requires the interdisciplinary skills of either a periodontist or an oral surgeon to assist in site development.[4] The time involved in the nurturing and maturation of these cases often can be underestimated. If the treatment that is rendered in this case type is limited, criteria related to smile design often are de-emphasized.

In this particular case, the missing tooth to be replaced was the maxillary right lateral incisor. The candidate was a laboratory technician. The examiners recognize the challenges that laboratory technicians have in managing certain clinical criteria in case presentations. Although this limitation is taken into account when the case is judged, the standard of excellence is not diluted. Accreditation success requires accountability of both the restorative dentist and the laboratory technician. In this case, the examiners did recognize that a level of excellence had been achieved, with mostly minor faults referencing the following criteria:[5]

- **Criterion 53:** The value was low and the restoration would benefit from more chroma.
- **Criterion 71:** The periodontal health was not optimal.
- **Criterion 73:** Gingival recontouring or shaping would have created a more natural emergence profile to mimic the adjacent architecture.
- **Criterion 83:** A distal axial inclination was noted by one examiner for the restoration on #7.
- **Criteria 84/87:** Examiners noted a lack of harmony in the development of line angles, incisal embrasures, and contours of the restoration that balanced with the contralateral tooth.

Excellence in restorative dentistry requires dedicated collaboration between a restorative dentist and a laboratory technician who embrace a common set of accepted criteria. These criteria, through the Accreditation process, have become the gold standard for smile design. The American Board of Cosmetic Dentistry® is extremely pleased with the increased interest in the laboratory technicians' credential. The more technicians and restorative dentists who utilize this measurement, the greater the advances will be within our mission to provide excellence in esthetic dental care.

Figures 2a & 2b: An ovate pontic design gives the illusion that the missing tooth is actually erupting from the tissue.

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> **"If the treatment that is rendered in this case type is limited, criteria related to smile design often are de-emphasized."**

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A "Plus and Minus" Formula

Ruling Opacity and Gaining Control Over Porcelain

Hiroki Goto, RDT

Introduction

It is often a challenge for dental technicians to achieve esthetically accurate restorations. Whether the restoration cases are basic or advanced, the work begins with controlling the opacity of porcelain materials. With a solid understanding of material properties and creative methodology, it is possible to gain ultimate control over the porcelain and to "rule the opacity." This article introduces an updated method for controlling the opacity of porcelain materials and discusses a "plus and minus" formula that has been successfully used to achieve this goal.

Figure 1: Cemented veneers on #7, #8, and #10, and a porcelain-fused-to-metal crown on #9.

The veneer seems to lose its value due to its translucency. The crown, on the other hand, seems to increase in value due to its opacity.

Failure Teaches Success

When a patient has veneers and there are crowns in the same arch, it can be challenging for a dental technician to fabricate both types of restorations to be exactly the same.

Consider a case involving four maxillary incisors restored with veneers and a crown. Tooth #9 is a crown; and #7, #8, and #10 are porcelain veneers. Exactly the same porcelain ratio was utilized for all four teeth. **Figure 1** indicates an obvious value mismatch between the crown and veneers, and **Figure 2** shows the results.

The result is related to the behavior of light. Because the light does not pass through on the crown side, what we see on the crown is the reflection of the opaque material. Hence, the crown's color appears brighter than that of the veneers and seems more opaque due to the difference in light dynamics among the restorations.

Light Behavior

The actual nature and properties of light are difficult to describe. The light behaviors and dynamics are different between both restorations. With the crown, light reflects on the opaque surface. The light does not pass through, however, so what we view on the crown is actually reflected opaque color. Even though the crown is porcelain-fused-to-zirconia coping, the light behavior is not the same **(Fig 3)**.

Conversely, once light hits the surface of a veneer, it passes through or is absorbed and reflects on some areas, essentially making the veneer translucent **(Fig 4)**. In simpler terms, the veneer seems to lose its value due to its translucency. The crown, on the other hand, seems to increase in value due to its opacity.

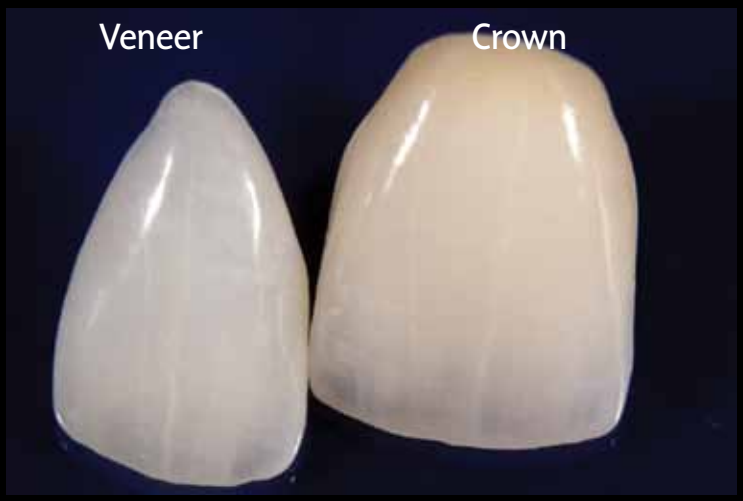


Figure 2: Visual discrepancy between veneer and crown.

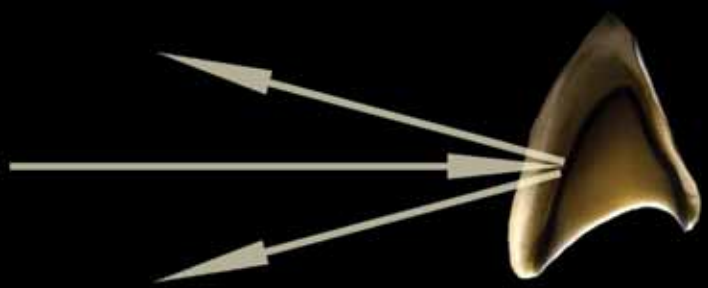


Figure 3: Image of the light reflection on the opaque surface.

"Plus and Minus" Formula

One way to control for opacity is to apply a "plus and minus" formula that involves adding value to the veneers and subtracting value from the crown **(Fig 5)**.[1,2] Consequently, the opacity levels can be more closely matched.

Clinical Case

Consider the case of a male patient in his fifties who required treatment on his anterior teeth in the maxilla arch. Tooth #9 would receive a porcelain-fused-to-zirconia crown, whereas veneers would be restored on ##6-8, and on #10 and #11 **(Fig 6)**.

The preferred shade was 1M1 from the Vita 3D Master Shade Guide (Vident; Brea, CA) **(Fig 7)**. Tooth #9 was noticeably discolored compared to other restorations. Zirconia coping can hide this discoloration due to its opacity, and there is enough thickness in the porcelain to also conceal the discoloration.[3]

Four Essential Elements

There are four essential steps before applying the "plus and minus" formula **(Fig 8)**:

1. Adjust the color of the zirconia coping.
2. Regulate the dentin-opacity level for crowns and veneers.
3. Regulate the enamel-opacity level for crowns and veneers.
4. Emphasize the characterization for crowns via the internal stain technique.

Clinical Case

There are several steps involved in applying the four essential elements to a clinical case. They are as follows:

1. a) Adjust and manipulate the color of the zirconia coping. In this case, the color is not simple for veneer preparations because there is a color gradation on the tooth. Hence, if the zirconia coping has a character similar to the veneer preparation, the porcelain buildup composition could be simpler. Therefore, the coping here is modified by a shade base stain (Cerabian ZR porcelain, Noritake Dental Supply Co. Ltd.; Miyoshi, Aichi, Japan) **(Figs 9a & 9b)**. The reason why the zirconia coping color needs to be modified is that each case situation is different; for example, the teeth are not always ideally aligned, which means the translucency of the zirconia copings are easily changed, because the thickness of the coping is changed by this issue. According to a 2005 article,[4] zirconia copings can achieve adequate translucency by minimizing thickness. This is good news for the clinicians who struggle against its opaque zirconia copings. However, the reality is not that simple. What if the space for the

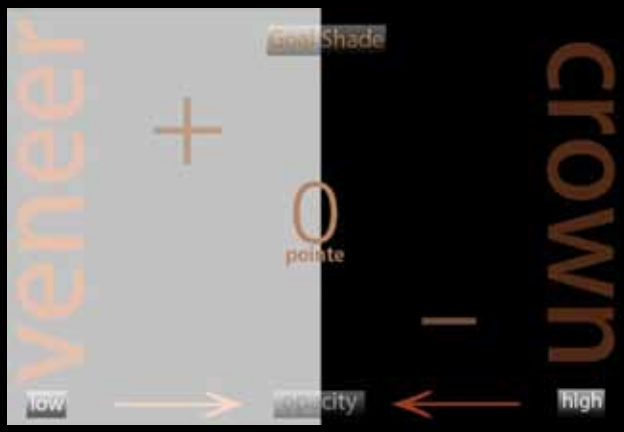


Figure 5: Theoretical outline to achieve the ideal value (middle line) by offsetting the value difference between the veneer and crown.

Figure 6: Before treatment.

Figure 7: Color of the preparations.

1. Adjust color for zirconia coping.

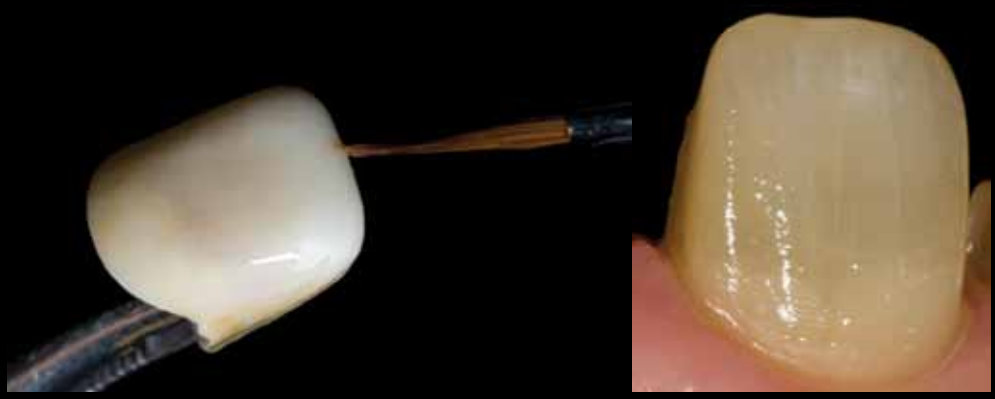
2. Regulate dentin-opacity level.

4 ESSENTIAL ELEMENTS

3. Regulate enamel-opacity level.

4. Emphasize the characterization for crown.

Figure 8: Four essential elements for applying the "plus and minus" formula.



Figures 9a & 9b: Tooth color can be replicated by using a shade base stain and shade base stain modifier.

porcelain layering is far greater than the veneer? This would mean that the thickness of layered porcelain between crown and veneer is not the same. This is why the opacity between both restorations needs to be controlled differently.

b) Apply masking porcelain to the refractory dies. The reflection of the preparation color on the porcelain veneer restorations is expected in this case. Therefore, 20% of the screening porcelain is mixed with opacious dentin porcelain as follows: four parts OB white and one part NW 0.5G, the screening color porcelain from Noritake EX3 porcelain (Fig 10).[5]

The next stage concerns contrast effect, which involves controlling an "effective interaction" by taking advantage of different opacity levels in order to equalize the opacity level.

2. Regulate the dentin-opacity level for crowns and veneers. For the dentin layer, the "Regular Body" is utilized as a dentin porcelain for crowns, while the

Figure 10: Screening porcelain is layered as a masking material.

"Opacious Body" is used as a dentin porcelain for porcelain veneer restorations. What is important here is that the opacity of a veneer restoration has been added; as a result of this contrast effect, the value has been subtracted from the crown restoration **(Fig 11)**.

3. Regulate the enamel-opacity level of crowns and veneers. Utilizing different opacity levels of enamel porcelain is another essential element involved in this concept. In short, the veneer's enamel porcelain has more opacity while the crown's enamel porcelain has more translucency.

One part LT natural enamel porcelain (Noritake) is selected for both restorations, but a different ratio of translucent porcelain is mixed to regulate the opacity level **(Fig 12)**.

4. Emphasize the characterization for crowns via the internal stain technique. It is known that the stain technique can modify chroma and hue, but at the expense of a decreased value.[6] For this reason, more stain should be applied on the crown, and the crown value needs to be subtracted.

Therefore, chroma and hue around the cervical area and shadows on the mesial and distal line angle/interproximal area are emphasized. As a result of this contrast effect, the veneer's value increases and becomes more prominent **(Fig 13)**.

To finalize the porcelain build-up stage, the same translucent porcelain/luster porcelain is layered on the enamel layer.

Morphologic Shaping

Providing a proper form is quite important for restorations to have a natural appearance. Hence, creating a delicate, controlled surface texture and luster is another essential factor that produces "diffused light reflection."[7]

Conclusion

As part of the dental team, our mission is to make patients happy, which can provide immense job satisfaction. Creating esthetically accurate restorations, whether the case is simple or complex, requires an ability to control the opacity of porcelain materials **(Figs 14-20)**. The case presented in this article is a typical clinical example often seen in dental practices, but one that can easily be mishandled without proper planning and understanding of opacity control.

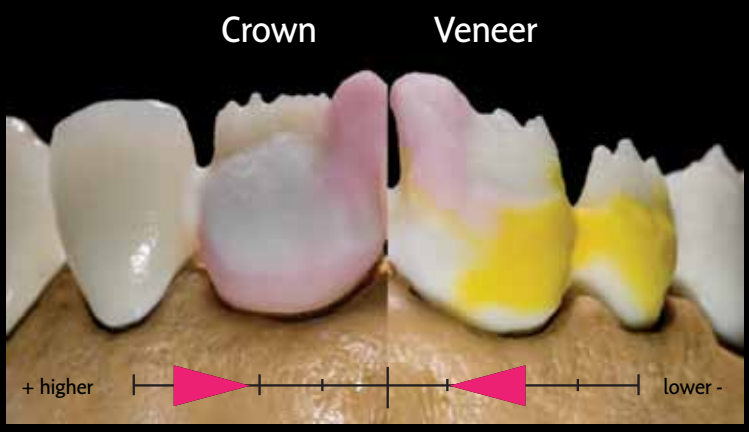


Figure 11: Different types of dentin porcelain (different opacity) are layered: a mixture of OBA1*2 + NW0.5B*1 (two parts "Opacious" dentin A1 to one part "Regular" dentin NW0.5) is layered to the veneer, while a mixture of A1B*2 + NW0.5B*1 (two parts "Regular" dentin A1 to one part "Regular" dentin NW0.5) is layered to the crown.

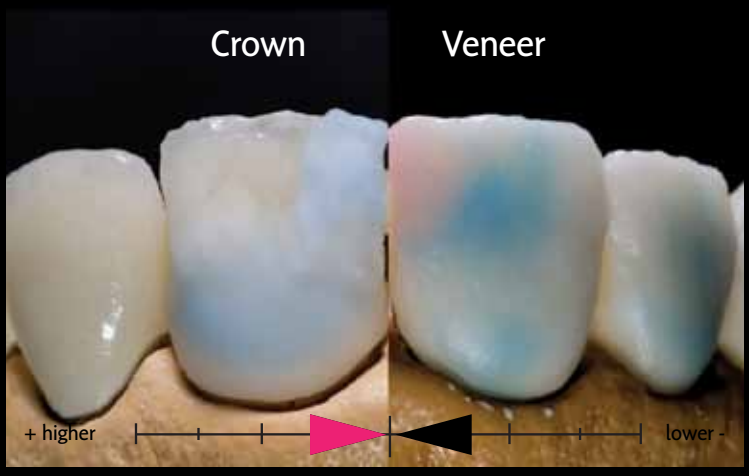


Figure 12: A different ratio of enamel porcelain (different translucency) is mixed to regulate the opacity level: a mixture of E2*1 + LT Natural*1 (50/50 mixture of Enamel E2 and Translucent LT Natural) is layered to the veneer, while a mixture of E2*1 + LT Natural*2 (one part Enamel E2 to two parts Translucent LT Natural) is layered to the crown.

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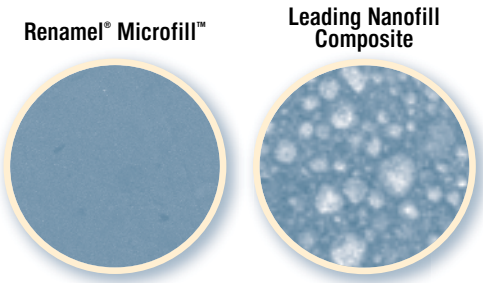

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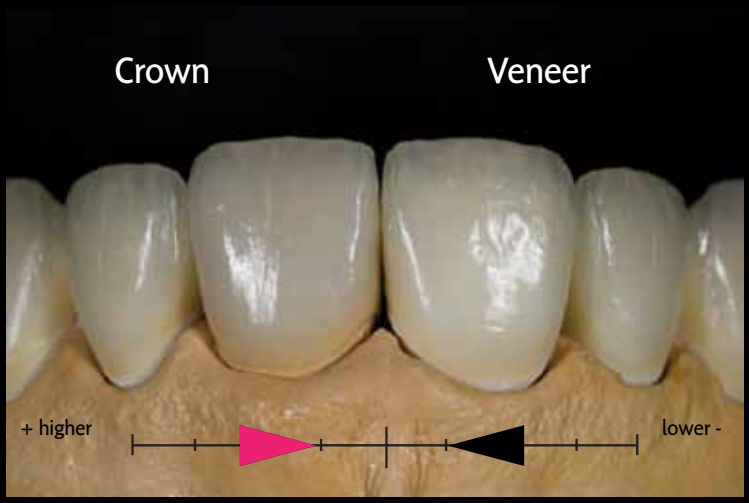

Figure 13: An internal stain is applied. The chroma and hue around the cervical area and shadows on the mesial and distal line angle/ interproximal area are emphasized.

Creating esthetically accurate restorations, whether the case is simple or complex, requires an ability to control the opacity of porcelain materials.

Figure 14: The vertical and horizontal undulation of natural teeth morphology is captured by utilizing different sized diamond burs.

Figure 15: Completion of the master solid cast.

Figure 16: Even though the crown is all ceramic, the light transmission is different between the veneer and crown.

Figures 17a & 17b: All restorations are preceded by a meticulous try in.[7]

Figures 18a & 18b: Lateral views of the restorations. Note that the value shifts from crown to veneer favorably on the left.

Figure 19: Intraoral view showing the results after implementing this successful "plus and minus" formula in the mouth.

Figure 20: Image showing a good value match between veneers and crown.

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Mr. Goto is the laboratory manager at Sheets & Paquette Dental Practice, in Newport Beach, California.

Disclosure: The author did not report any disclosures.

The method described in this article can also essentially be utilized for implant superstructure. However, different material selection should be considered for each case as necessary.

If a ceramic abutment is selected for substructure, then ceramic coping can be chosen. There is no negative color influence from the abutment.

If a metal abutment is selected, then material selection for the superstructure is critical. A ceramic coping can be utilized on metal abutment if:

- there is adequate space for porcelain layering
- an opaque coping is selected.

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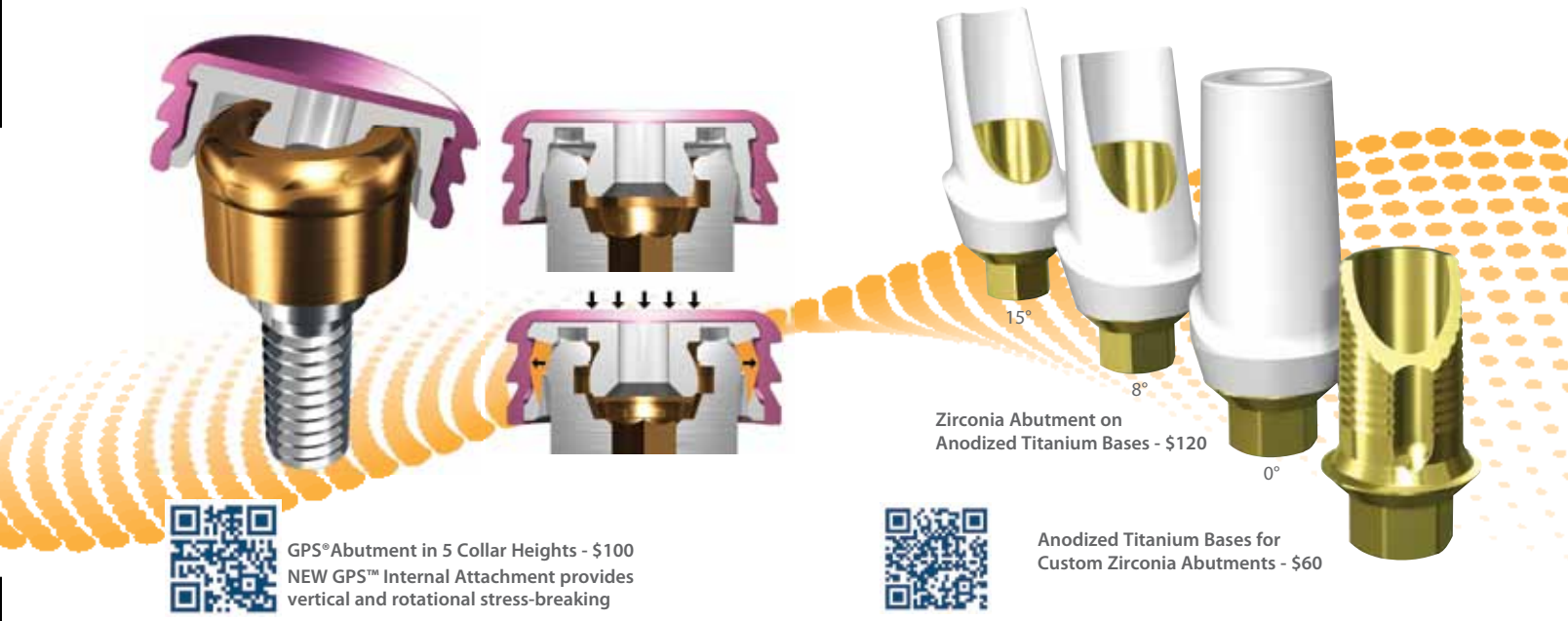

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Adjacent Implants in the Anterior Maxilla

Surgical and Prosthetic Concepts

Eric Van Dooren, DDS

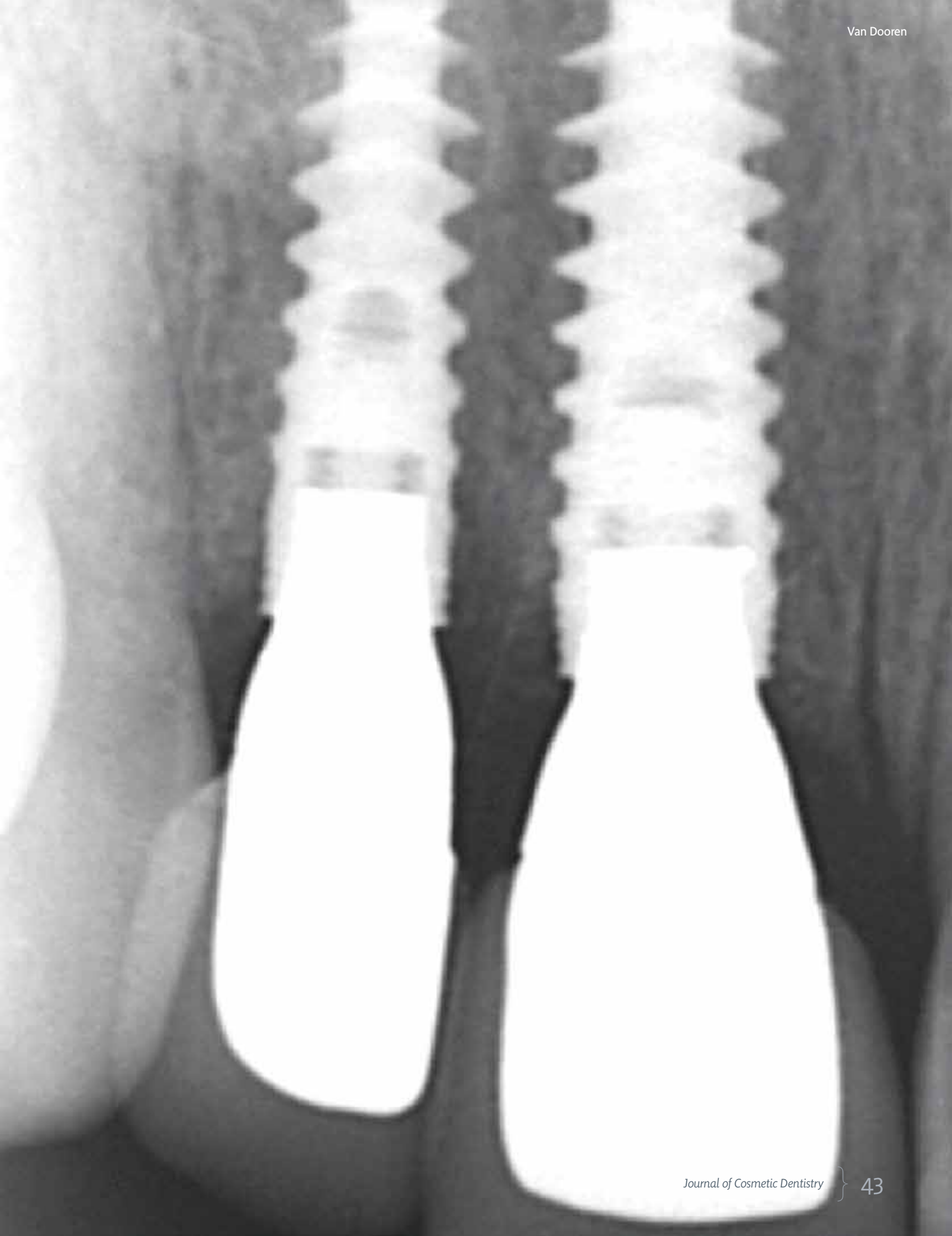
Key Words: prosthetic-soft tissue interface, immediate implant placement, anterior implant restorations

Introduction

To optimize tooth proportions and esthetic outcomes in anterior implant restorations, the challenge is really not achieving "white esthetics." Instead, the difficulty is in addressing the prosthetic-soft tissue interface. Particularly in implant dentistry, it can become quite onerous to establish a balance between pink and white at this critical junction.

Single-tooth anterior implant restorations are very predictable in most clinical situations, if certain guidelines are respected. The placement of two adjacent implants in the esthetic zone, especially while treating a unilateral defect, has always been a challenge. To achieve the longest-lasting, most esthetically pleasing restoration, a strict surgical and prosthetic protocol must be respected.

This case presentation will describe the clinical protocol and concepts for immediate implant placement when replacing adjacent lateral and central incisors with implant-borne restorations.



Figures 1 & 2: A 25-year-old woman with a very high smile line presented with a fractured right central and right lateral incisor.

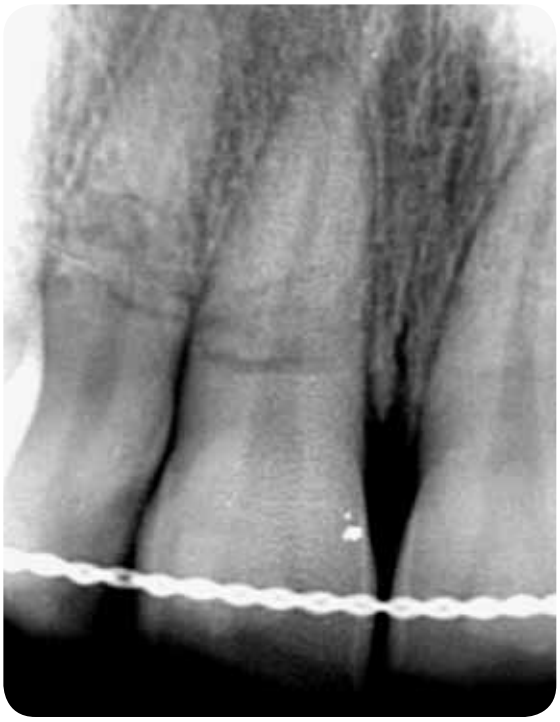


Figure 3: It was not initially clear whether the left central incisor, although discolored, was fractured. The x-ray clearly revealed the fractures of #7 and #8.

"To achieve the longest-lasting, most esthetically pleasing restoration, a strict surgical and prosthetic protocol must be respected."

In these difficult anterior cases, cone beam x-ray technology can give us very specific additional information. Fracture lines, buccal bone levels and thickness, and available palatal bone volume for implant placement become evident.

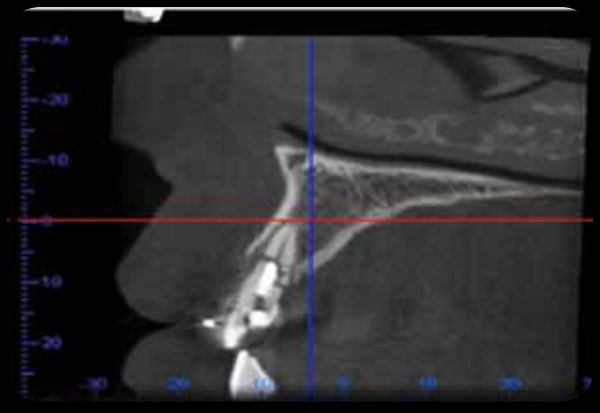


Figure 4a: A specific, simple protocol of photography and digital dynamic documentation (a short video of the face and smile), as well as radiographic findings and precise silicone impressions, allowed us to transfer the intraoral information to the laboratory, translate it into a comprehensive wax-up, and establish a comprehensive treatment planning protocol for this case.[1]

Figures 4b: A precise impression was taken, and two models were poured. It was clearly visible that #7 and #8 were displaced after trauma; hence, it was important to reestablish the exact position on the arch and redistribute the available space.

Figure 4c: A wax-up was fabricated, establishing an ideal incisal edge position, form, and gingival root emergence. This ideal wax-up defined the final three-dimensional tooth position and would, consequently, guide us through the treatment. From this wax-up, a two-unit shell provisional and surgical guide were fabricated.

Active Clinical Treatment

Surgical Treatment

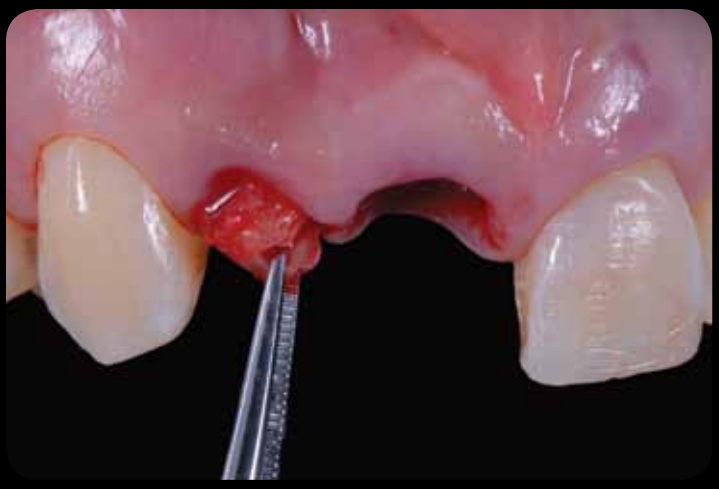


Figure 5: Atraumatic extraction of the fractured root. Aggressive curettage and debridement of the socket was performed.

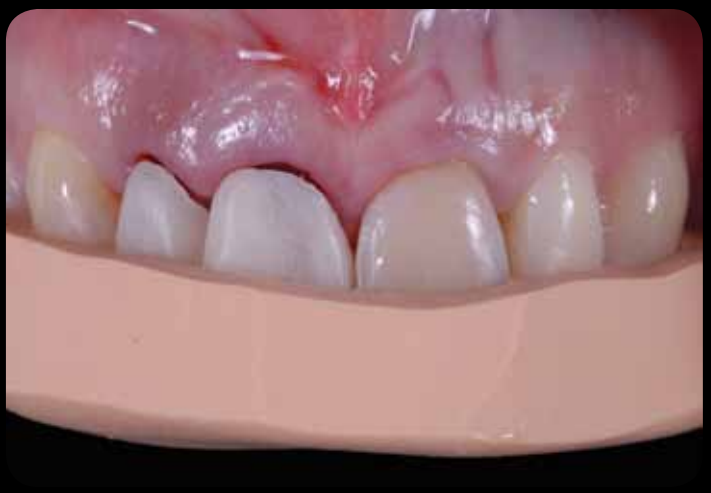


Figure 6: Trying the shell provisional. A silicone index allows for optimal positioning.

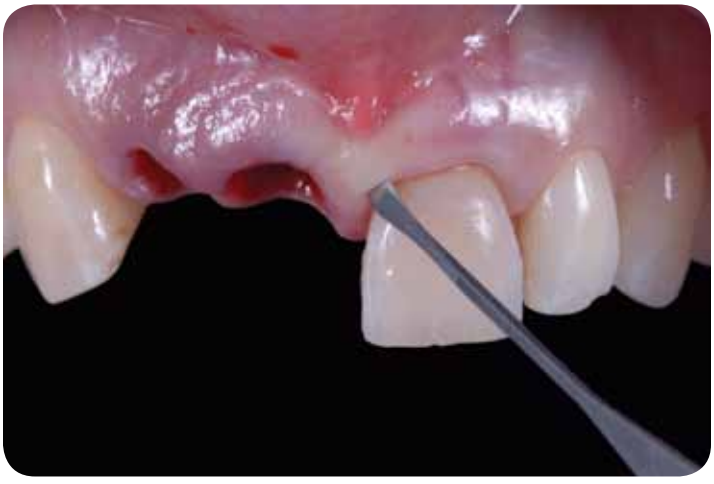


Figure 7: Preparing the receptor site for the connective tissue graft. Care was taken, with a lateral and sulcular approach, to make a split thickness lateral pouch, avoiding vertical release of the incisions. It is important to augment gingival volume in the papilla area surrounding the implant restoration.

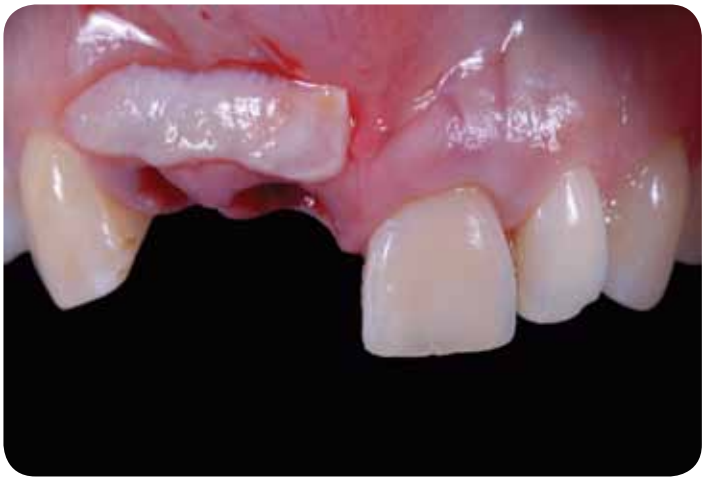
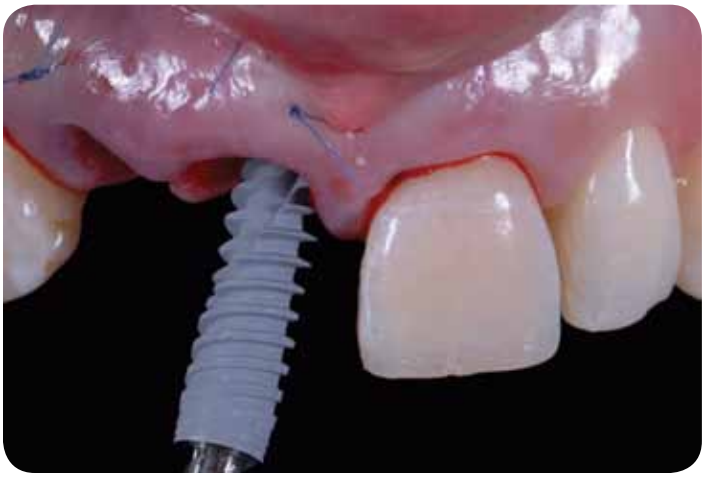
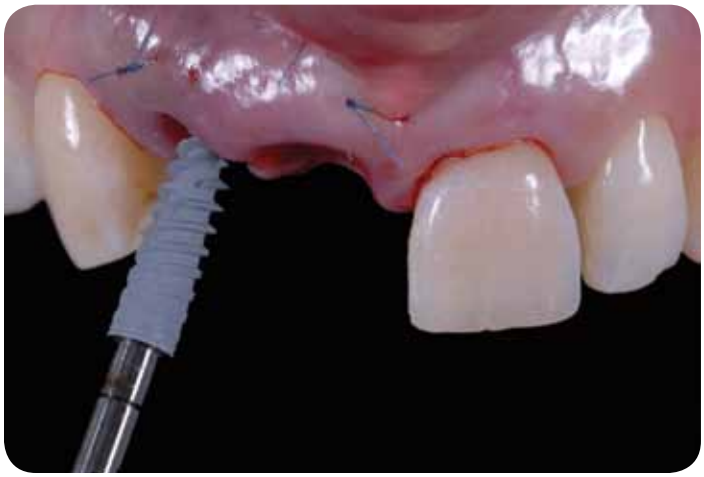
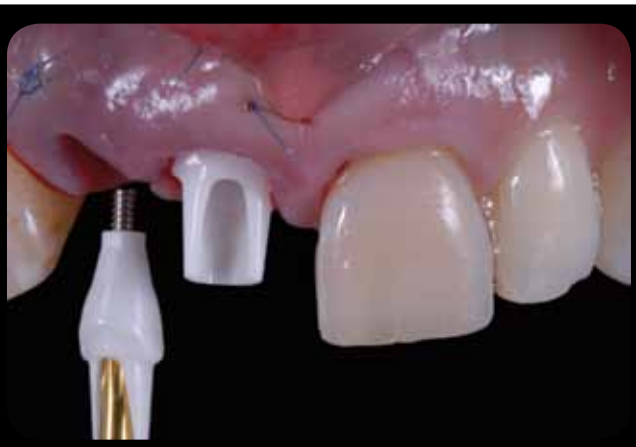


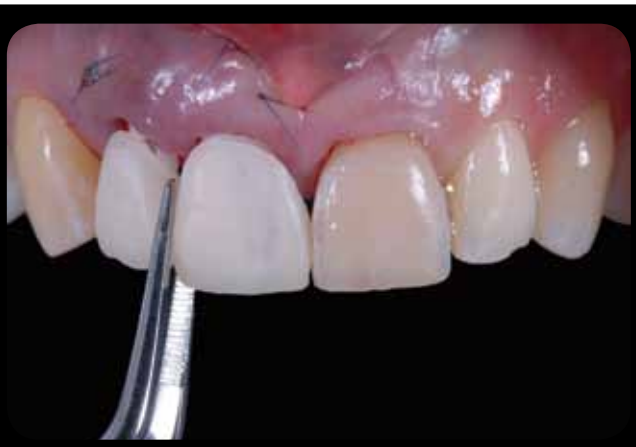
Figure 8: A connective tissue graft was harvested from the maxillary tuberosity area and inserted into the pouch. This dense, fibrous tissue will result in long-term peri-implant soft tissue stability and thickness.[2]





Figures 9a & 9b: The connective tissue graft was secured using 6/0 Seralene sutures (American Dental Systems; Vaterstetten, Germany). Flapless immediate implant placement (NobelActive NP for #7 and NobelActive RP for #8, Nobel Biocare; Kloten, Switzerland) was guided by a surgical stent designed and fabricated from the wax-up of the provisional restoration. Care was taken to leave a gap between the buccal bone and the implant. The gap was filled with a bovine filler material (Geistlich Bio-Oss, Geistlich Pharma North America, Inc.; Princeton, NJ).[3,4] Palatal implant placement, accomplished by engaging the palatal socket wall, allowed for excellent primary implant stability.





Figures 10 & 11: A prefabricated 15° zirconia abutment (Procera, Nobel Biocare) was placed immediately on both implants. In this method, the final abutment is permanently placed on the day of the surgery and is no longer removed. Using a biocompatible material promotes cellular adhesion. The abutment design (concave form) should allow for thickness and stability of connective tissue in the transmucosal zone. This will form a mechanical barrier that protects the bone from the external environment. Minor adjustments enable precise relining of the provisional bridge.

Figure 12: After final torquing of the zirconia abutments, the provisional bridge was cemented with provisional cement (TempBond, Kerr; Orange, CA). Care was taken to avoid any contact in centric relation and in excursive and protrusive movements.

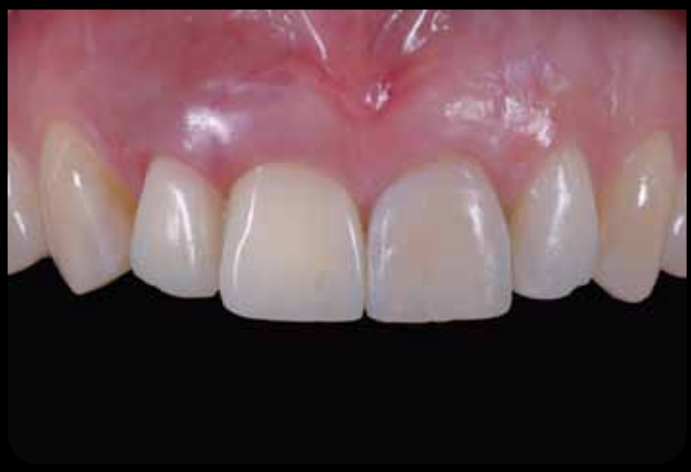
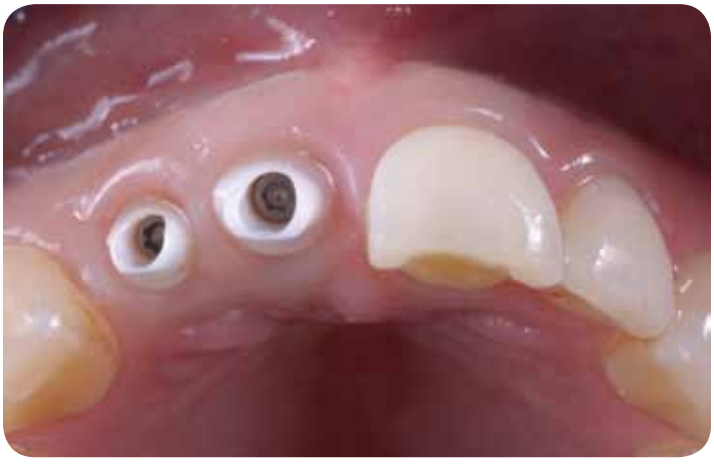
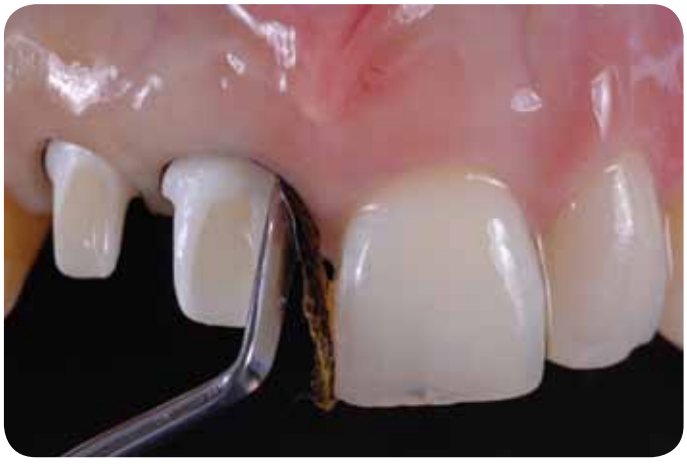


Figure 13: Healing was uneventful, and initial soft tissue maturation was achieved after 12 weeks. This is the ideal time for final prosthetic treatment. At this point, nonvital bleaching was initiated on #9, and excellent results were achieved **(compare with Fig 15)**.

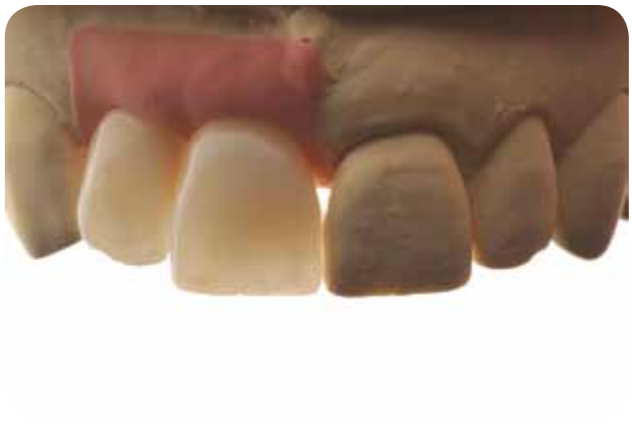




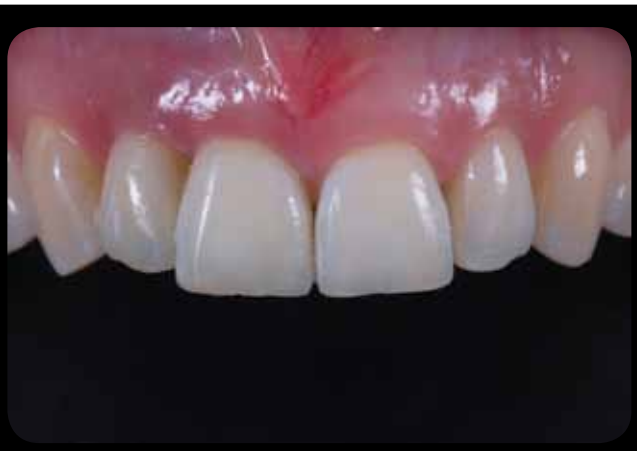
Figures 14 & 15: At this point, the provisional bridge was removed. The occlusal image clearly shows that the buccal contours were optimal. Furthermore, it clinically proves that using a connective tissue graft and bovine filler material compensates for the buccal and vertical bone resorption that occurs after extraction.[5] The abutments were torqued at 20-35 Ncm. The screw access hole was closed with polytetrafluoroethylene and an opaque composite material (SO Miris, Coltène/Whaledent; Cuyahoga Falls, OH). Retraction cords were placed, and final preparations were performed. From this point, the objective is to mimic the preparation of a natural tooth, with the abutment margin being positioned in the sulcus.[6]

Prosthetic Treatment

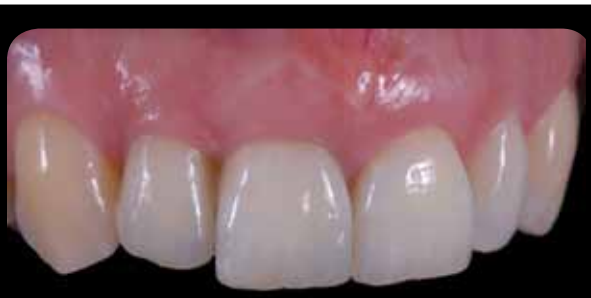
Prefabricated zirconia abutments have the advantage of being esthetic and biocompatible. However, there are also some disadvantages compared to CAD-CAM-individualized abutments, including color, fluorescence, and limited gingival contour and diameter.
A final impression was taken and final plaster casts were poured and mounted in an articulator.



Figures 16 & 17: To best match the central left incisor's high value, two Procera zirconia dentin-colored copings were fabricated. Layering was performed with Noritake CZR zirconia porcelain (Kuraray Noritake Dental; Tokyo, Japan). Special attention was given to surface texture, form, light reflection, soft tissue support, and line angle position to best mimic the natural contralateral teeth. The goal is to achieve optimal harmony and balance, not necessarily perfect symmetry.[7]



Figures 18 & 19: For final cementation, retraction cords were inserted to protect the transmucosal space. After conditioning (air abrasion and 10 MDP monomer) the internal aspect of the zirconia crowns and the zirconia abutment, both crowns were adhesively cemented with composite cement. All cement excess was removed and a minor gingival correction was performed on #9 to balance the form and zenith position.[8] Occlusion and hygiene were then checked, and the patient was placed on a six-month periodontal and restorative maintenance program.



Figures 20-22: Final clinical appearance after two years. The papillae volume and height seem to have improved with time. Coronal migration of soft tissue levels around grafted implant restorations can be observed. In many of these anterior implant restorations, after two to three years, gingivoplasty and recontouring become part of the maintenance protocol. Apparently, the placement of a connective tissue graft can trigger three-dimensional gingival expansion or growth in certain cases. Understanding of the surgical/biological and prosthetic concepts is crucial in obtaining optimal esthetic and functional results.

Figure 23: An x-ray taken two years postoperative. The inter-implant bone peak has been preserved, and satisfactory marginal bone levels can be observed.

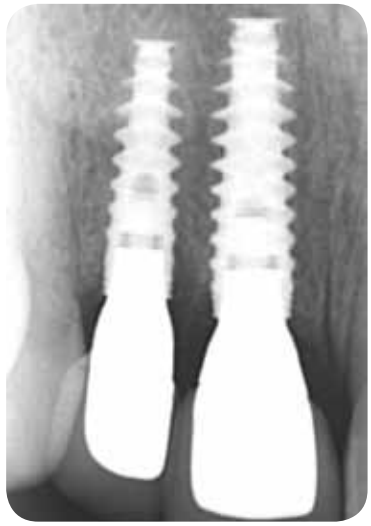


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Figure 24: Final facial image. Striving for facial balance, harmony, and equilibrium should be the goal of every esthetic dental treatment.

Acknowledgments

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Disclosure: Dr. Van Dooren is a consultant for Nobel Biocare and Anaxdent, and he receives honoraria from Ivoclar Vivadent.

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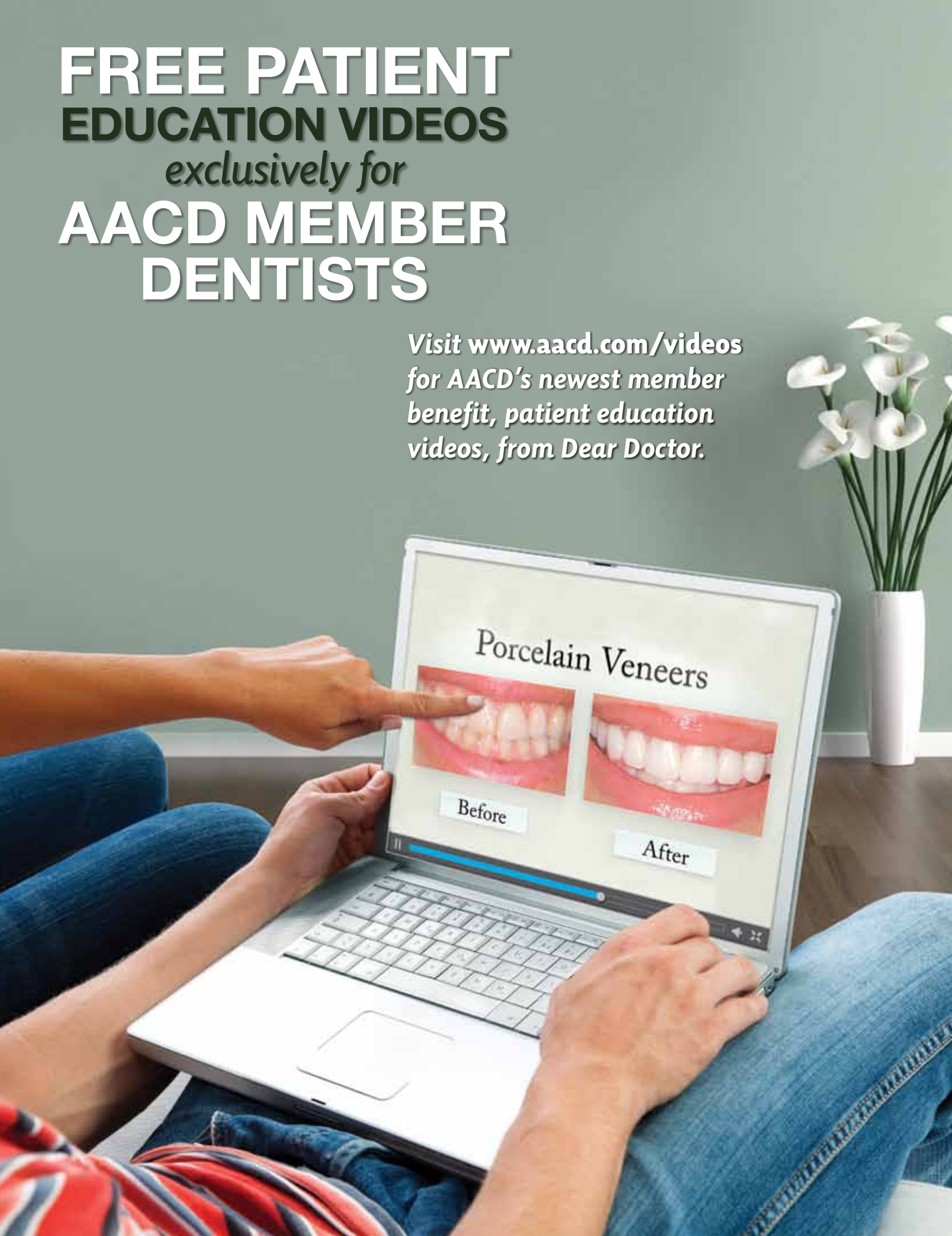

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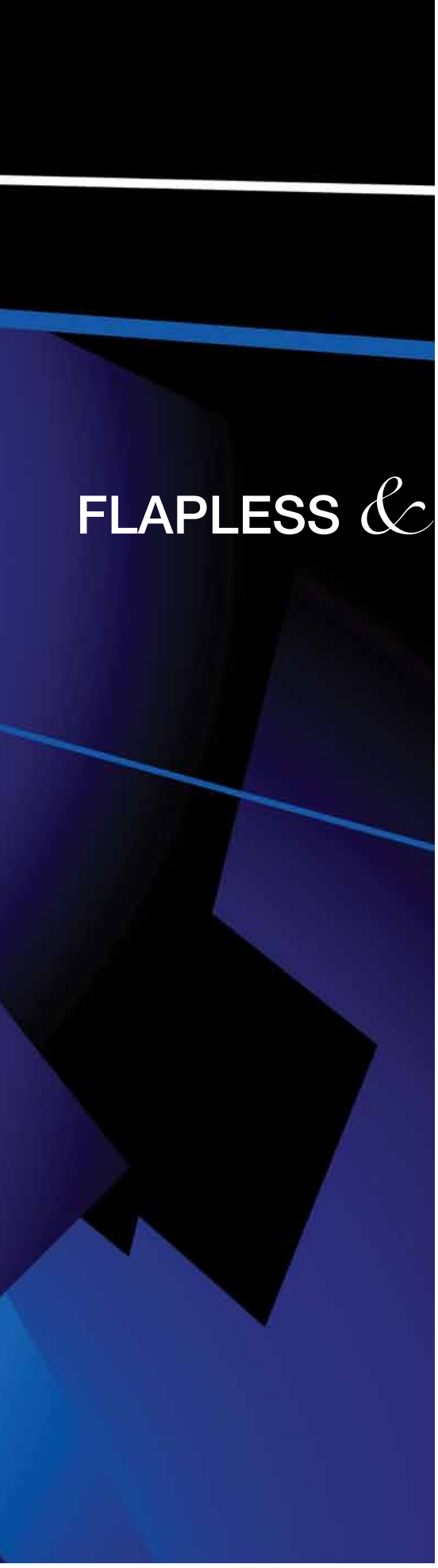

FLAPLESS & FLAP IMPLANT SURGERY

Michael A. Pikos, DDS
Marius Steigmann, Dr.medic.stom., PhD

A number of modifications have occurred in the surgical protocol for dental implant placement since its development in the late 1970s. These include, but are not limited to, noteworthy technological advances. As a result of these improvements, there is increasing acceptance of implant placement among patients and clinicians. It is critical for clinicians to minimize trauma to the patient and to produce responsible esthetic outcomes while understanding patients' hard and soft tissue conditions. Each patient is unique, and experience and training are essential to successful surgical implant procedures. Here, Dr. Michael A. Pikos and Dr. Marius Steigmann, both well-trained and experienced implant surgeons, share their experiences with flap and flapless approaches to implant placement.

> A number of changes have occurred in flap design since the late 1970s, including the use of a flapless approach.

Key Words: flapless, minimally invasive, entry-level clinician, incision design, cone beam computerized technology

Dr. Pikos Discusses the Flapless Approach to Dental Implant Placement

The surgical protocol for dental implant placement was established by Brånemark in the late 1970s. This approach included an incision in the mucosa or muco-buccal fold and was followed by a full-thickness mucoperiosteal flap that was reflected to expose the underlying bone. Implants were then placed and the flaps were re-approximated with sutures.[1-3] Over the past 30 plus years a number of flap design modifications have been made, especially with regard to esthetic zone considerations. Full maxillary reflection allows for direct visual assessment of existing bone quantity and morphology. However, in the early 1970s, Wood and colleagues[4] demonstrated a correlation between flap elevation and gingival recession, as well as bone resorption around natural teeth. In addition, Van der Zee[5] and colleagues showed postoperative tissue loss from flap elevation, implying that flap surgery for implant placement may have a negative influence on implant esthetics.

A number of changes have occurred in flap design since the late 1970s, including the use of a flapless approach. Additionally, during the past decade, there have been a number of significant technological advances in dental radiographic imaging, including cone beam computed tomography (CBCT), as well as three-dimensional (3D) dental implant treatment-planning software for evaluation of potential implant sites. These developments have had a direct impact on the popularity of flapless implant surgery, which has become a technique of choice for a number of clinicians. This article focuses on five myths and realities of the flapless approach for dental implant placement.

Myth

Flapless surgery provides the entry-level implant surgeon with a safe and predictable protocol for implant placement.

Reality

With the advent of in-office, head- and neck-specific CBCT, along with innovative 3D dental implant treatment-planning software, the use of flapless surgery for implant placement has become more popular among implant surgeons. Although the flapless protocol has been promoted as a conservative and minimally invasive approach that should be embraced by the entry-level implant surgeon, in reality the successful application of this methodology is proportional to the clinician's experience and training, including surgical and advanced imaging skill sets.

The implant surgeon should have a sound working knowledge of both extensive full-flap and minimally invasive soft tissue flap procedures associated with dental implant reconstruction. In addition, he/she must understand the surgical principles of peri-implant soft tissue management, including the anatomical, biological, and vascular elements that contribute to predictable and long-term implant stability.

Finally, the implant surgeon must possess the knowledge and skill sets related to various incision designs and suture techniques for soft tissue manipulation, especially in the esthetic zone. Papillae-sparing, modified papillae-sparing, and sulcular-only incision approaches are just a few skills that must be mastered. The clinician must also be comfortable using small needles (P-3) and suture materials (5-0, 6-0, 7-0) for a variety of applications such as horizontal mattress, vertical mattress, and sling suturing.

Campelo and Camara,[6] in a 10-year clinical retrospective study, placed 770 implants in 359 patients via a flapless approach, to restore both completely edentulous and partially edentulous arches with fixed prostheses or removable dentures. The cumulative success rate for implants using a one-stage surgical protocol after 10 years varied from 74.1% for implants placed in 1990, to 100% in 2000. Eight of the 31 failed implants occurred during the first year. Per this clinical analysis, implant survival with the flapless approach was proportional to the number of years the procedure had been performed by the surgeon, as well as by the number of implants placed.

Jeong and colleagues[7-9] evaluated implant stability, crestal bone loss, and vascularity of the peri-implant mucosa, comparing flap and flapless implant surgery. In the human study,[7] 100% implant success with negligible levels of crestal bone loss and minimal changes

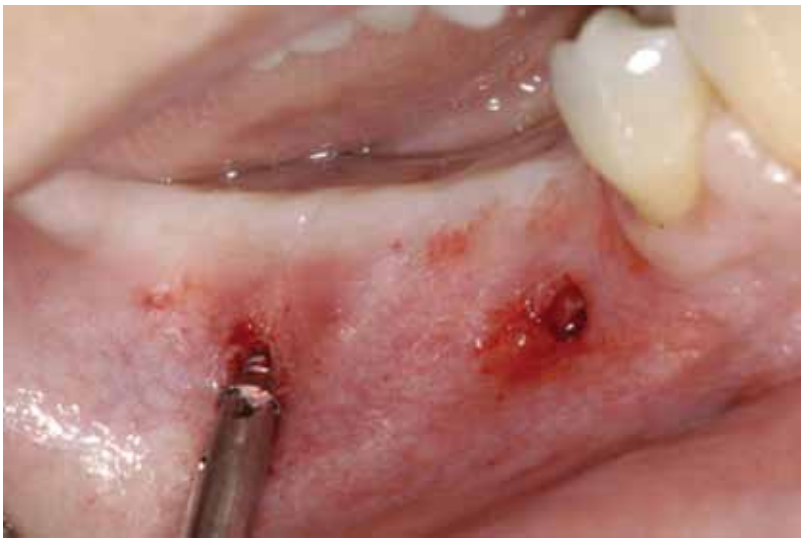

Figure 1: Flapless screw fixation retrieval four months after ramus buccal shelf block graft lateral augmentation.

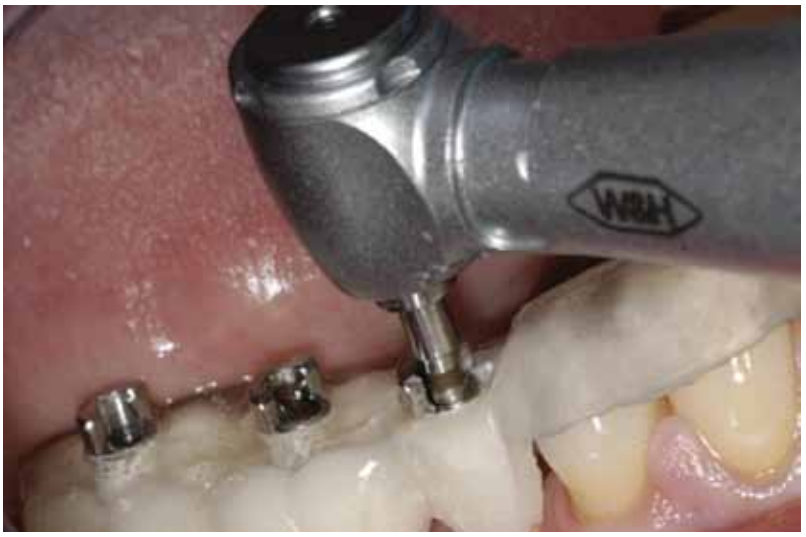

Figure 2: Guided implant surgery.

in adjacent soft tissue was reported, consistent with this author's experience. Case selection and presurgical evaluation of bone morphology of the proposed surgical site is critical to the success of the procedure.[10,11] Detailed preoperative planning (especially in the esthetic zone) that includes the use of CBCT and CT-guided technology, also plays a key role in the success of flapless surgery **(Figs 1-4)**. Currently, the use of flapless implant placement as a "routine" procedure in daily practice is not recommended.[12] It is this author's opinion that minimally invasive procedures, such as flapless surgery, should be performed only by clinicians able to convert to conventional open access surgery if these procedures prove to be inadequate and/or fail. The general clinical experience, knowledge, and skill sets of the surgeon are most important for good case selection, predictability, and ultimate success of the flapless procedure.

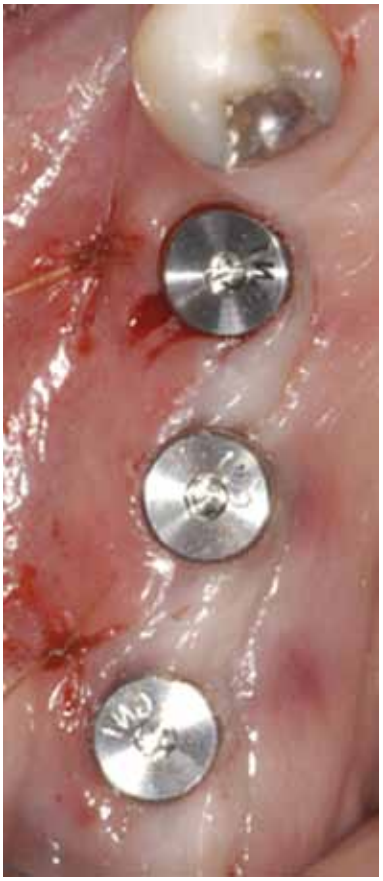

Figure 3: Flapless implant placement.

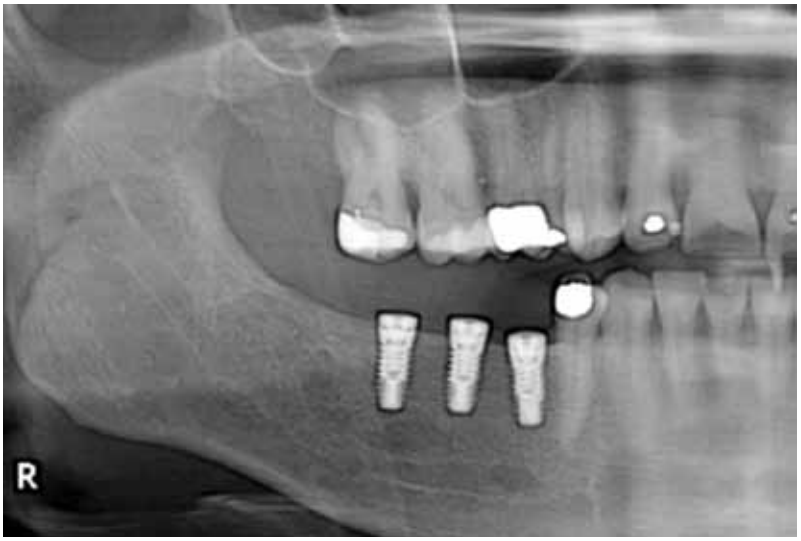

Figure 4: Flapless implant placement radiograph.

Myth

Flapless implant placement causes less anxiety and discomfort for patients.

Reality

In addition to high success rates and long-term predictability of implant placement surgery, patient acceptance and quality of life in the immediate postoperative period are of most importance. In most studies of flapless implant placement, the procedure is well accepted by patients, who report less postoperative swelling, pain, and discomfort as compared to patients who undergo conventional flap surgery.[13-15]

In a study by Cannizaro and colleagues,[16] this author evaluated the efficacy of flapless and flap techniques, comparing 76 flapless and 67 flap implant placements. The success rate and number of complications of the two techniques were similar. The surgical time was reduced by two-thirds in the flapless group, which increased patient acceptance. The level of swelling, pain, and use of analgesics was reduced in the first three days of the postoperative period. In another study, Lindeboom and colleagues[17] did an in-depth comparison of flap and flapless implant placement and took into consideration multiple additional variables, including dental anxiety, emotional impact, and procedure duration. The surprising outcome of this study was that patients undergoing flapless surgery endure more than patients in the flap group. This was thought to be the result of the high level of technical difficulty that is associated with the flapless surgical protocol.

Generally speaking, swelling and immediate postoperative pain were reduced with the flapless group, but the assumption should not be made that the level of patient anxiety is ultimately reduced depending upon the specific nature of the case.

Myth

All flap implant placement procedures measure equally inferior to the flapless approach.

Reality

The argument made for flapless implant placement is related to the intact dual blood supply (intrabony and periosteal) of the bony alveolar crest, compared to the single blood supply (intrabony) of the flap technique. In a well-referenced study, Kim and colleagues[18] compared the healing of peri-implant tissue after flapless and flap implant placement. They found that vessels in the flapless group were wider, more abundant, and had a higher vessel fraction average. But careful atten-

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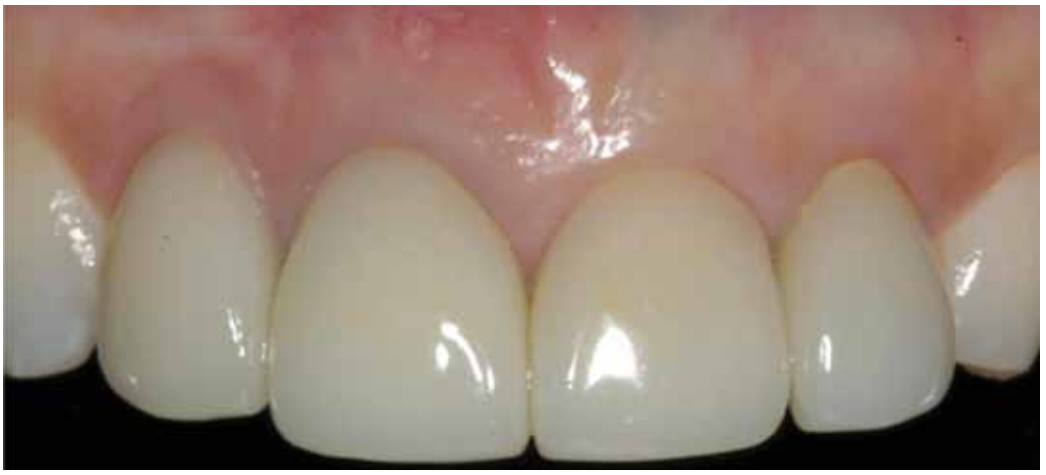

Figure 5: Fractured maxillary left lateral incisor.

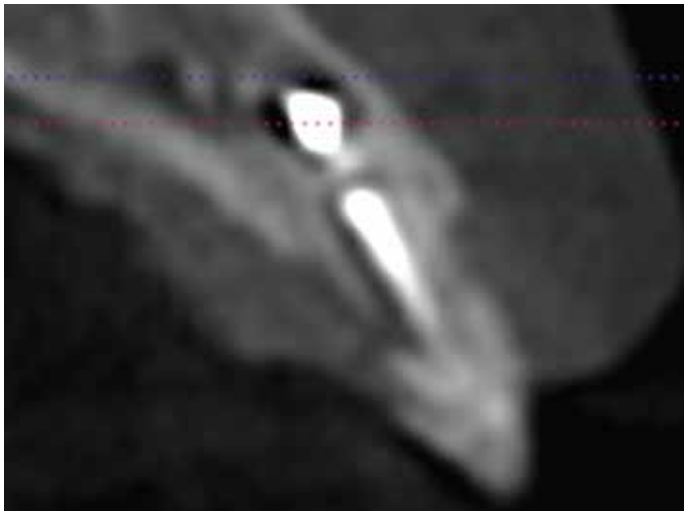

Figure 6: CBCT sagittal view, #10.

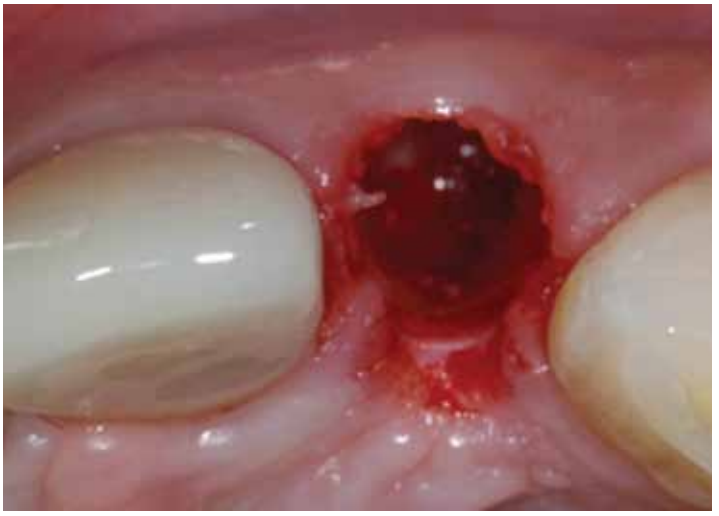

Figure 7: Flapless extraction, #10 (periotome).

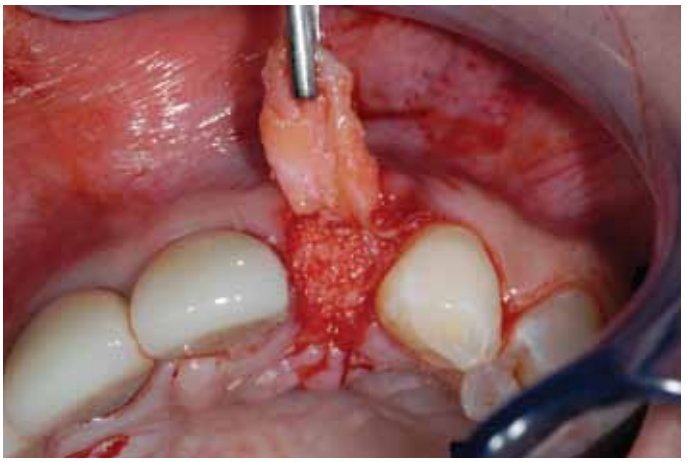

Figure 8: Mineralized allograft and connective tissue graft (into facial subperiosteal pouch).

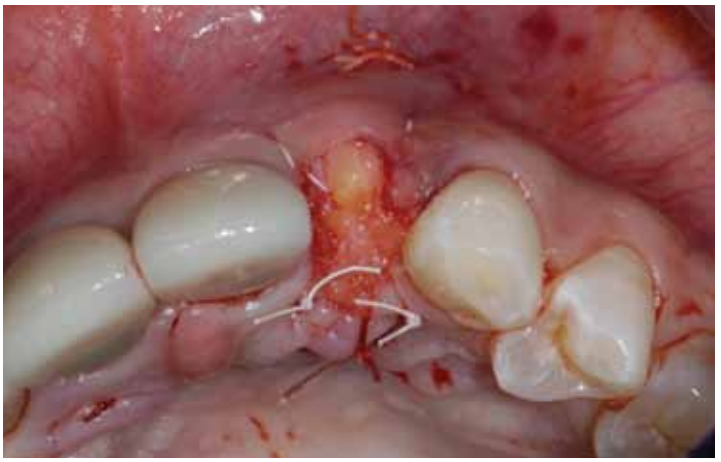

Figure 9: Connective tissue graft sutured in place.

tion should be given to the reality that the surgical technique in the flap group included utilizing a vertical release and aggressive mucoperiosteal exposure.

The designs of various flap implant placement surgeries are not created equal, resulting in different patterns of revascularization and healing of the peri-implant architecture. A mucoperiosteal flap design raised in the exposure of alveolar bone and advanced beyond the attached gingiva with release incisions, will cause the reorganization of its disrupted vasculature.

When the mucoperiosteal flap is elevated without releasing incisions, the morphology and quantity of the underlying bone is easily assessed. Furthermore, the ability to manipulate the implant site, which includes bone and soft tissue augmentation, is made feasible. In this flap surgery modification the vascular anatomy and architecture are not disrupted, and the most common complication of flapless surgery, fenestration of the buccal and lingual plates, is easily avoided **(Figs 5-12)**.

Jeong et al.[7] compared the miniflap and flap techniques by analyzing their effect on the peri-implant apparatus and proved the miniflap to be a successful and reliable technique. This technique simulates a crestal incision and elevation of up to 5 mm of mucoperiosteal flap. Further histomorphometric studies are required to evaluate the vascular changes in the miniflap and flap group.

It is this author's opinion that, in a relatively large number of cases, adjunctive procedures are necessary to develop the implant site in order to improve the longevity of implants placed. The miniflap technique, without vertical release incisions, allows for direct visual access to the site, while maintaining the vascular network of the flap and minimizing possible complications of flapless implant placement **(Figs 13-18)**.

Myth

There are few if any disadvantages to flapless implant placement.

Reality

As is true with all surgical procedures, flapless implant placement is also subject to its own subset of disadvantages and complications. The potential for morbidity is greatest for the entry-level implant surgeon. Most importantly, there is a lack of overall "situational awareness" with this approach as it is essentially a "blind" procedure. There is no direct visual access to the underlying anatomy, including vital structures. As a result, there is increased potential for penetration of sinus or nasal membranes, violation of the inferior alveolar, lingual, or mental neurovascular bundles, and perforation of the bony alveolar plates.

Brodala[12] reported on four studies that evaluated intraoperative complications, including perforations of the buccal or lingual bony plate.[6,16,19,20] These studies also addressed primary implant stability problems at the time of placement, resulting

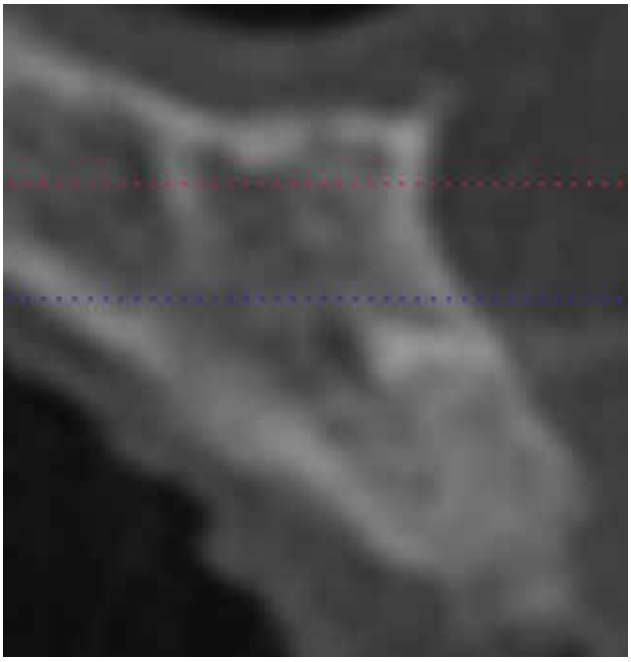

Figure 10: CBCT sagittal view four months after bone graft.

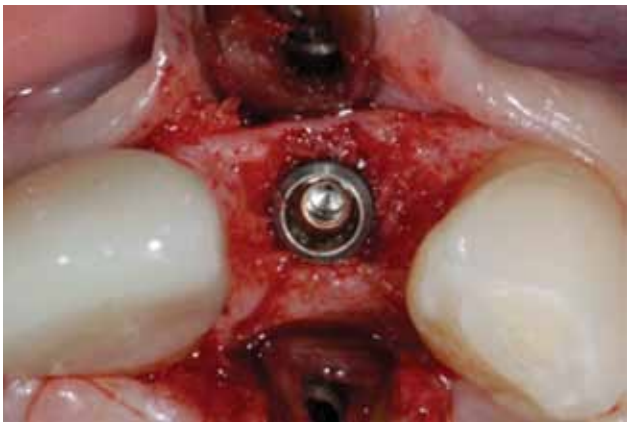

Figure 11: Minimally invasive flap reflection for implant placement.

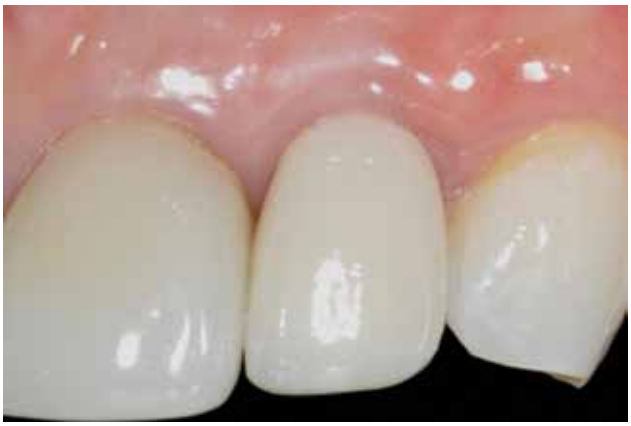

Figure 12: Completed prosthetics, #10.

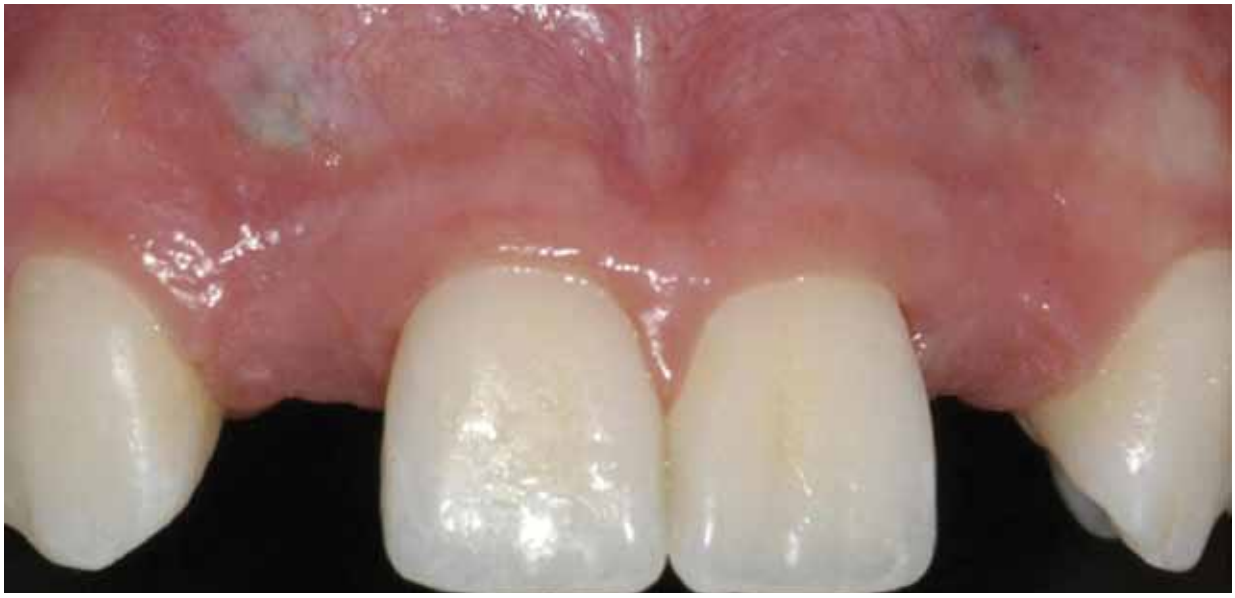

Figure 13: Four months after ramus buccal shelf block graft to #7 and #10.

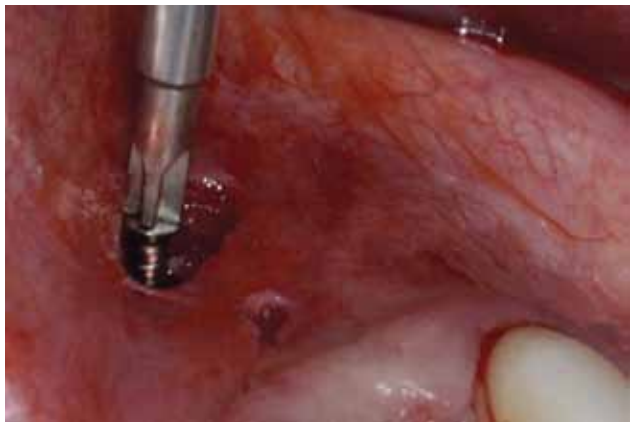

Figure 14: Minimally invasive screw retrieval, permucosal.

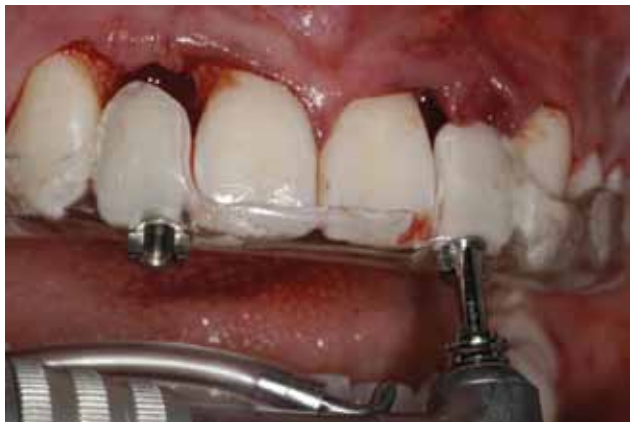

Figure 15: Guided implant surgery placement.

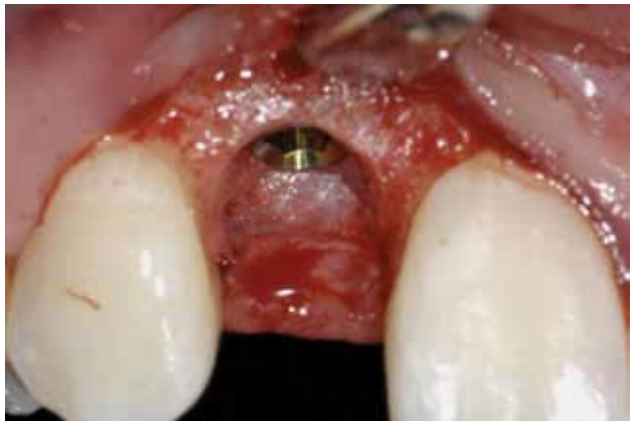

Figure 16: Implant placement, #7, with crestal contouring.

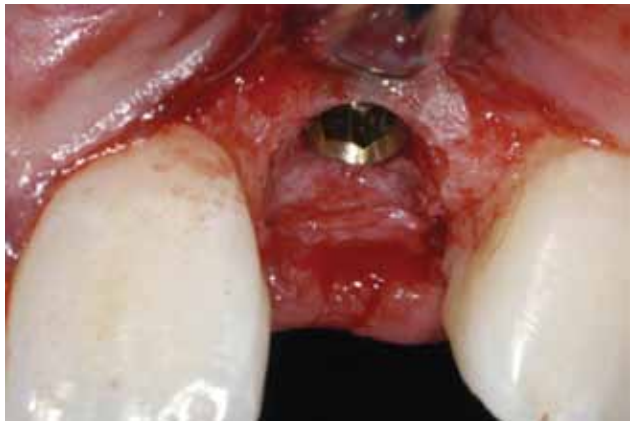

Figure 17: Implant placement, #10, with crestal contouring.

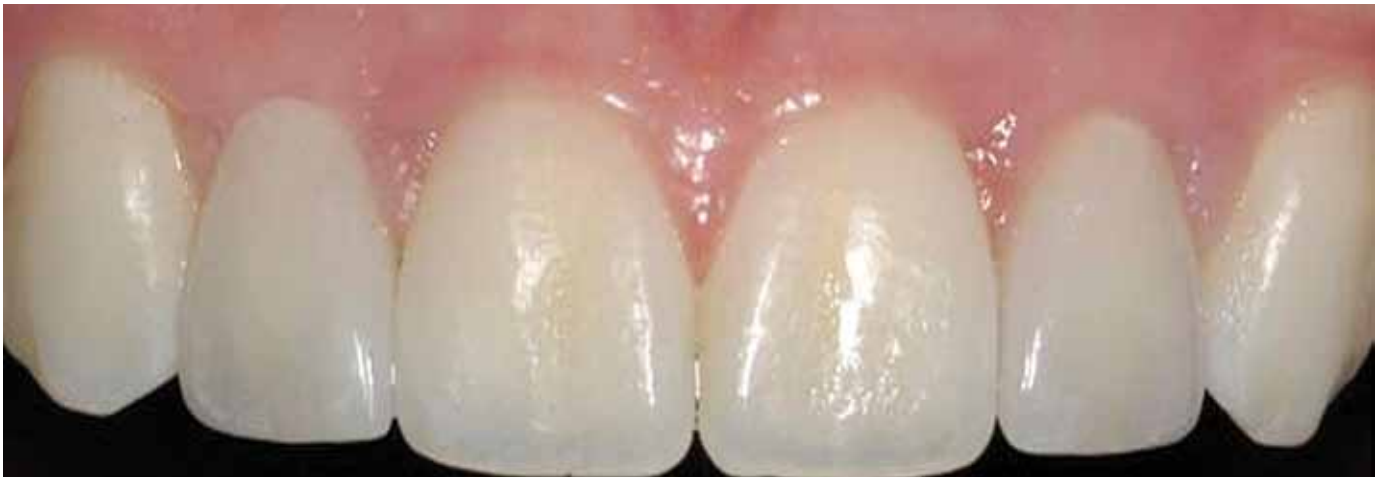

Figure 18: Completed prosthetics (after three and a half years).

in removal or submergence of the involved implants. It often is advantageous in the esthetic zone to utilize a minimally invasive crestal and sulcular incision without release incisions for implant placement. This also allows for adjunctive soft tissue and hard tissue augmentation through the use of a pouch technique **(Figs 19-30)**.

Although the use of CBCT and dental implant placement software is strongly recommended for flapless implant placement, complications such as misalignment can occur.[19-21]

Myth

Flapless implant placement has no effect on adjacent soft and hard tissue.

Reality

The general rationale behind flapless implant placement is to maintain the architecture, periosteum, and blood supply of the relatively poorly vascularized peri-implant tissue. Currently, there is no well-established and controlled study that proves the benefit of flapless implant placement and maintenance of crestal bone height. As per Araujo and colleagues,[22] evaluation of flapless versus flap techniques of fresh extraction sites of dogs showed similar bony resorption rates. Their results were corroborated by histomorphometric studies from Caneva and colleagues.[23]

When compared with the average bone loss of flap surgery, less crestal bone loss has been reported with flapless surgery in the clinical human study by Jeong et al.[8] In this study for flapless implant placement, a tissue punch smaller than the implant diameter was used. The average crestal bone loss after the first year of implant placement had a mean average of 0.3 mm and maximum of 1.2 mm. This result was lower when compared to the reported crestal bone loss of flap surgery (0.4 to 1.2 mm) in previous studies.[24,25]

Few studies have been performed on soft tissue changes comparing flapless and flap surgery. Per Jeong et al.,[8] the gingival index and bleeding on probing index were lower for flapless surgeries, and were related to the small access, which was created with the use of a tissue punch smaller than the implant itself. In an animal study by You and colleagues,[26] bone healing and soft tissue morphogenesis of the

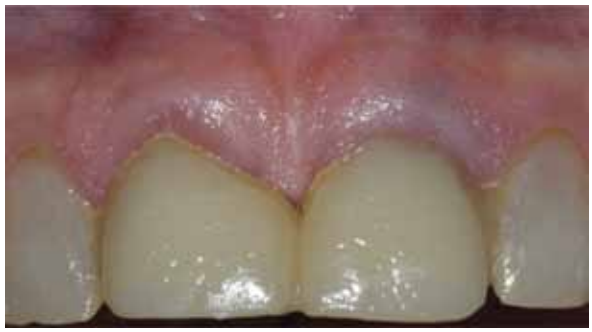

Figure 19: Fractured maxillary central incisors.

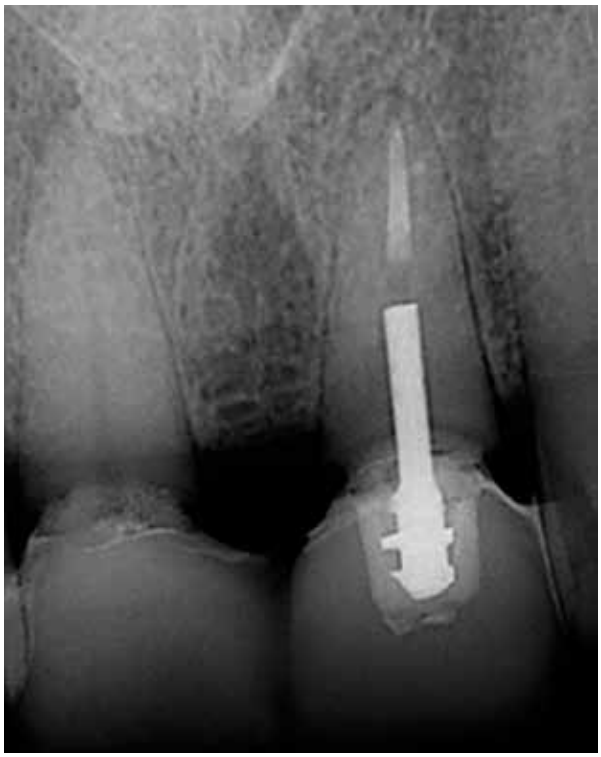

Figure 20: Radiograph of maxillary central incisors.

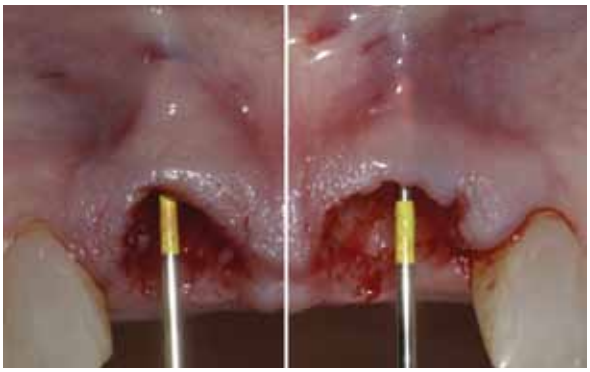

Figure 21: Flapless extraction, #8 and #9. Note complete lack of labial plates.

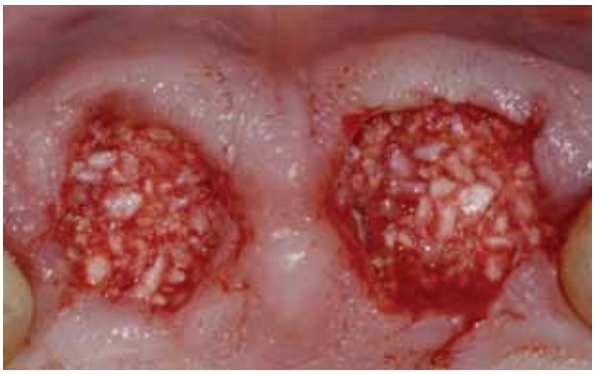

Figure 22: Socket grafts with mineralized allograft.

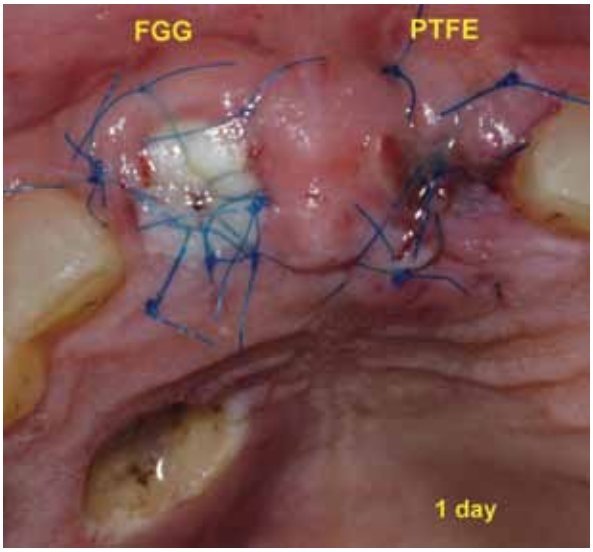

Figure 23: Free gingival graft, #8; polytetraflouroethylene membrane, #9 (one day postoperative).

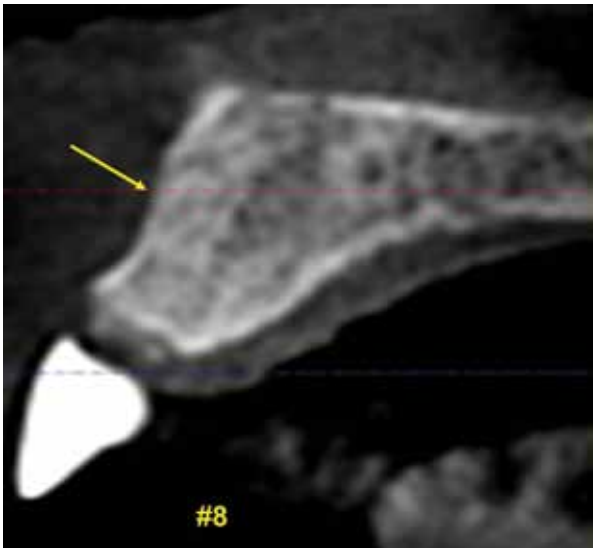

Figure 24: Eight months post-extraction/socket graft.

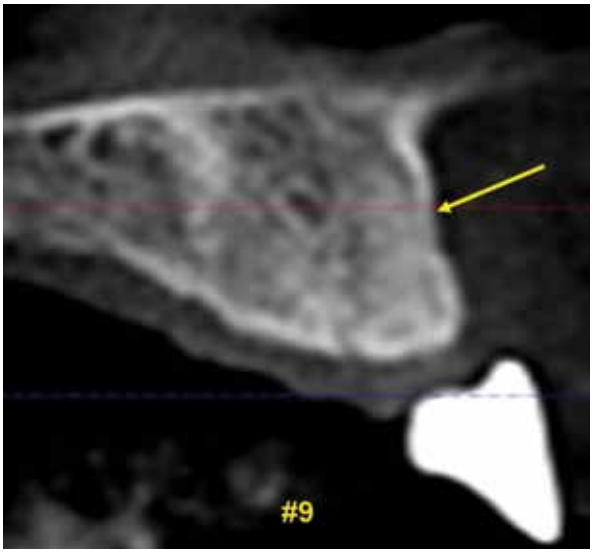

Figure 25: Eight months post-extraction/socket graft.

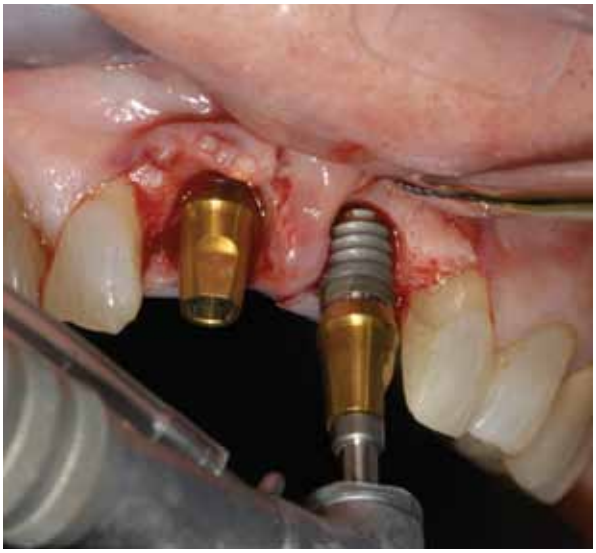

Figure 26: Reentry with minimal flap reflection for implant placement.

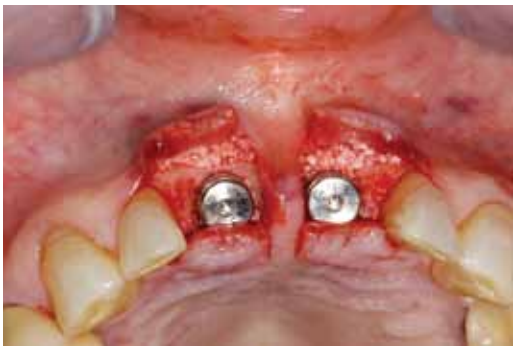

Figure 27: Subperiosteal veneer xenograft.

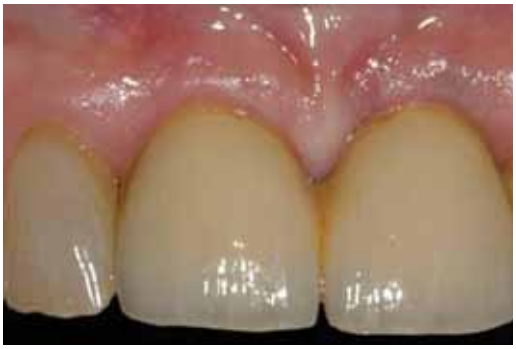

Figure 28: Completed prosthetics after three and a half years.

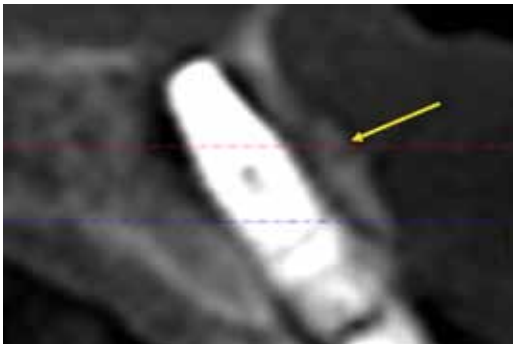

Figure 29: CBCT sagittal view, #8, after three and a half years. Note labial plate stability.

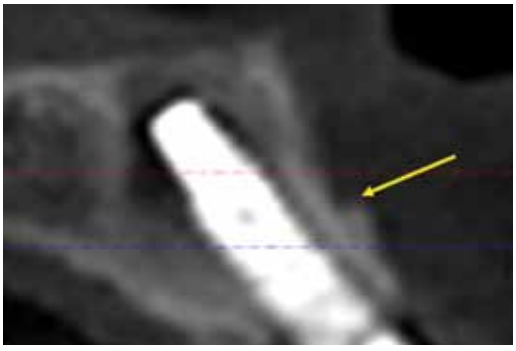

Figure 30: CBCT sagittal view, #9, after three and a half years. Note labial plate stability.

flap and flapless surgery were compared. Bone loss, tissue inflammation, and early signs of inflammation were higher in the flap group. A higher average of mucosal width was measured in the flap implant placement surgery when compared with the flapless group. This was thought to be the result of improved quality of healing due to the amount of injury.[27] You et al.[26] reported that the length of junctional epithelium was higher and more apically based in the flap group, contributing to longer probing depths. These findings are consistent with the clinical studies of Jeong et al.,[8] resulting in decreased peri-implantitis in the flapless category.

Conclusion

Flapless surgery is not spared from soft tissue changes. Bony changes do happen and seem to be improved by smaller tissue punch techniques.[8] The mucosal tissue is more abundant in flap surgery and thinner in flapless surgery. Although the role of keratinized tissue in the health of peri-implant soft tissue is controversial,[28,29] flap surgery seems to provide an abundance of mucosal tissue, but results in a longer and more apically based junctional epithelium.

Due to the controversies related to flapless implant surgery, several myths were explored along with the reviewed literature. Publications on this topic are ever increasing. Well-controlled studies, however, are necessary to accurately assess the merits of this technique.

The available data, although relatively short term, indicate that this implant placement approach is not recommended for entry-level clinicians, despite the use of CBCT and implant placement software. In actuality, the flapless approach often is more involved and technically challenging than the conventional open flap approach, and works best in the hands of a well-trained, experienced implant surgeon with appropriate surgical and advanced imaging skill sets.

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> Research has shown that gingival morphology is critical to the esthetic outcome of implant surgeries, root coverage procedures, and periodontal therapies.

Key Words: aesthetic buccal flap, ABF, soft tissue, periodontal biotype, implant surgery

Dr. Steigmann Addresses the Flap Approach to Implant Surgery

When performing implant placement, it is commonly believed that the larger the gingival flap, the better the view, and an optimal view is crucial to proper implant placement. Because the movement in dentistry today is toward minimally invasive treatment, larger flaps are considered to pose greater risks,[1] especially in patients presenting with a thin biotype. Research has shown that gingival morphology is critical to the esthetic outcome of implant surgeries,[2-4] root coverage procedures,[2,5,6] and periodontal therapies.[2,7] Thicker tissue is important for successful outcomes of implant restorations and root coverage procedures.[1]

An alternative solution is to devise a viable flap design (i.e., the aesthetic buccal flap [ABF] design) and to carefully plan the relaxation of the tissue and tension of primary closure. The ABF design was developed to protect the soft tissue and provide an esthetic outcome.[1] However, its application is contingent upon specific conditions, including the absence of soft tissue recession and limited interproximal bone resorption.[1]

The many different flap design variations each have their own criteria by which their use is determined. As a prerequisite to implant surgery, a critical evaluation of the hard and soft tissue conditions—including gingival scalloping and periodontal biotype—is crucial to planning the incisions and evaluating the surgical outcome.[1] The individual gingival characteristics of each patient will dictate the surgical technique, how to approach suturing, whether augmentation of the area is required, and other considerations when analyzing the utility of different flap designs. Another flap design that can maintain the papillae is the papillae preservation flap for healed sites.[8] In cases with late implant placement, the soft tissue can partially be maintained with the help of a Maryland bridge and a pontic that enters the extracted site.

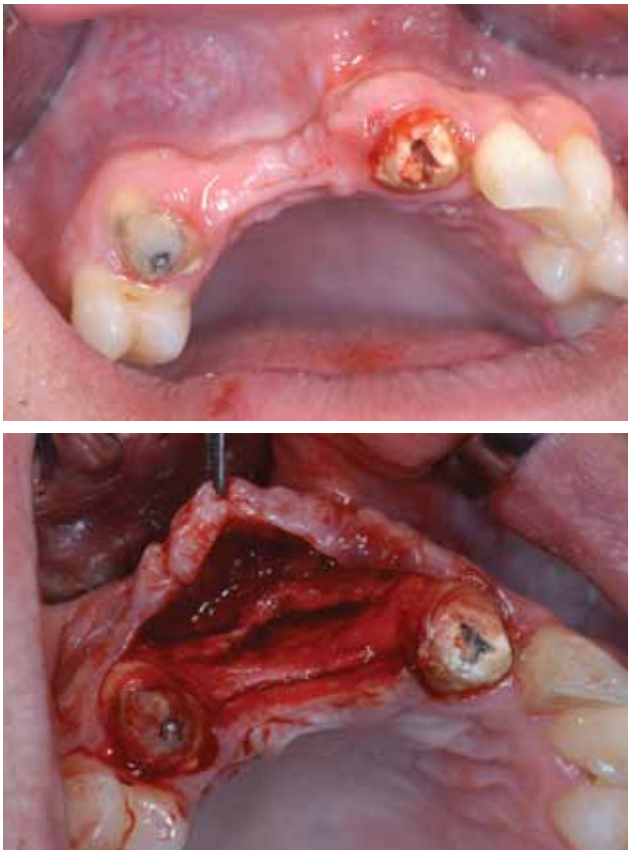
Myth
All techniques from oral surgery, periodontology, and implant dentistry are applicable to implant placement.

Reality
Many of the procedures performed in a general dentist's office are classified as oral surgery, including procedures related to tooth extraction, corrective jaw surgery, oral pathology, facial trauma, and the correction of temporomandibular joint disorders. Today, dental implant treatments are also being performed by some general practitioners. However, implant placement is a sensitive and specialized procedure that requires knowledge of occlusion, surgical training, and skill in performing techniques indicative of its complexity. While certain surgical techniques synonymous with oral surgery and periodontology have been found suitable for implant dentistry, others have required alteration and adaptation to meet the implant placement requirements. The oral characteristics of the individual patient will affect the outcome of the procedure as well. For instance, tooth extraction in patients with thin biotype can cause unexpected anatomical changes, while patients with thick biotype experience only minor (if any) changes. Therefore, implant procedures are modified according to very specific individual characteristics **(Figs 1 & 2)**.

Myth
Soft tissue biotypes are consistent among patients.

Reality
The quality of tissue differs among patients. Prior to performing a flap design, the patient's biotype, as well as the quality and quantity of available tissue, must be considered. A thick biotype reacts to injuries, surgery, and other trauma by forming pockets to maintain the soft tissue frame. Conversely, a thin biotype reacts to injuries and trauma with soft tissue recession.[2]

Identifying the patient's biotype is a prerequisite to implant surgery so as to determine tissue response to that particular surgical procedure. Surgery is adjusted based upon the diagnosis of biotype due to the reaction of the involved tissues—the soft tissue and the underlying bone—which depends upon the patient biotype. A flap design applicable to a thick biotype is not necessarily suitable for a thin biotype **(Figs 3 & 4)**.



Figures 1 & 2: Split thickness flap for guided bone regeneration to make coverage of high-volume augmentation possible without overstretching the tissue.

> The esthetic and functional success of the flap approach with implant placement depends upon tissue and surgical wound type.

Myth

The patient's soft tissue biotype is irrelevant when considering implant placement surgical approaches.

Reality

In 1969, Ochsenbein and Ross determined that gingival morphology could be divided into flat-thick and scalloped-thin[2,9] gingiva, which were later categorized by Seibert and Lindhe as "periodontal biotypes."[2,10] These biotypes have been indicated in the outcomes of implant surgeries and periodontal procedures.[2] Thick tissue biotypes have been proven to have more successful outcomes than thinner tissue biotypes, which is an important consideration when embarking upon any implant surgery.[11]

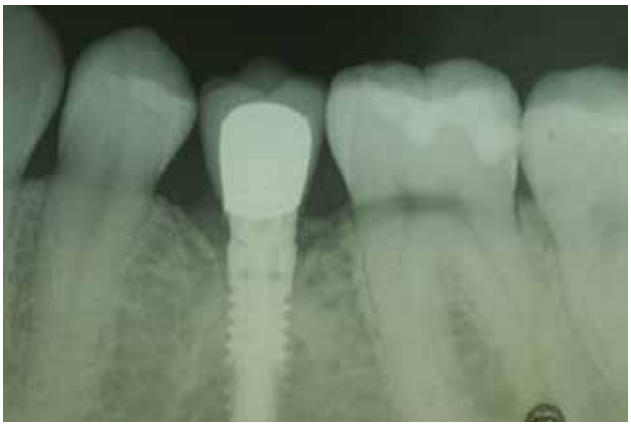
While there is a tendency to use one flap design for every indication, the reality is that flap designs require modification according to the periodontal biotype of the individual patient, requiring different treatment modalities. During a bone grafting procedure, to cover the bone augmentation, tissue is stretched. It is possible to stretch thick biotype over the augmentation; if slight tension exists, healing will take place without complication. Stretching thin biotype, however, results in tearing, rupturing, and necrosis.[12] Additionally, while an incorrect incision may result in scarring with a thick biotype, the same situation involving a thin biotype may prevent proper nutrition and revascularization, resulting in necrosis.[12] Therefore, incisions in very thin tissue should be avoided and a flap approach that preserves the biotype employed **(Fig 5)**.[12]

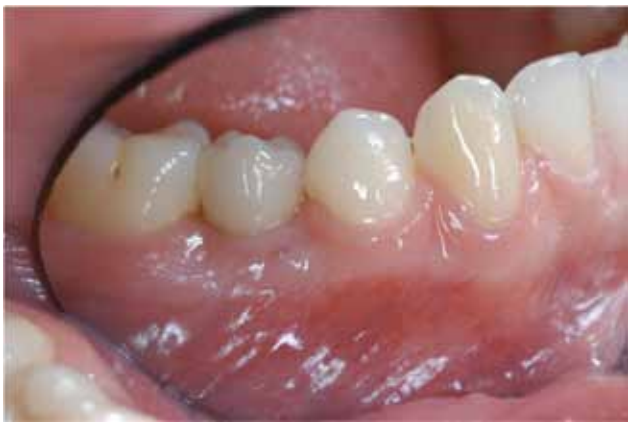
Myth

Tissue grafting for augmentation does not require adjustments to the suturing technique.

Reality

When performing a grafting procedure in implant dentistry, it is necessary to suture the flap with a tension-free suture following surgery **(Fig 6)**.[13] This becomes more difficult for high-volume augmentations. Because a bone graft requires the addition of either bone or a bone-like material, the presence of additional material makes it difficult to manipulate soft tissue.[13] Primary flap closure requires stretching the tissue, rendering it difficult to suture the flap in a tension-free fashion.[13] Additionally, stretching the tissue in the esthetic zone changes the tissue quality.





Figures 3 & 4: Successful esthetic outcome for an immediate implant placement in thick biotype.

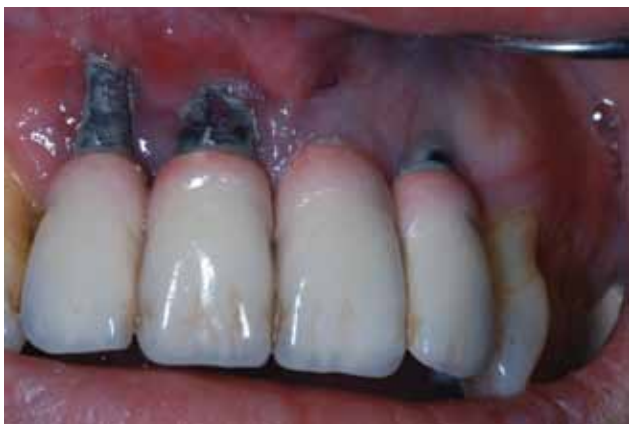


Figure 5: Failure of an immediate implant placement in thin biotype.

Therefore, an approach must be devised to maintain tissue quality while administering proper closure **(Figs 7a-7c)**. If the facial flap is stretched over the opening, the vestibular tissue will be pulled coronally, resulting in a thin biotype and insufficient volume of attached tissue.[12] Equally, if the tissue is pulled too taut in patients with thick tissue, the tissue will stretch thin and be prone to rupture or other complications.[13]

Conclusion

Modern dentistry seeks to minimize trauma to the patient and the masticatory system. When working in the anterior region, esthetics is also key **(Figs 8a & 8b)**. The fact that different tissue types heal differently and react differently to trauma necessitated the development of several variations in flap design to provide the least invasive, most successful, and most esthetic implant treatments. The esthetic and functional success of the flap approach with implant placement depends upon tissue and surgical wound type. Conservative flap design and effective suturing reduce tissue trauma and optimize the rate of soft tissue healing.[13] An assessment of the patient's hard and soft tissue is crucial prior to any implant surgery. Treatment should be determined based upon the condition and quality of each patient's individual gingival tissue morphology.[13]

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Figure 6: Tension-free sutures for flap adaptation. This approach protects the gingival margin from recession.

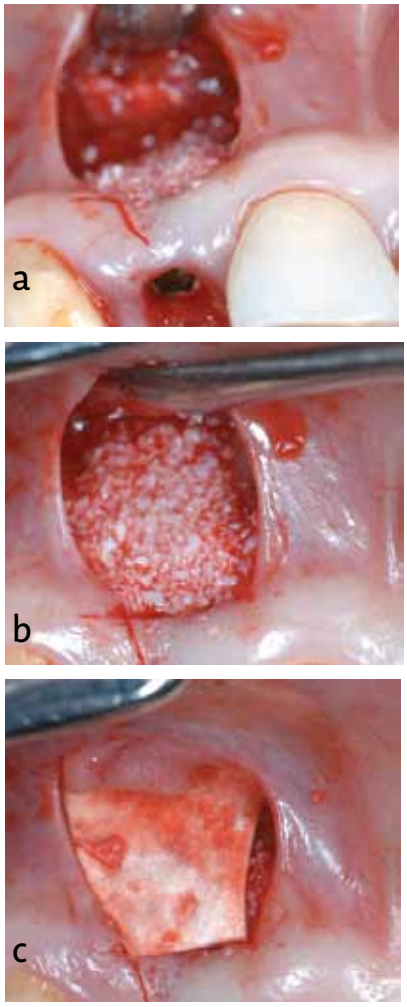

Figure 7: Performance of the esthetic buccal flap for maintenance of the supraosseus soft tissue (Fig 7a), with simultaneous guided bone regeneration (GBR) with grafting material (Fig 7b) and collagen membrane (Fig 7c).

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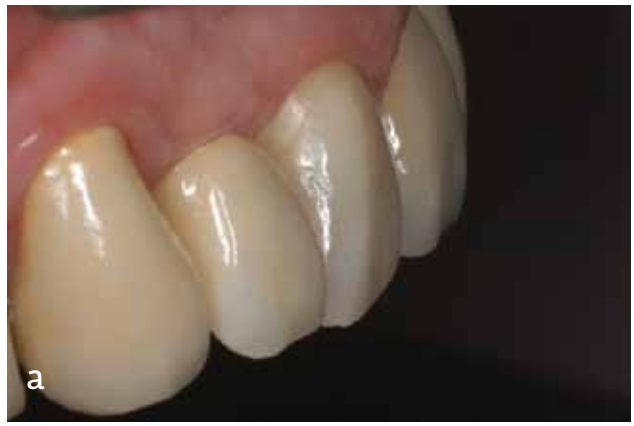

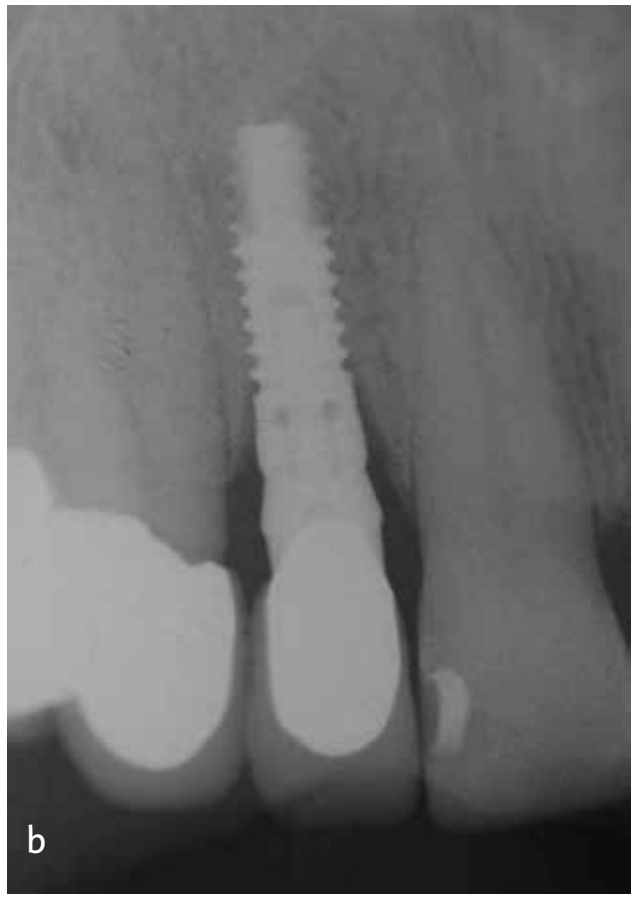

Figures 8a & 8b: Long-term follow-up three years after surgery with preservation of the soft tissue and GBR.

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Key Words: immediate dental implant placement, CAD/CAM-fabricated surgical guides, dental extraction techniques, provisional implant restorations, crown contours

Introduction

The successful placement of an immediate implant and its provisional restoration requires the confluence of many clinical variables and treatment steps. It is critical to understand which of these factors can be controlled and which cannot. Done successfully, an immediate implant and provisional provides a valuable treatment option for patients, who appreciate the reduced treatment time and the enhanced esthetic outcomes.[1,2] Our challenge is to provide this service without compromising the long-term result. This article summarizes the 10 key steps in delivering this service.

KEY STEPS in Immediate Implant Placement

Delivering a Screw-Retained Provisional

Kevin G. Murphy, DDS, MS

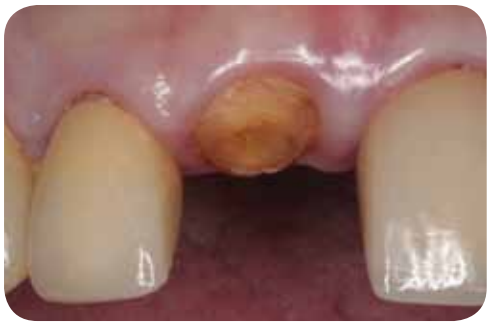

Figure 1a: Preoperative clinical presentation of nonrestorable tooth #8.

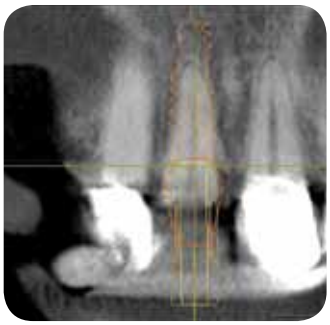

Figure 1b: CBCT tangential image of immediate implant site with simulation of implant and generic abutment placement.

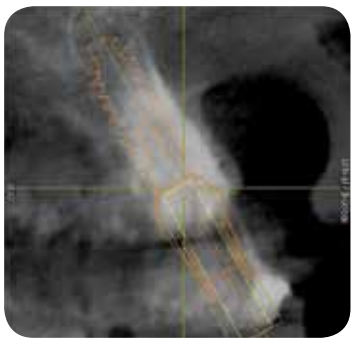

Figure 1c: CBCT cross-sectional view demonstrating the implant and abutment simulations. By using a cotton roll placed in the labial vestibule during the scan process, this image helps to determine the thickness of the labial plate and the overlaying soft tissues.

1

Step 1: Arrive at a Proper Diagnosis

The use of a preoperative cone beam computed tomography (CBCT) scan for immediate implant placement is becoming the norm. The use of CBCT does not ensure a successful outcome; rather, it helps to prevent long-term failures.[3,4] This scan will help determine if sufficient thickness of the labial plate is present, and the location of the incisive foramen. Placement of the implant with a deficient labial plate or into the incisive foramen will most likely result in fixture failure **(Figs 1a & 1b)**.

Enhanced visualization of the gingival tissue thickness and labial plate dimensions can be easily achieved by placing a cotton roll in the vestibule adjacent to the proposed surgery site. The cotton roll creates space and prevents shadowing from the soft tissue of the lip **(Fig 1c)**.

From the CBCT image it is also possible to plan the placement of the implant and the approximate abutment size.

Step 2: Fabricate the Diagnosis Wax-Up, Matrix, and Eggshell

Fabricate a diagnostic wax-up **(Fig 2a)**. Pay attention not only to the esthetics of the provisional restoration, but also to those of the lingual and incisal contours and lengths. For the first three months, this restoration will need to be out of any occlusal contact. Plan out the protrusive and lateral-protrusive movements.

A methyl methacrylate or Radica (Dentsply Prosthetics; York, PA) "eggshell" provisional is fabricated from a silicone putty. This matrix will be used later to help orient and index the eggshell over the temporary abutment **(Fig 2b)**. Sandblast the inside of the eggshell.

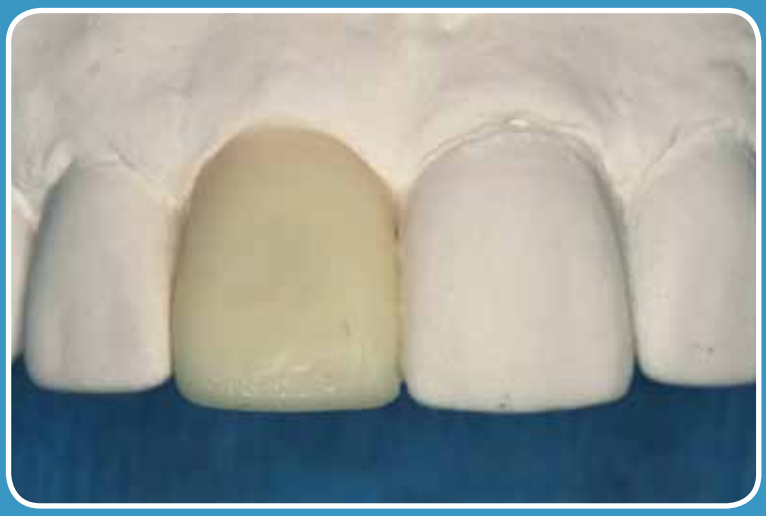

Figure 2a: Diagnostic wax-up.

Figure 2b: Silicone matrix with eggshell provisional restoration.

Done successfully, an immediate implant and provisional provides a valuable treatment option for patients.

3

Step 3: Preserve the Labial Plate During Extraction

The term *atraumatic extraction* is a misnomer. All extractions are traumatic to the bone and periodontal ligament (PDL). Minimizing outward expansion of the thin labial plate conceptually should decrease postoperative bone resorption. Start by gently tapping a thin surgical blade (Beaver-Visitec; Waltham, MA) into the PDL space with a mallet in the interproximal and palatal areas only. A 6900 Beaver blade is used to begin the PDL separation **(Fig 3a)**. Removal of the root is best achieved by applying only forces that are either rotational or coronal in direction. Apply rotation forces in a counter clock-wise direction using narrow beak forceps (Karl Schumacher; Southampton, PA). Extraction appliances (e.g., Benex [Meisinger; Centennial, CO]; or Sapian [Sapian Research; Fort Worth, TX]) direct force coronally and are used when there is not enough remaining tooth structure for forceps. The Sapian system uses a large serrated post that is threaded in the canal system of the tooth **(Fig 3b)**. The fulcrum tray and pry bar allow for a coronally directed force vector and subsequent removal of the intact root **(Figs 3c & 3d)**.

Placement of a slowly resorbing particulate bone graft between the implant and the socket is suggested. Depending upon the tissue biotype, a subepithelial connective tissue graft may also be required.

Figure 3b: Insertion of threaded extraction post.

Figure 3c: The fulcrum tray and pry bar. An apically directed force is applied to the pry bar, resulting in the threaded extraction post and root being pulled in almost a purely coronal direction. This force minimizes the trauma to the thin labial plate.

Figure 3a: Tapping of a blade into the PDL space with a surgical mallet. The blade acts as a periotome and facilitates rotational movement of the root within the alveolus when forceps are used.

Figure 3d: Extracted root.

Step 4: Use a Surgical Guide and Locate the Implant Precisely

The implant is ideally located slightly toward the palatal aspect of the socket, allowing for screw access palatal to the incisal edge of the provisional restoration. Establishing the correct osteotomy direction is often difficult as the pilot burs will tend to migrate to the apex of the socket. Side-cutting Lindemann burs (Salvin Dental Specialties; Charlotte, NC) can help to establish the correct osteotomy pathway. In this case, a higher level of control was gained by using a CAD/CAM-fabricated guide (SiCAT, Sirona Dental; Charlotte, NC). Using this type of guide, it is possible to correlate the bone geometries with the prosthetic simulation. These guides precisely orient the osteotomy drills using a series of sleeves matched to the diameter of the drill **(Figs 4a-4c)**.

The coronal aspect of the socket is usually scalloped with the height of the interproximal bone 2 to 3 mm more coronal than the labial aspect. If the implant is placed too deeply, the provisional restoration's subcrestal contours will be difficult to shape, may impinge upon the bone within the socket, and lead to long-term bone loss. If the implant is not placed deeply enough, the lack of vertical height will result in contours that have an extreme horizontal component, and it will be difficult to create an esthetically acceptable result.

Figure 4a: Fabricated surgical guide. This guide transfers the information from the CBCT implant placement simulation to the mouth.

Figure 4b: Guide with the interchangeable sleeves. The sleeves are matched to the diameter of the osteotomy burs.

Figure 4c: Guide with implant driver and implant. This guide facilitates precise positioning of the implant according to the computer simulation.

Step 5: Fabricate the Temporary Abutment Cylinder

Try in an indexed screw-retained abutment cylinder. Mark the ideal length and lingual contour on the abutment. Unscrew the abutment and place it on an implant analog. Adjust with a high-speed bur as necessary, but do not do this in the mouth. Retry the abutment in the mouth to verify the correct position. If satisfied, remove the abutment from the mouth and sandblast the retentive portion of the abutment with aluminum oxide, leaving the apical portion smooth and highly polished **(Fig 5)**. Hand torque the abutment into place and take a radiograph to verify the abutment has completely seated. Make sure the abutment is not impinging on the interproximal bone.

Figure 5: Sandblasted temporary abutment cylinder.

Remember that the interproximal surfaces will most likely be subcrestal and these contours should be slightly concave.

6

Step 6: Trim the Matrix and Adapt the Eggshell

Trim the buccal aspect of the matrix in a horizontal direction, removing the labial gingival and middle thirds. The remaining matrix will support and orient the eggshell on its palatal and incisal aspects. Cut an oval-shaped access hole in the palatal aspect of the eggshell **(Fig 6a)**. Take the wooden dowel portion of a cotton-tip applicator and break it in half. Lubricate the dowel and insert it into the screw access chamber of the abutment **(Fig 6b)**. Make any adjustments necessary to ensure that the access hole does not bind on the dowel. On the palatal aspect of the matrix, cut a 3-mm wide channel that runs from the palatal edge of the matrix to the incisal edge of tooth. Reposition the eggshell within the matrix. Position the matrix with the eggshell over the dowel and gently seat it on the gingival tissues. Verify the fit **(Fig 6c)**.

Figure 6a: Trimmed silicone matrix with eggshell provisional. The labial aspect of the matrix is removed, leaving the incisal and palatal aspects of the matrix to stabilize the eggshell provisional.

Figure 6b: Insertion of a lubricated wooden dowel into oval-shaped access hole of the egg-shaped provisional restoration.

Figure 6c: Lingual aspect of silicone matrix with palatal channel. The silicone matrix is trimmed on the palatal aspect to allow the direct visualization of the access hole and dowel.

7

Step 7: Bond the Abutment Cylinder to the Eggshell

Remove the abutment from the mouth and coat the retentive portion with an adhesive (OptiBond XTR, Kerr; Orange, CA), being careful to not get any resin on the apical polished end **(Fig 7a)**. Likewise, coat the inside of the eggshell with the resin and light cure **(Fig 7b)**. Reposition the eggshell within the matrix. Replace the cylinder with hand torque only. Insert the lubricated wooden dowel. Add a moderate amount of a flowable composite (Revolution Formula 2, Kerr) to the labial aspect of the inside of the eggshell and also to the labial aspect of the abutment cylinder **(Fig 7c)**. Position the matrix and eggshell into the mouth and verify that the eggshell is seated fully into the matrix **(Fig 7d)**. Light cure the labial aspect for 20 seconds, tacking the eggshell to the cylinder. Remove the dowel and gently remove the matrix by lifting the incisal edge first. Check the positioning of the provisional and light cure for another 20 seconds. With a pencil, mark the location of the gingival margin on the labial and palatal aspects.

Figure 7b: Application of adhesive to inside of the eggshell provisional.

Figure 7c: Placement of small amount of flowable resin to the labial aspect of the temporary abutment cylinder.

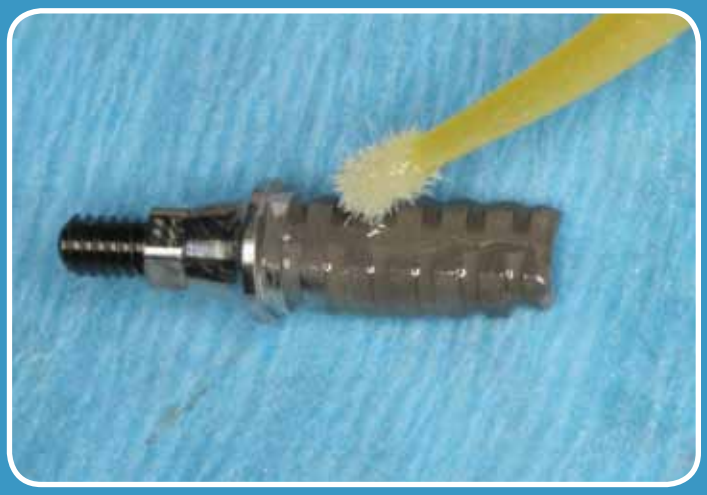

Figure 7a: Application of adhesive to the temporary abutment cylinder.

Figure 7d: Positioning of the silicone matrix with eggshell. The matrix aligns the eggshell provisional over the abutment cylinder. The flowable composite is light cured through the eggshell, bonding it to the temporary abutment cylinder.

8

Step 8: Fill in the Subgingival Contours

Unscrew the abutment from the implant and place an unflaired healing abutment while fabricating the provisional. The eggshell will be attached to the abutment cylinder in just one spot **(Fig 8a)**. Place the abutment on an implant analog and re-insert the lubricated dowel. Visualize the coronal emergence profile and subcrestal profile of the tooth being replaced. Add flowable composite in 1- to 2-mm increments. Remember that the interproximal surfaces will most likely be subcrestal and these contours should be slightly concave. If these surfaces are angular, they could impinge on the bone and prevent complete seating of the abutment. Apical to the interproximal tooth contacts, the surface contour should be concave, providing for a volume of soft tissue that will later comprise the papillae **(Fig 8b)**.

The labial contour should follow that of the contralateral tooth. Just apical to the free gingival margin, the contour should be slightly convex without blanching of the tissue. This area then smoothly tapers toward the implant-abutment interface with a concave contour **(Fig 8c)**.

Figure 8a: Initial bonding of the eggshell to the temporary abutment cylinder.

Figure 8b: Interproximal subgingival contour of the provisional restoration. The subgingival interproximal contour is concave and not flat. The proper shape will keep the provisional from binding on the bone and promote the maintenance of the gingival papillary tissues.

Figure 8c: Labial contour of the provisional restoration. The subgingival labial contour of the provisional restoration is convex apical to the free gingival margin and concave coronal above it.

9

Step 9: Check the Fit and Occlusion

Remove the healing abutment. Insert the crown abutment and check the interproximal contacts. If the contacts are too tight, complete seating of the crown will not occur. A greater concern with too-tight contacts is when the screw is tightened and the crown becomes "wedged" between the adjacent teeth, forcing the implant out of the osteotomy. Confirm the fit with a radiograph **(Fig 9)**.

The percentage of bone contact to the implant surface in immediately placed implants will actually decrease over the first eight weeks of healing and then gradually increase thereafter.[5] Protection of the restoration from any occlusal loading during this period is very important. Check the centric, protrusive, lateral-protrusive and cross-over occlusal positions.

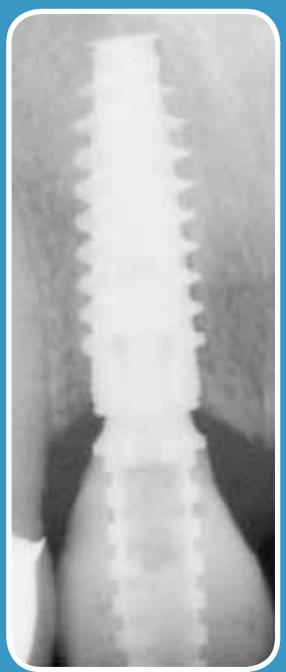

Figure 9: Radiographic confirmation of proper seating of the provisional restoration.

10

Step 10: Polish and Seat

Remove the provisional restoration and highly polish or add a glaze if desired. Insert the provisional and apply only a hand-torque force to secure the restoration **(Fig 10)**. Place a sponge in the access hole and cover with resin adhesive and a flowable composite. Confirm the occlusion again. The occlusion should be checked frequently for the first three months, as supraeruption of the occlusal antagonist can occur.

This provisional restoration will function as a template for the final restoration. Adjustments to the provisional contours and contacts that will affect the gingival shape can be worked out in this early phase of treatment. Fabrication of the final restoration will be more predictable and the long-term result more stable.

Figure 10: Finished immediate provisional implant restoration at time of insertion.

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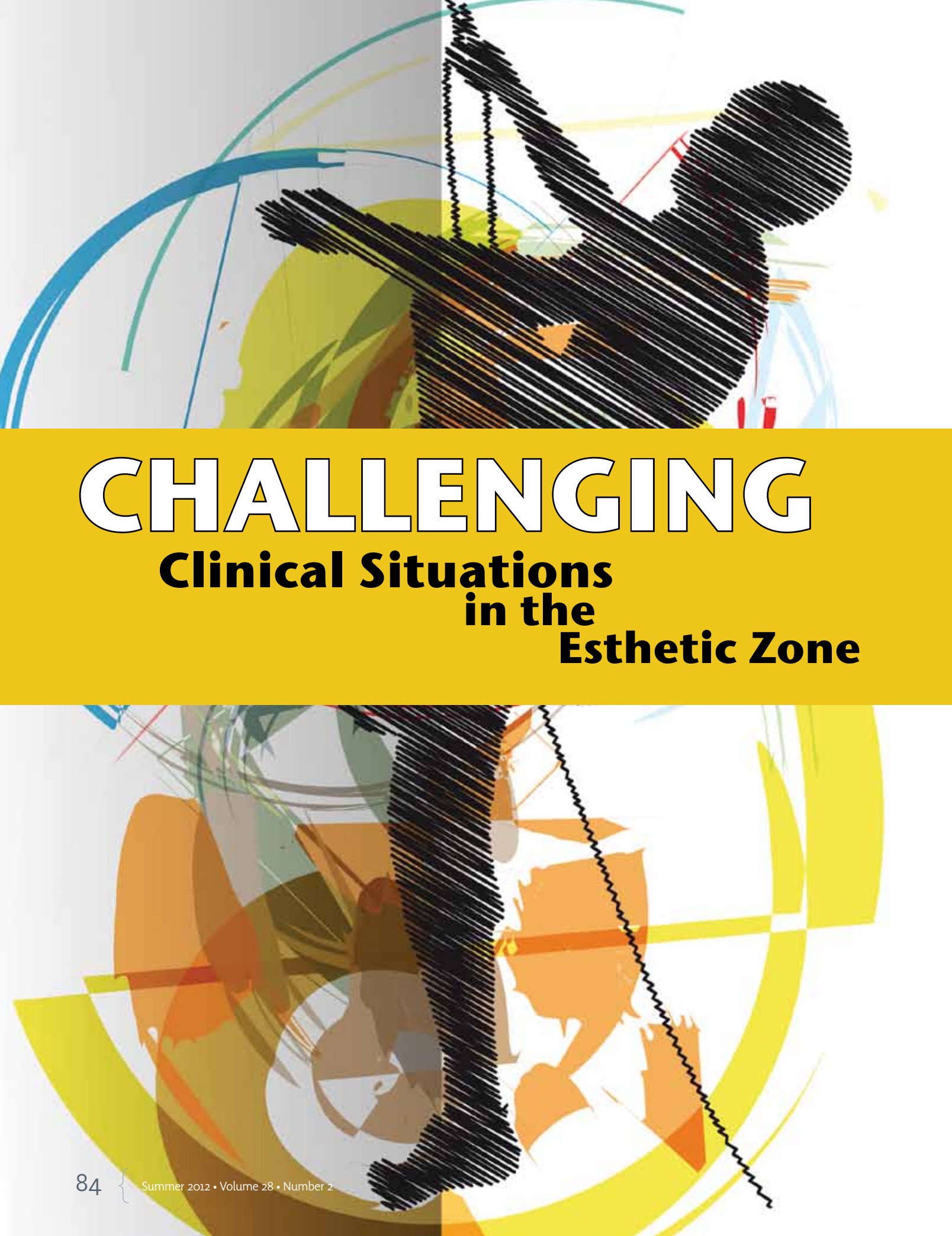

CHALLENGING
Clinical Situations in the Esthetic Zone

Maintaining and Creating Natural Soft Tissue Contours and Emergence Profiles Around Dental Implants

Paul S. Petrungaro, DDS

Abstract

This article will address the immediate tooth removal process/implant placement/provisionalization procedure in a single tooth maxillary central incisor. It will also describe the procedure applied to a case requiring both maxillary central incisors being removed, and the immediate implant placement and provisionalization process performed. Both of the case types described are traditionally considered to be challenging in regards to management of the diastema (Case 1), followed by the replacement of both maxillary central incisors simultaneously (Case 2).

Key Words: dental implants, provisionalization, surgical procedure, esthetic tissue profiles, minimally invasive

Introduction

Dental implant treatment continues to be a significant option in the treatment-planning process for tooth replacement procedures and is becoming commonplace in contemporary restorative and surgical dental practices. The more conventional, multi-step process of Stage One and Stage Two surgical implant placement and attachment procedures, followed by an additional final prosthetic procedure, is the method taught at most university-based implant training programs and private continuing education learning programs. Additional procedures, often prior to Stage One (implant placement procedure) require either bone replacement or soft tissue replacement procedures.[1-3] These multiple treatment phases utilizing dental implants for single or multiple tooth replacement could take anywhere from six to nine months of treatment, and in more complex cases, from 12 to 16 months of treatment, even for clinicians with extensive training.[1-3] Additionally, patients often were required to go without provisional restorations, or removable provisional restorations, throughout these lengthy healing phases.

Over the last 10 years, the option of immediate tooth replacement and provisionalization...for the delivery of the implant process has gained presence in treatment plans for those requiring single or multiple implants.

Immediate Implant Placement and Restoration Procedure

Over the last 10 years, the option of immediate tooth replacement and provisionalization (with or without occlusal loading) for the delivery of the implant process has gained presence in treatment plans for those requiring single or multiple implants.[4-6] This protocol differs from the more conventional multi-step approach of the implant placement process, with its three-to-six-month healing phase, a second surgical procedure (uncovering of the implant and healing abutment placement), and periodic observation of soft tissue maturation prior to the final restorative completion of the process. It simplifies that process into one procedure, wherein the implant is placed, and an abutment (either contoured final abutment, or a provisional abutment) and a provisional restoration are all accomplished at one single visit. Often, only a three-month healing and observation period is required. It is also important to note that most cases of immediate tooth removal and implant placement require some sort of bone replacement and tissue regeneration procedure, either as an entirely separate procedure, or in conjunction with the implant placement. In the more conventional multi-step approach, that may be managed as an entirely separate surgical procedure, hence expanding the entire treatment time. However, in the immediate procedure of placement and provisionalization, whether tooth removal is required or not, the bone and tissue regeneration is routinely completed simultaneously with implant placement and provisionalization.

Additional Benefits

Additional benefits of the immediate implant placement and restoration procedure include the following:[7,8]

- less invasive, flapless approaches, often realized in the surgical procedure
- minimal soft tissue changes or loss due to fewer surgical procedures
- more predictable soft tissue emergence profiles for the final restoration, as the provisional restoration acts to sculpt and maintain papillary tissues and natural emergence profiles
- patients benefit from an immediate fixed provisional restoration
- decreased treatment times to complete the implant treatment process
- patients realize a quicker return to their normal day-to-day life.

Process Success

The process of immediate tooth replacement and provisionalization for single-tooth restorations has been well documented in the dental literature.[4-12] The process in which a tooth is removed, the implant is placed (with or without bone or soft tissue replacement) by a minimally invasive means (flapless), a final abutment placed, and a well-contoured, highly esthetic provisional restoration seated, has been shown in the literature to be highly successful, with long-term success rates of 97.2% over an eight-year period in more than 3,200 sites.[7]

Multiple tooth replacement, following a similar protocol, has also been shown to be highly successful.[2]

Single and multiple tooth replacement, with immediate loading of the implants, following strict surgical and prosthetic principles,[13-15] and occlusal management, also has shown to be successful for those seeking dental implants as a tooth replacement option. As previously mentioned, these cases often require either bone or soft tissue replacement, or both, to replace the necessary surrounding environment for the implant to be successful long term,[16] with these procedures being accomplished simultaneously with the initial, and only, surgical procedure.

Dental Implant Technology

Dental implant technology has continued to expand, with most implant systems offering enhanced surface technology for a more rapid integration process, thread designs leading to a greater initial stability of the implant fixture at placement, implant collar designs specific for alveolar crest of the ridge maintenance, and soft tissue seal in the implant/abutment interface, all leading to an implant process whereby bone and soft tissue preservation can be extremely predictable.[17-19] With initial stability quotient (ISQ) measurements and either machined, contoured titanium, or contoured stock zirconia abutments, the abutment removal process, prior to final restorative protocols, can be totally eliminated. This protects the soft tissue attachment apparatus of the gingival tissue and the implant/abutment complex, helping to maintain bone level long term around dental implants.

All of these advances contribute to the rationale for a more immediate, one-stage protocol for implant placement and provisionalization/loading procedure.

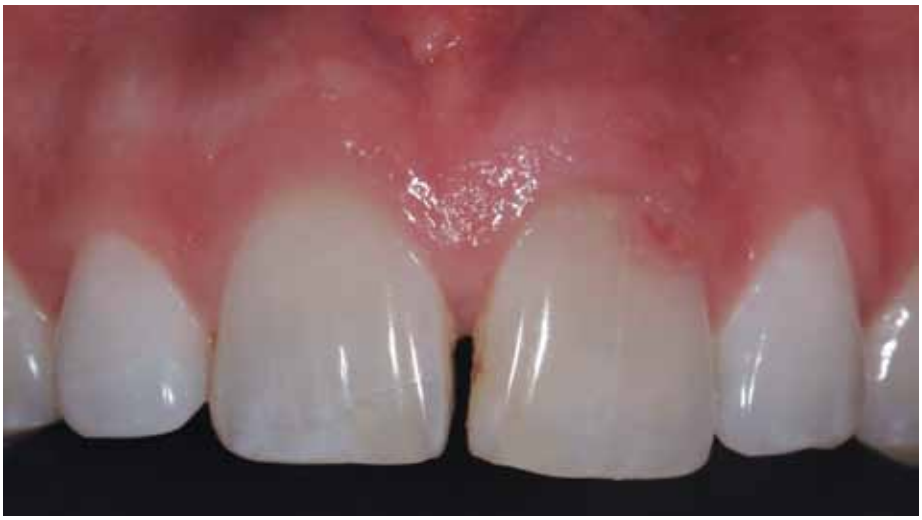

Figure 1: Pretreatment clinical view, Case 1.

Case 1

A 33-year-old, nonsmoking male presented for treatment of an endodontically failing maxillary left central incisor **(Fig 1)**. The patient had previously experienced facial trauma, which caused partial avulsion to both maxillary central incisors, resulting in devitalization and, subsequently, the root canal treatment. The left maxillary central had undergone external resorption resulting in the necessity for removal **(Fig 2)**, and an implant was planned for the tooth replacement. After reviewing multiple alternatives for implant placement procedures, the patient selected the option of immediate tooth removal, implant placement, and immediate provisional. The patient's medical history was noncontributory and, after a complete dental examination was performed, maxillary and mandibular study models were obtained, along with a facebow transfer. A diagnostic wax-up was then completed for the right and left central incisors, followed by the fabrication of a surgical guide/provisional system (TempStent II, Dr. Paul Petrungaro; Chicago, IL)[20] to facilitate the conversion of the surgical guide to immediate provisional at the implant placement procedure **(Fig 3)**.

Prior to the implant placement surgical procedure, the patient was placed on Augmentin (GlaxoSmith-Kline; Philadelphia, PA): 20 tablets, one tablet every 12 hours, and was instructed to start the antibiotic the day before the procedure, and one tablet, one hour before the procedure.

An incisal edge index of the maxillary anterior sextant was obtained before surgery, to register the preoperative spatial arrangement of the maxillary left central incisor. After administration of an appropriate local anesthetic, the maxillary left central incisor was removed by an atraumatic technique, preserving the natural emergence profile of the surrounding gingival

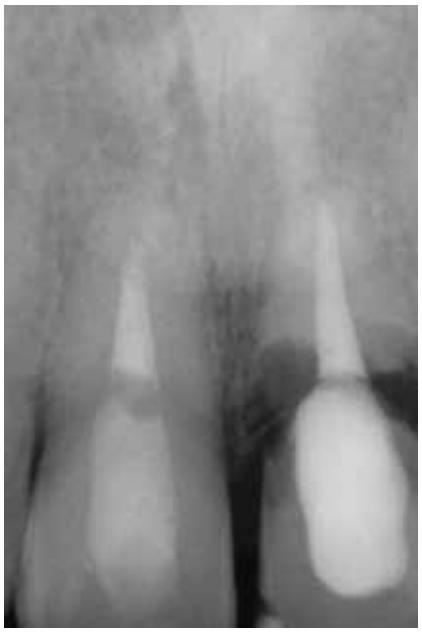

Figure 2: Pretreatment digital periapical view, left central incisor.

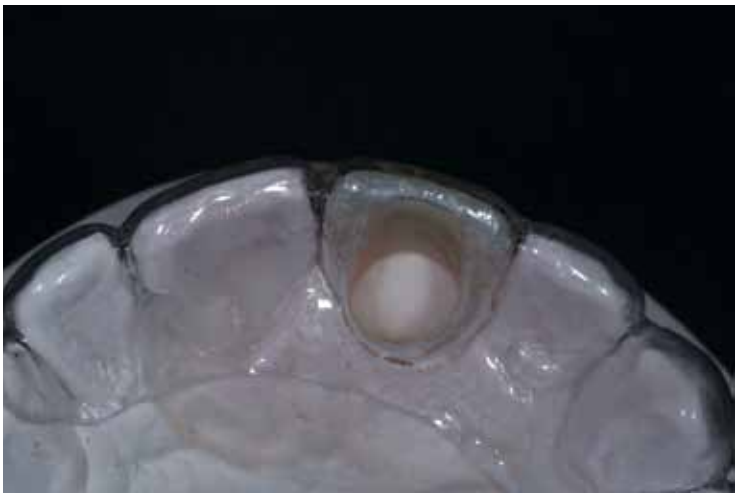

Figure 3: TempStent II surgical guide, occlusal view.

Figure 4: Occlusal view, TempStent II, intraorally.

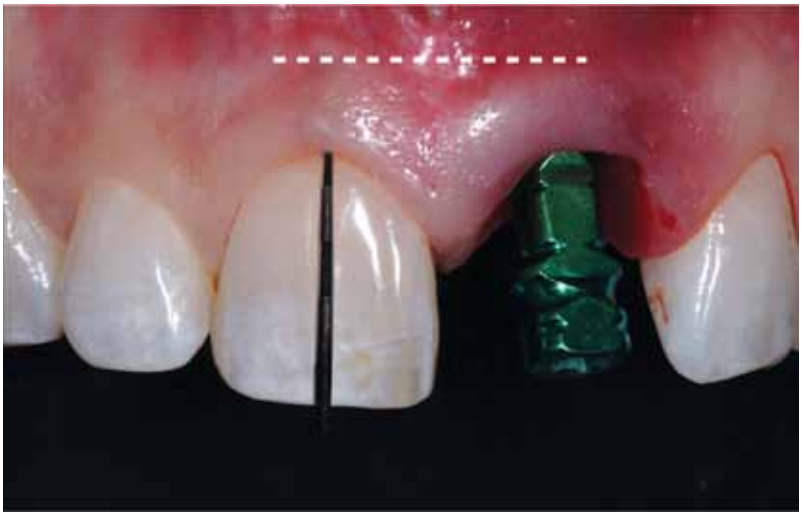

Figure 5: Proper depth of implant placement, left central incisor.

tissues. Debridement of the extraction socket was completed by mechanical curettage with a small molt curette, and rotary instrumentation with a coarse diamond on a high-speed handpiece with saline irrigation. All remnants of the periodontal ligament and/or granulation tissue were thoroughly removed to prevent the possibility of soft tissue in apposition to the implant surface, hindering the bone-implant interface at the initial healing phase, resulting in non-integration. Once debridement was completed, the TempStent II surgical guide was inserted **(Fig 4)** and site preparation completed. A 3.7 x 13-mm implant (Zimmer Dental; Carlsbad, CA) was placed at the palatal aspect of the extraction socket, with the depth of the implant placement dictated by the facial height of contour of the bone at the contralateral right central incisor **(Fig 5)**.[21] Removal of the implant carrier was followed by placement of the healing screw, followed by placement of an allogenic, mineralized cancellous graft, 1- to 2-mm particle size (Exactech; Alachua, FL), heavily condensed into the peri-implant defect on the facial of the implant. This was fixed to the facial aspect of the implant to fill the void up to the fenestration present in the buccal plate **(Fig 6)**. Removal of the healing screw was followed by placement of a stock contoured titanium abutment (341S, Zimmer), and the center screw hand tightened. A plastic provisional coping was roughened and bonding agent applied; it then was picked up in the natural tooth shell that had been altered and hollowed out previously. The natural tooth shell was lined with a regular composite and placed back into the incisal edge index obtained before surgery. The entire complex was then placed over the provisional coping, which was seated on the contoured abutment, and the tooth shell/composite complex was cured with a curing light. This registered the pre-surgical spatial arrangement of the left central exactly over the implant/abutment complex placed in the fresh extraction socket.

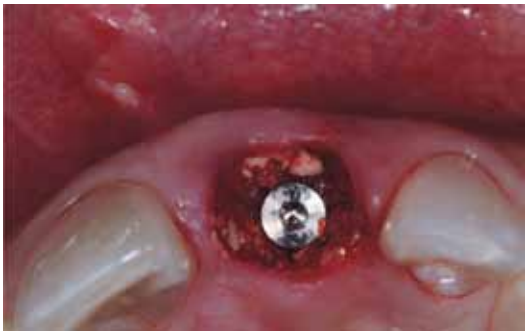

Figure 6: Peri-implant bone grafting.

Figure 7: Immediate postoperative clinical view, Case 1.

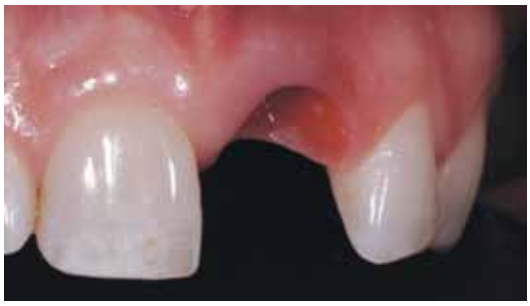

Figure 8: Two and a half months postoperative, Case 1, lateral view.

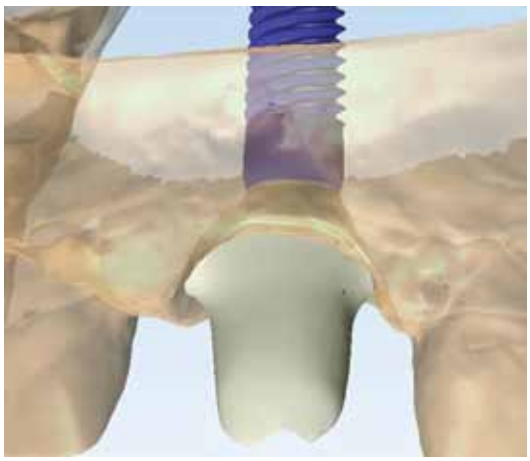

Figure 9: CAD/CAM-designed milled zirconia abutment.

Figure 10: Final milled zirconia abutment, all-ceramic restoration, Case 1.

Figure 11: Clinical view, 10 days after seating.

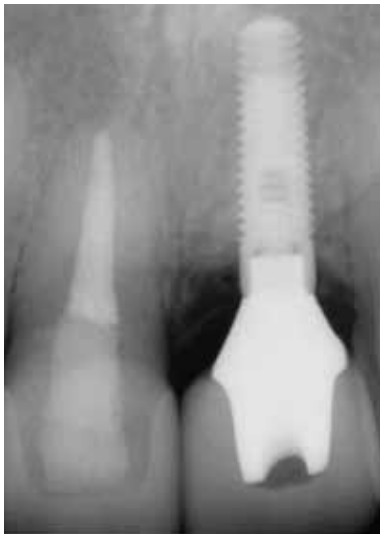

Figure 12: Digital periapical view, Case 1; case complete.

The natural tooth shell provisional complex was then removed from the mouth, and the margins of the provisional restoration were completed to the provisional coping with a flowable composite, with the provisional properly contoured and polished. The provisional was then temporarily cemented with clear TempBond (Kerr; Orange, CA), and the cement again light-cured. The immediate postoperative clinical appearance is shown in **Figure 7**. Please note how the contouring of the medial and distal line angle relationships offers passive support to the preexisting soft tissue emergence profiles.

The patient was then evaluated for occlusal contact in the centric, protrusive, and lateral excursive movements to ensure that no contact was present at the implant site, as this was an immediate nonfunctional load.

After two and a half months, impressions for a custom-milled zirconia abutment were completed. **Figure 8** shows the natural soft tissue emergence profiles that had been maintained and sculpted for the immediate provisionalization procedure at the implant placement visit. Following fixture level impressioning, the resulting model was sent for design of the milled zirconia abutment **(Fig 9)**.

Three months after surgery, the implant process was completed. Placement of the milled zirconia abutment and torqueing of the center screw to 30 Ncm **(Fig 10)** preceded placement of the final all-ceramic restoration. The 10-day post-seating clinical view is shown in **Figure 11**, with the case-complete periapical radiograph shown in **Figure 12**. A six-month post-seating lateral view **(Fig 13)** demonstrates the natural appearance of the emergence profile obtained for this procedure.

Figure 13: Six-month post-treatment clinical view, lateral emergence profile.

One of the most challenging issues facing the implant team is maintaining and/or sculpting soft tissue contours throughout the dental implant process in the esthetic zone.

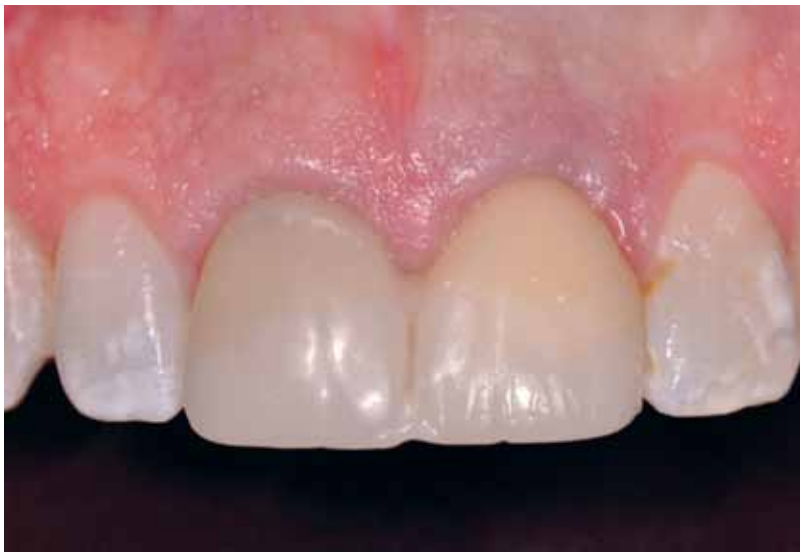

Figure 14: Pretreatment clinical view, Case 2.

Case 2

A 47-year-old nonsmoking male presented for treatment of failing dentition at the maxillary right and left central incisors **(Figs 14 & 15)**. Previous treatment included root canal therapy as a result of trauma to the incisors, with prior full-coverage restorations that had failed, with a vertical fracture present at the left central incisor. The present state of the centrals necessitated that crown lengthening be performed to determine the depth of fracture at the left central incisor, which would compromise the esthetic result to be obtained. The decision was made to proceed with implant therapy at both maxillary central incisors and to accomplish definitive treatment for the compromised situation present.

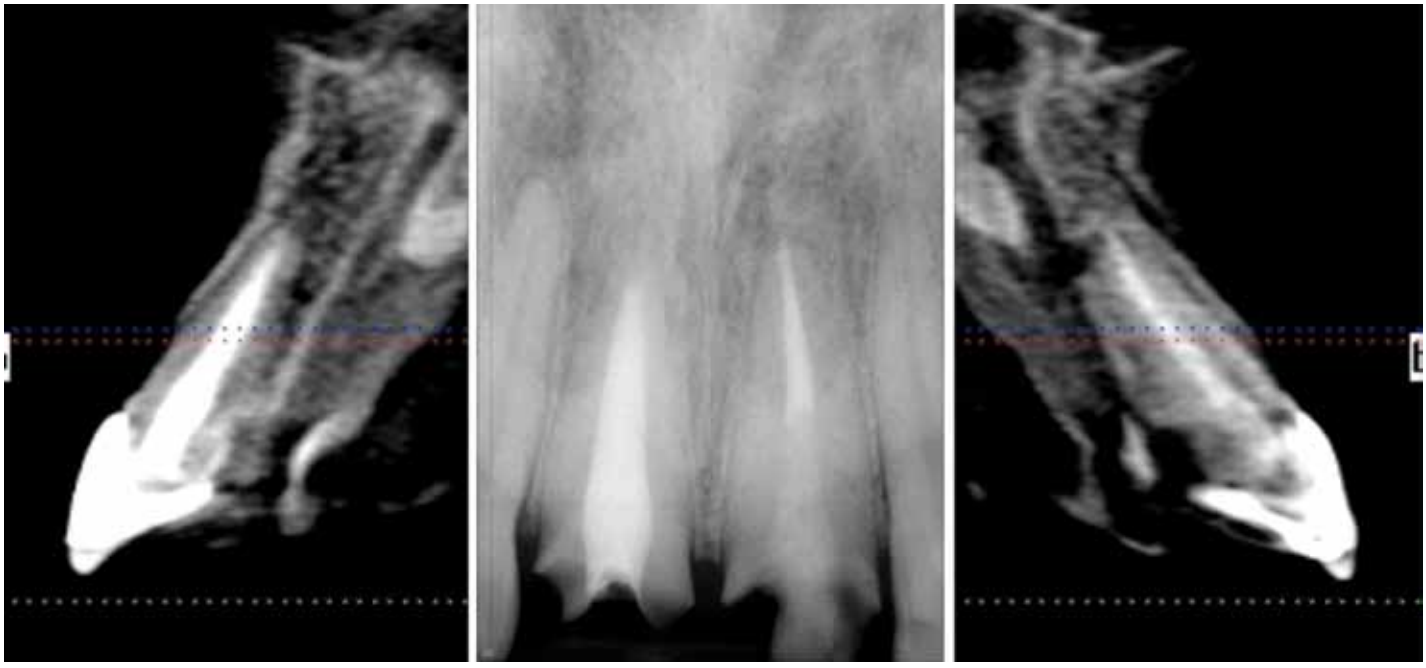

Figure 15: Pretreatment digital periapical radiograph, Case 2, and CT scan serial views of the right and left maxillary central incisors.

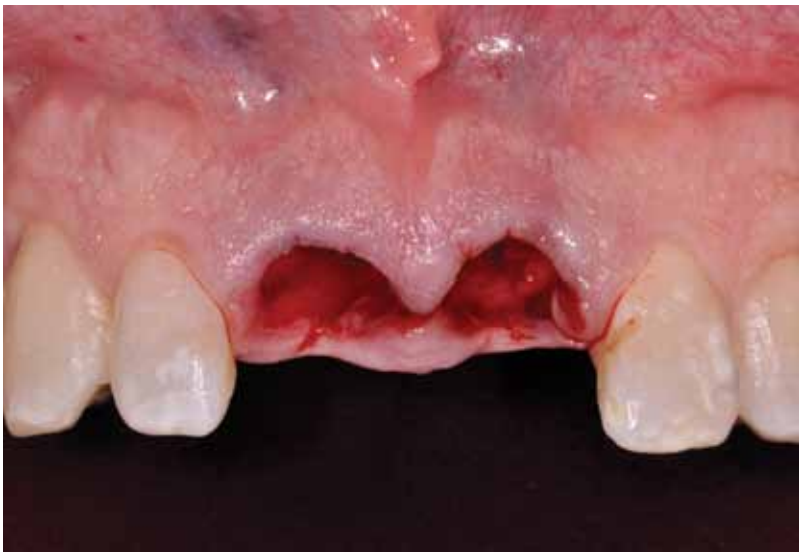

Figure 16: Atraumatic tooth removal.

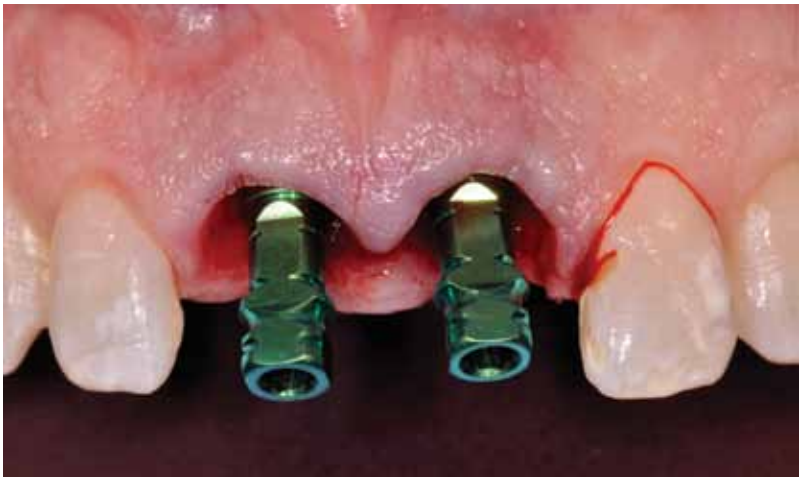

Figure 17: Implant placement, central incisors, minimally invasive placement.

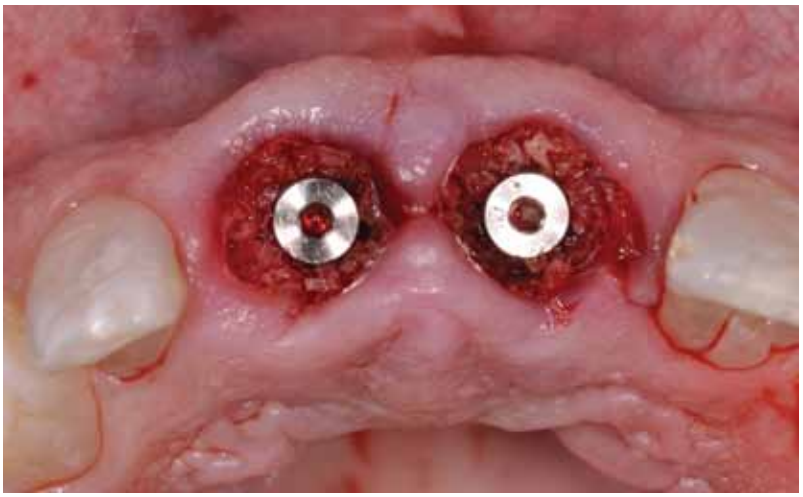

Figure 18: Minimally invasive bone grafting, peri-implant defects.

After maxillary and mandibular study models and a facebow transfer were obtained, a diagnostic waxing of the maxillary anterior sextant was performed. A surgical guide was then fabricated. The patient had decided to concentrate on only the maxillary central incisors, declining esthetic enhancement of the surrounding dentition.

After administration of an appropriate local anesthetic, the maxillary central incisors were removed atraumatically, preserving the pre-existing gingival emergence profiles **(Fig 16)**. Following debridement of the extraction sockets, ensuring that all remnants of the periodontal ligament and any granulation tissue were removed, the surgical guide was inserted and initial coring procedures were accomplished. After appropriate site preparation, two 3.7-mm diameter by 13-mm length implants (Zimmer Dental) were placed to the appropriate depth within the extraction sockets **(Fig 17)**. A sufficient initial ISQ measurement was obtained, allowing for immediate provisionalization of the implants. Prior to abutment placement, the peri-implant alveolar defects (fenestration type defect) required correction. An allogenic, mineralized cancellous bone graft, 1 to 2 mm in particle size (RTI Biologics, Alachua, FL) was placed and heavily condensed into the peri-implant defect at the facial of the implants **(Fig 18)**. Stock titanium abutments were then seated over the implants placed, and retrofitting of the TempStent II surgical guide was accomplished. The nonfunctional provisional restoration was then properly contoured, highly polished, and temporarily cemented with strong temporary cement. The immediate postoperative clinical view is shown in **Figure 19**. A seven-day postoperative view is shown in **Figure 20**; please observe the maturity level of the soft tissue emergence profile so soon after surgery. The patient had a three-month healing and observation period for integration of the implants to occur. A fixture-level impression was then obtained prior to final seating of the milled zirconia abutments fabricated in this case. **Figure 20** demonstrates the soft tissue emergence profiles that were sculpted and maintained throughout the healing phase, by the properly contoured provisionals fabricated at placement. **Figure 21** shows the natural soft tissue emergence profiles obtained prior to fixture-level impressioning. **Figure 22** shows the final implant-supported restorations obtained. The case-complete digital periapical radiograph is shown in **Figure 23**, and the CT scan serial views of the implants are shown in **Figures 24 and 25**.

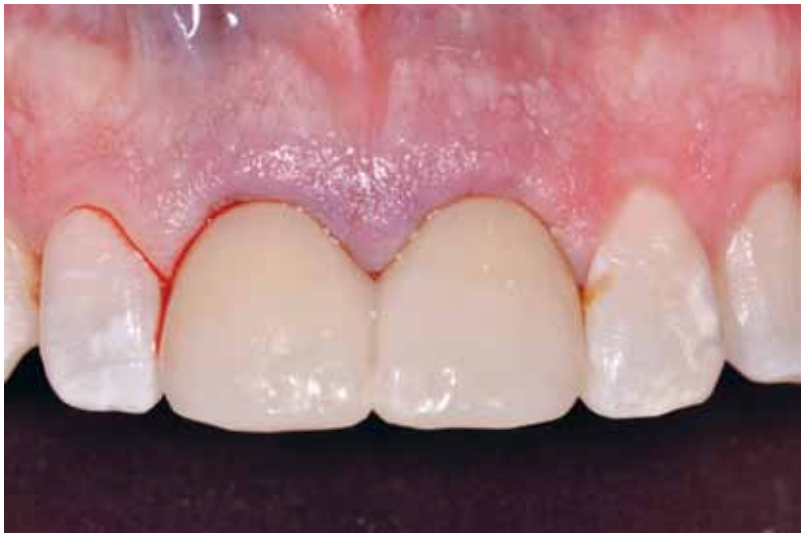

Figure 19: Immediate postoperative clinical view.

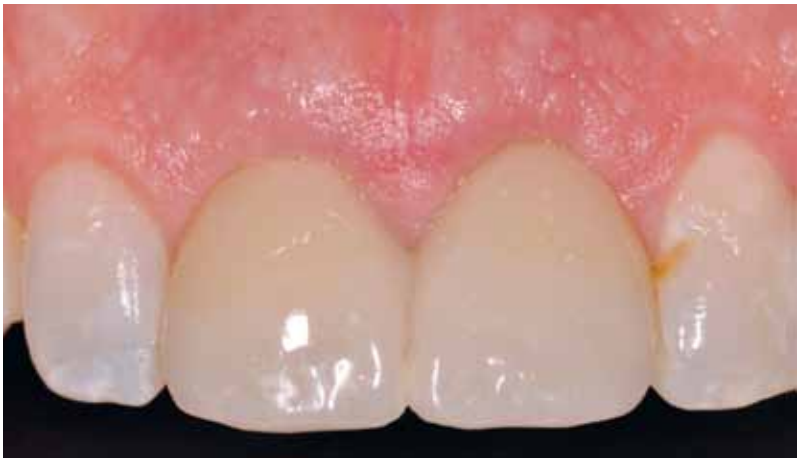

Figure 20: Seven-day postoperative clinical view.

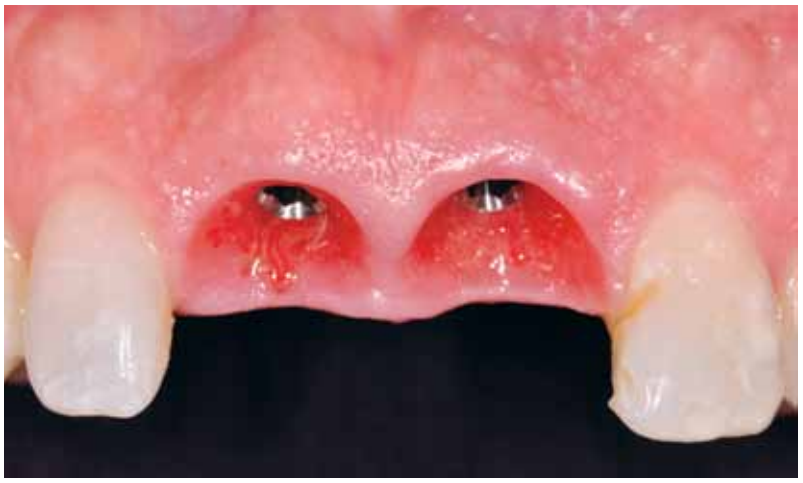

Figure 21: Natural, esthetic, soft tissue emergence profiles obtained prior to fixture-level impression.

Conclusion

One of the most challenging issues facing the implant team is maintaining and/or sculpting soft tissue contours throughout the dental implant process in the esthetic zone. Additionally, the replacement of compromised alveolar contours is one of the key determining factors to the long-term stability of soft tissue contours that compromise the natural emergence profile of the implant-supported esthetic restoration. Numerous surgical procedures have been clinically observed to affect not only the quality, but also the quantity of soft tissue contours around dental implants in the esthetic zone. This is even more exemplified in challenging clinical situations of multiple implants adjacent to one another in the esthetic zone, and single-teeth implants where compromised alveolar contours are present, and natural spacing exists between central incisors. Provisionalization of dental implants at placement, following minimally invasive surgical protocols; and properly contoured esthetic provisionals, have been shown in the dental literature to aid in the sculpting and preservation of esthetic soft tissue contours around dental implants in the esthetic zone.[4-12] Additionally, following this immediate restoration protocol, as the implant matures and integrates in the three-month healing phase, along with the bone replacements graft, the esthetic soft tissue emergence profile also has this time frame maturation. This can result in stable, contoured esthetic soft tissue profiles, which allow the final implant-supported restoration to be fabricated following the natural soft tissue emergence profile maintained or sculpted at the initial tooth removal and implant placement process. The author has observed this procedure to provide esthetic soft tissue contours around dental implants in the esthetic zone.

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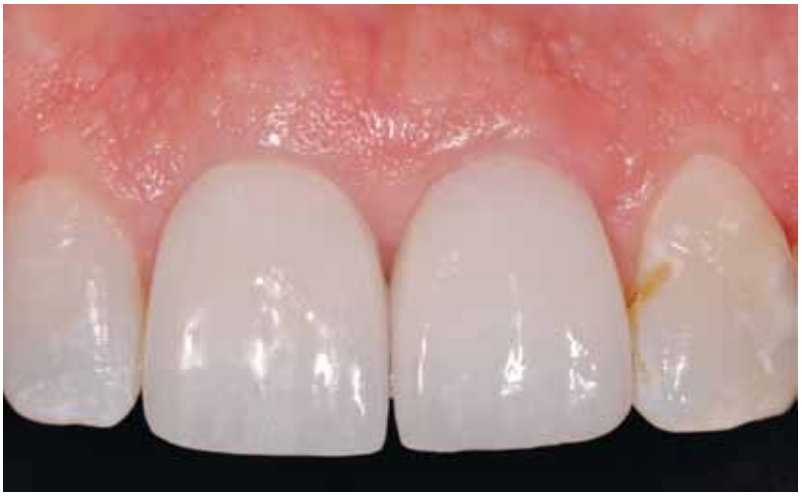

Figure 22: Case-complete clinical view, Case 2.

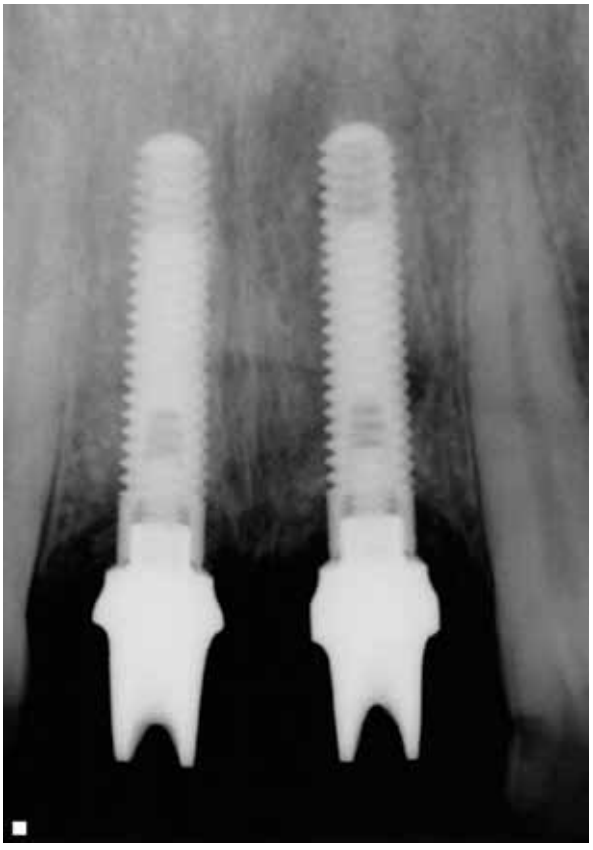

Figure 23: Case-complete periapical digital radiograph, maxillary central incisor.

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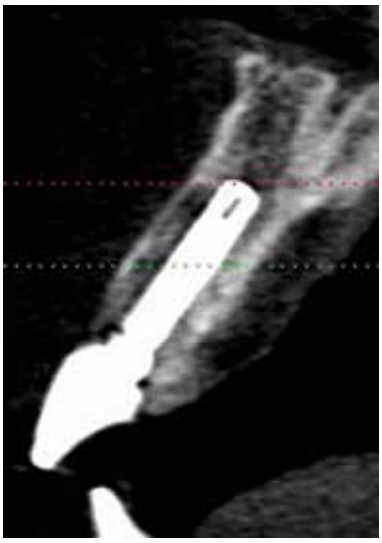

Figure 24: Case-complete CT scan, serial view, right central incisor.

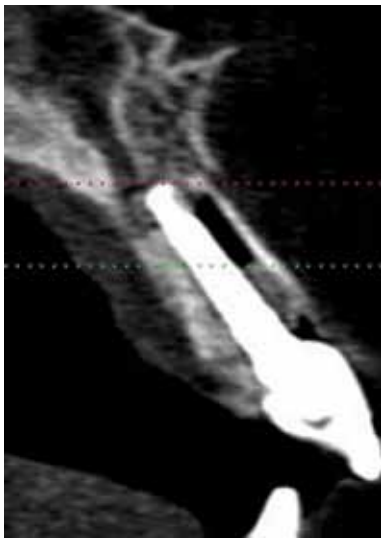

Figure 25: Case-complete CT scan, serial view, left central incisor.

Dr. Petrungaro is the founder of The Implant Learning Center, in Chicago, Illinois. He has a private practice in Chicago.

Disclosure: Dr. Petrungaro is a surgical consultant and speaker for Zimmer Dental. He is the developer of the TempStent II surgical guide discussed in this article.

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Correcting Gingival

Application of Tunnel Techniques and Acellular Dermal Matrices

Douglas H. Mahn, DDS

ADMs have been highly successful in the treatment of gingival recession and allow for the treatment of multiple teeth in a single visit.

Abstract

The soft tissue architecture is an important part of an attractive smile. Autogenous connective grafts have been successful in treating gingival recession. Their availability, however, is limited by palatal anatomy. Acellular dermal matrices have been shown to be successful in the treatment of gingival recession and do not have availability problems. Traditional flap elevation can lead to shrinkage of the interdental papillae and diminish esthetic results. Tunnel techniques protect the interdental papillae. This article discusses the use of an acellular dermal allograft and a tunnel technique in the treatment of multiple gingival recession sites in the esthetic zone.

Key Words: gingival recession, connective tissue graft, acellular dermal matrix, tunnel technique

Recession

Introduction

Gingival recession represents a challenge in the development of an attractive smile. Proper tooth size and proportion is dependent upon the soft tissue architecture.[1] Covering root surfaces, however, must not be the only goal in corrective techniques. Such techniques should consider protection of the interdental papillae and avoid the complication of blunted interdental papillae.

The subepithelial connective tissue graft (CTG) was first described as a method to enhance anterior cosmetics.[2] An "envelope" technique was developed to achieve root coverage on a single tooth without the problems associated with vertical incisions.[3] Tunnel grafting techniques, which protect the interdental papillae, improved the esthetic results of connective tissue grafting for multiple recession sites.[4-9]

The number of teeth to be treated using CTGs is limited by the amount of tissue that can be harvested from the patient's palate.[10,11] An acellular dermal matrix (ADM) does not have this drawback because it is derived from human donor skin.[12-14] ADMs have been highly successful in the treatment of gingival recession and allow for the treatment of multiple teeth in a single visit.[15-22] An ADM's uniform thickness makes it ideal for use with a tunnel technique.[16-18,21,22]

Case 1

A 36-year-old nonsmoking female reported the chief complaint of an "ugly smile" caused by gingival recession **(Fig 1)**. Teeth ##5-12 were found to have 1 to 4 mm of gingival recession **(Fig 2)**. After discussing the findings, treatment plan options, and risks with the patient, the author agreed to treat these teeth with connective tissue grafting.

Profound local anesthesia was achieved using 2% lidocaine with 1:100,000 epinephrine. Intrasulcular incisions were made along the facial surfaces of ##4-13 using a Bard-Parker (Becton Dickinson; Franklin Lakes, NJ) #15 blade **(Fig 3)**. Only in the areas between #5 and #6, and #11 and #12 were incisions made in the facial interdental papillae. Leaving the interdental papillae intact from ##6-11, a full thickness flap was raised using an Orban knife (Hu-Friedy; Chicago, IL). Individual pouches were created adjacent to each tooth. These pouches were extended beneath the mucogingival tissues until a continuous tunnel extended from #5 to #12. The flaps were dissected into the mucosa until each flap was freely mobile and could be passively positioned over the root surfaces. Root planing using curettes was performed to reduce root prominences and smooth root surfaces.

An ADM (AlloDerm, BioHorizons; Birmingham, AL) was trimmed to approximately 5 mm in height and 40 mm in length **(Fig 4)**. Using the Orban knife, the ADM was inserted into the mucogingival tunnel between #5 and #6. It was pushed and pulled through the tunnel until the roots of ##5-12 were covered. The ADM was secured using a continuous 4.0 plain gut suture **(Fig 5)**. The gingiva was then coronally advanced over the root surfaces, including the ADM, and secured with a continuous 4.0 chromic gut suture **(Fig 6)**.

Postoperative discomfort was controlled using ibuprofen (600 mg, every six to eight hours) as needed. The patient was prescribed amoxicillin (875 mg, every 12 hours) for 10 days. She was instructed to rinse twice daily with 0.12% chlorhexidine gluconate (Peridex, Proctor & Gamble; Cincinnati, OH), and told not to brush or floss the area for seven days.

After one week, the surgical site was healing well **(Fig 7)**. The remaining sutures were removed. The patient was directed to discontinue the rinse and to begin gentle brushing and flossing.

After 12 weeks, the treatment sites were found to have healed well, with complete root coverage and improved gingival contours observed **(Fig 8)**. No interdental papillae were noted. The patient reported being very happy with the overall improvement in her smile **(Fig 9)**.

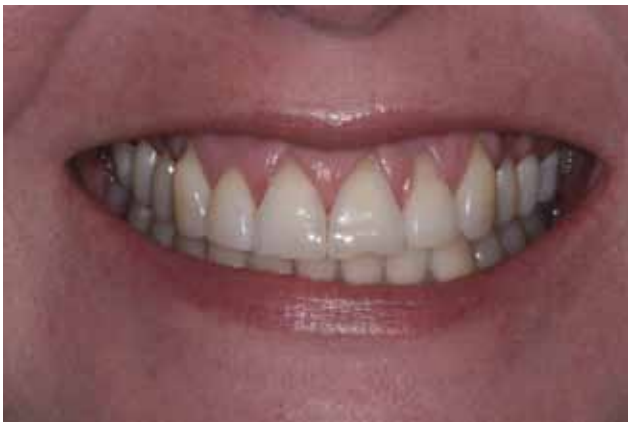

Figure 1: A pretreatment view shows how gingival recession detracts from the appearance of the patient's smile.

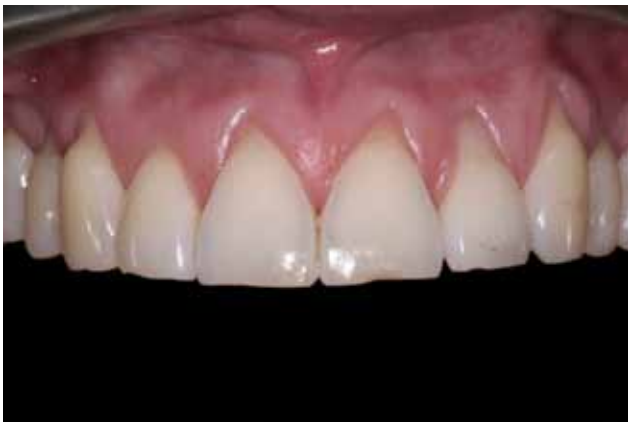

Figure 2: A pretreatment clinical view of ##5-12 demonstrates mild to severe gingival recession.

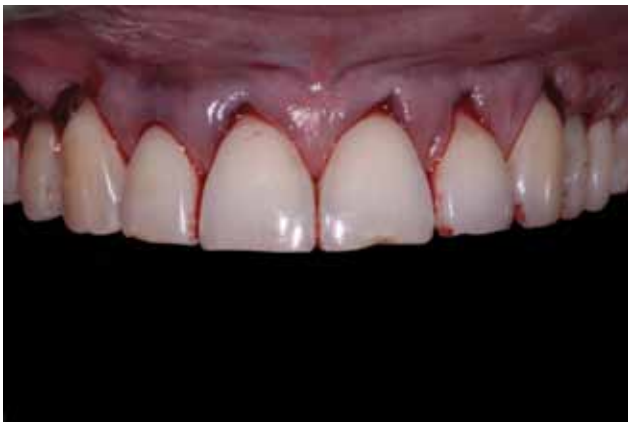

Figure 3: Intrasulcular incisions were carefully made buccally to ##5-12. Care was taken not to traumatize the interdental papillae.

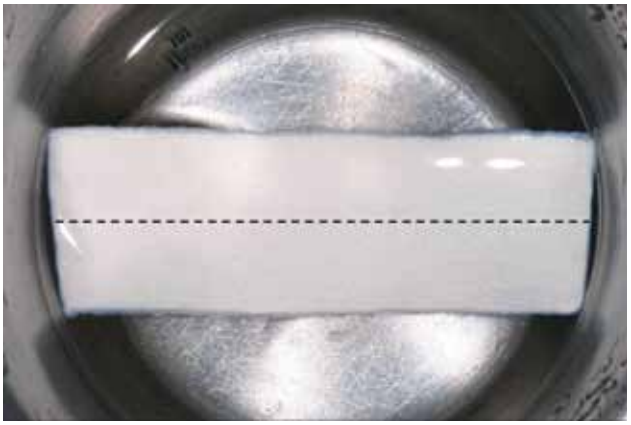

Figure 4: The ADM is rehydrated in sterile saline. The broken line indicates where the matrix was trimmed to the desired dimensions.

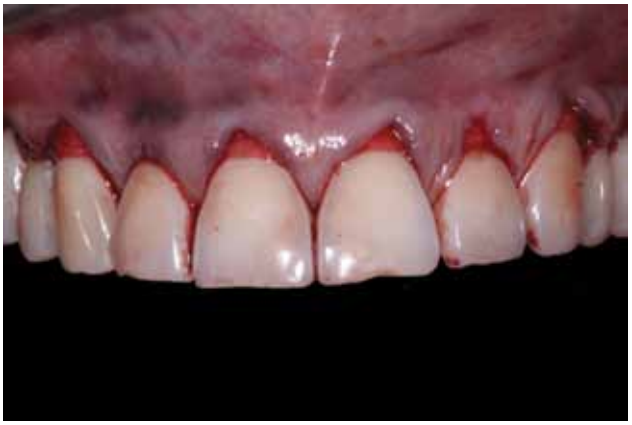

Figure 5: The ADM has been placed within the tunnel. The bloodstained matrix can be visualized below the gingival margin.

Figure 6: The gingival flap has been coronally advanced completely over the graft and the roots. A continuous 4.0 chromic gut suture secures its position.

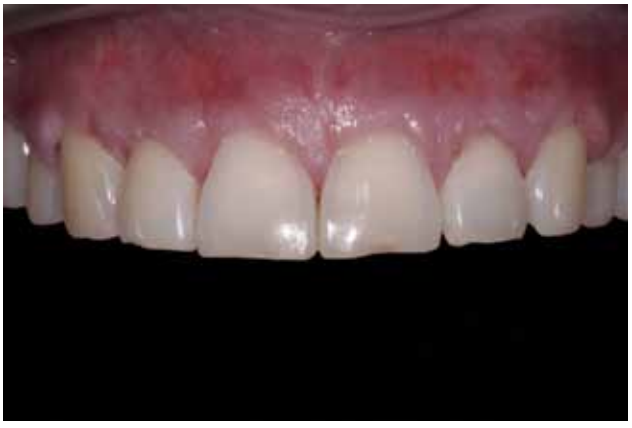

Figure 7: At the one-week follow-up visit, the surgical site is found to be healing well.

Figure 8: At 12 weeks, the surgical site has healed well, with complete root coverage and a healthy appearance.

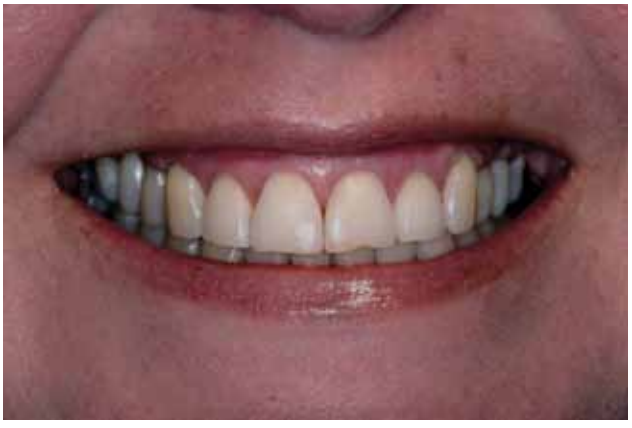

Figure 9: The improved soft tissue architecture greatly enhances the smile's attractiveness.

Cases 2 and 3

Cases 2 and 3 are very similar to Case 1. Both patients were nonsmoking females whose chief complaints were gingival recession in the esthetic zone. Tunnels were created beneath the mucogingival tissues from #6 to #11. The composite on #8 in Case 3 was removed using a football-shaped diamond bur, and the root was hand-curetted smooth. The ADM was placed within the tunnel and secured using a continuous 4.0 plain gut suture. A continuous 4.0 chromic gut suture was used to secure the mucogingival flap completely over the ADM and root surfaces. After 12 weeks, all sites were found to have healed well, with little to no residual recession and a natural appearance **(Figs 10-13)**.

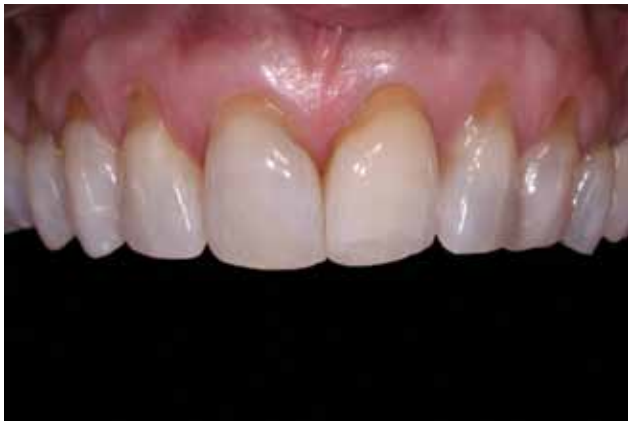

Figure 10: A pretreatment view of Case 2 shows the gingival recession.

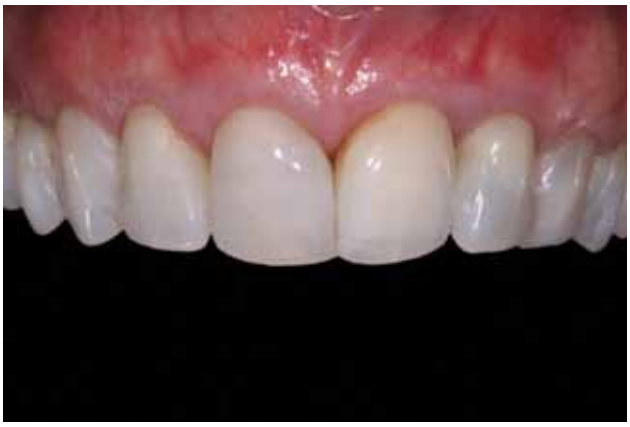

Figure 11: A post-treatment view of Case 2 shows the correction of the gingival recession.

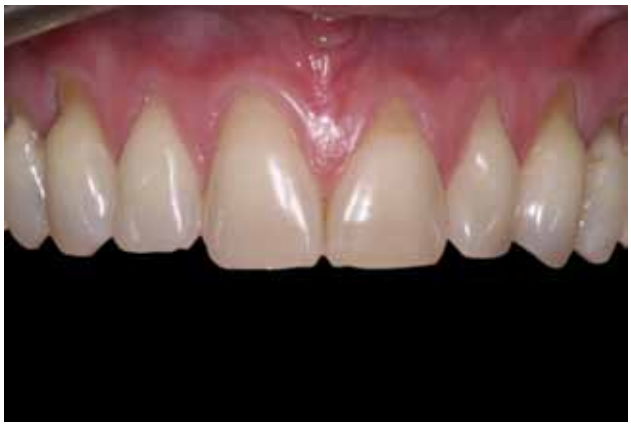

Figure 12: A pretreatment view of Case 3 shows the gingival recession. Tooth 8 has a cervical resin restoration.

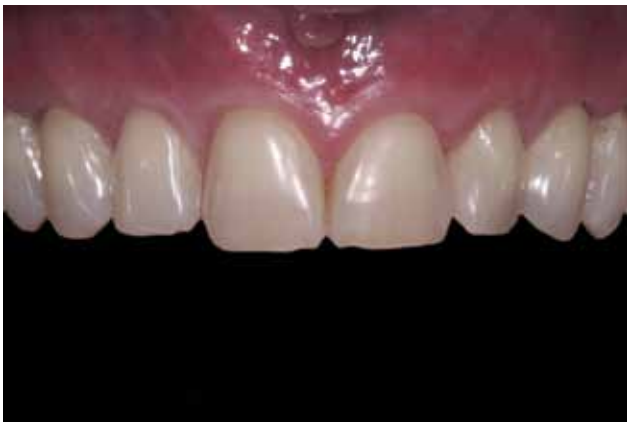

Figure 13: A post-treatment view of Case 3 shows the correction of the gingival recession and esthetic improvement.

Discussion

The treatment of gingival recession using CTGs is well documented.[2-9] A palatal donor site, however, limits the amount of tissue to be used.[10,11] This can impede the treatment of multiple teeth in a single appointment. In addition, postoperative discomfort has been associated with the palatal donor site.[23,24]

ADMs are derived from the skin of human donors.[12-14] Their cellular component is removed while maintaining their ultrastructural acellular matrix. ADMs are cut into pieces, having a uniform thickness between 0.89-1.65 mm. The undamaged collagen and elastin matrices do not initiate an inflammatory response in the recipient site. Cellular repopulation and revascularization of the ADM occurs through preserved vascular channels.[13,14,16,25] For the ADM to revascularize, it must be in direct contact with vital tissue. The ADM must be completely covered by the gingival flap for it to survive.[13,14,20,21]

ADMs have been documented to have been successful in the treatment of gingival recession.[15,16,20,21] Not being limited by palatal anatomy, ADMs are useful in the treatment of multiple sites in a single visit.[15,19,22] In addition, its uniform dimensions make an ADM ideal for use with tunnel techniques.[17,18,21,22]

Choice of surgical design and technique is an important consideration in cosmetic root coverage treatment.[26] Despite an apicocoronal direction of blood perfusion of the anterior gingiva, circulation is compromised where incisions are made.[27,28] By protecting the interdental papillae from incisions, tunnel techniques promote esthetic outcomes.

Creating access to the mucogingival tunnel can be done using different methods. Using the space provided adjacent to an individual tooth is one way.[3-5] Limited space, however, can make this difficult. The gingival margin tears, and damage to the interdental papillae is a concern.

Vertical incisions have been used to create access to the mucogingival tunnel. In one technique, vertical incisions are made on both sides of the tunnel.[16,17] In another technique, a vertical incision is made in a central site of the tunnel.[18] The vertical incision can create a wide opening that greatly facilitates graft placement. After the graft is placed and the gingiva is secured over the graft and root surfaces, the vertical incisions are then sutured closed.

Finally, the gingival flap can be detached from the interdental papillae at isolated sites that are not esthetically critical.[7,22] This is typically at a site distal to the treatment area. While not creating an opening as wide as a vertical incision permits, it will facilitate placement of a large graft. The detached area is sutured into position following graft placement. This method was chosen for all three cases described because it was deemed the least invasive and yet adequate for proper graft placement.

Summary

Correction of gingival recession can improve a patient's smile. Multiple gingival recession defects in the esthetic zone can be treated successfully using mucogingival tunnel techniques and acellular dermal matrices.

Choice of surgical design and technique is an important consideration in cosmetic root coverage treatment.

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Multiple gingival recession defects in the esthetic zone can be treated successfully using mucogingival tunnel techniques and acellular dermal matrices.

Dr. Mahn owns a private practice in Manassas, Virginia.

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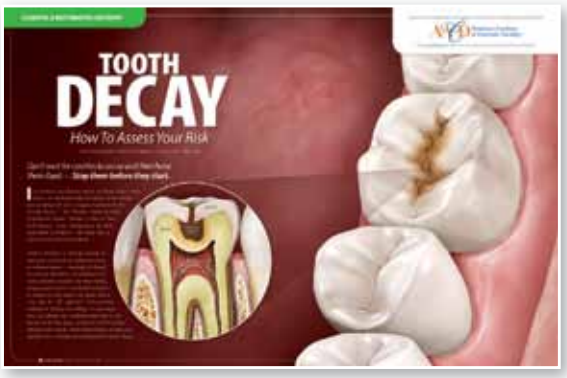

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Implants

as a **Contingency Plan for Restorative Failures**

Development of Gingival Architecture Around an Implant Using a Screw-Retained Provisional

Brian S. Vence, DDS

Abstract

Even when dentists execute proven principles and use contemporary techniques optimally, the oral environment, cyclic loading, and thermal cycling cause materials or structures to fail.[1] Implant dentistry enables dentists to limit the extent of their restorations and plan for one-tooth or fixed partial dentures of just three or four units, limiting the extent of replacing failures in contingency plans.

To illustrate this, the following article presents a case involving the failure of a single central tooth in a patient with a high smile line; moderate gingival display; and a thin, high scalloped biotype.[2,3] The case also demonstrates that pink esthetics are just as important as white, and that gingival health and architecture are critical to making restorations "transparent."

While grooming soft tissue is not essential to achieving gingival esthetics,[4] the technique simplifies fabricating the definitive restoration for the technician by eliminating the question of gingival architecture. The purpose of this case study is to demonstrate a technique to groom the soft tissue around an implant by developing the gingival architecture with the emergence profile of a screw-retained provisional as previously described in the literature.[5]

Key Words: screw-retained provisional, temporary abutment, subgingival contours, emergence profile, laboratory communication

Introduction

As an overview of the screw-retained provisional technique, the Fürhauser pink esthetic score defines the soft tissue goals for this phase in fabricating the provisional.[6] The restorative dentist utilizes a screw-retained provisional as a soft tissue management tool to groom the gingival tissue, and to develop the emergence profile and gingival architecture. The technique involves developing subgingival contours with the provisional to mimic the root of the tooth. The shape of the root portion of the implant-supported restoration supports the soft tissue and helps to create the scalloped height and form. While the papillary height is primarily achieved by interproximal bone levels on adjacent teeth,[7] the provisional assists with papillary form and tip height. The cylindrical shape of the soft tissue with the healing abutment in place is compressed and molded into the scalloped shape found around a tooth with the emergence profile of the provisional. Once the provisional is fabricated, the tissue is compressed by screwing the provisional temporary abutment down to the fixture abutment junction of the implant.

Case Report

Patient History

The patient, a 52-year-old Caucasian female, was first seen in April 1998 because she was unhappy with the appearance of her all-ceramic crowns (the restorations had been placed in 1989). The treatment plan in 1998 involved the replacement of the restorations due to deteriorating luting resin that had become discolored at the margins due to poor marginal integrity **(Fig 1)**. The crowns were sectioned and the preparations were refined to create proper space for movement of light through more modern ceramic material to replicate the optical effects of natural teeth.[8] A horizontal fracture line was evident due to discoloration at the margin level of tooth #9 **(Fig 2)**. The previous root canal in #9 was retreated by an endodontist prior to impression making for the definitive restorations. A direct orange hue composite was placed on the axial wall of the preparation to neutralize the dark area at the margin so that all-ceramic restorations could be utilized without opaquers. Opaquers in restorations drive down the value of the underlying tooth structure. The all-ceramic definitive restorations were bonded in 1999 using a three-step total-etch technique, and the patient accepted the esthetic outcome **(Fig 3)**.

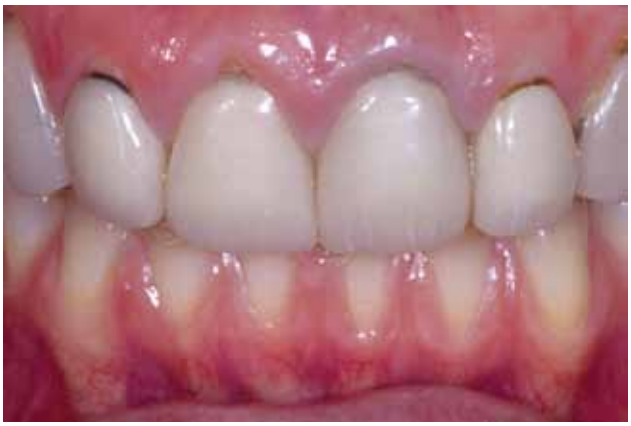

Figure 1: Original all-ceramic restorations were placed in 1989. Restorations were failing in 1998 due to excessive marginal gap and degradation of composite resin cement.

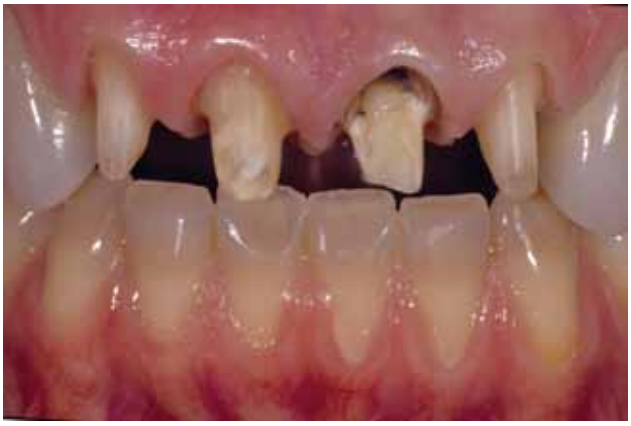

Figure 2: Horizontal fracture of #9 led to discoloration that was masked with an orange-colored composite resin. Eventually, this tooth developed a necrotic pulp and underwent root canal therapy, apicoectomy, and extraction.

Figure 3: Replacement of definitive all-ceramic restorations in 1999.

Diagnosis

In 2006, the patient had an abscess of the root canal treatment associated with #9 that discolored the mucosa. An oral surgeon performed an apicoectomy that created scar tissue in the mucosa. In 2010, the patient developed a 12-mm probing depth in an isolated area on the palatal side of #9. The tooth was diagnosed as fractured. Due to a very thin and dehisced buccal plate of bone, extraction with bone grafting of the socket utilizing mineralized freeze-dried bone (MinerOss, BioHorizons; Birmingham, AL) and a membrane (Biomend Extend, Zimmer Dental; Carlsbad, CA) was performed by an oral surgeon. A transitional treatment partial was fabricated for esthetics during healing of the dento-alveolar bone. Because the patient had a thin biotype of tissue, an immediate implant was ruled out to allow for multiple grafts, if needed. The ridge was allowed to heal for six months prior to implant placement **(Fig 4)**.

Treatment Plan

A surgical guide was fabricated from a cast of the diagnostic wax-up, and a second cast of the edentulous ridge was made after the extraction and bone graft healed. The decision was made not to utilize cone beam computed tomography (CBCT), based upon the previous bone graft, the location of the implant, and lack of critical structures in the area of the surgical site. The proposed implant site was placed ideally on the cast in all four critical dimensions: facial-palatal,[9] mesial-distal,[10] vertical depth,[11-14] and rotational timing by the restorative dentist. During surgery, the surgical guide only was partially utilized for implant positioning in the mesial-distal and vertical depth dimensions **(Figs 5 & 6)**. The surgeon had to decide, at the time of surgery, the rotational timing. In addition, the surgeon altered facial angulation from the surgical guide at the time of surgery due to available bone. The change in facial angulation during surgery makes a case for computer-guided[15] implant planning even for more routine cases as described in this case study. The change in facial angulation causes the access hole to pass through the facial of the provisional. The surgeon was asked to place the access hole—either palatal or facial—to the incisal edge, but not through the incisal edge, to simplify masking the access hole during the provisional phase. The surgeon placed a 3.8 x 12.0 mm endosseous tapered titanium implant with Laser-Lok, resorbable blast texturing, and an internal connection (Tapered Internal TLR3812, BioHorizons, Birmingham, AL). The surgeon also placed a 3.5 x 3.0 mm healing abutment (PYRHA3, BioHorizons) at the time of surgery. After three months of implant healing and a healing abutment in place, the process was initiated to fabricate a provisional on the implant.

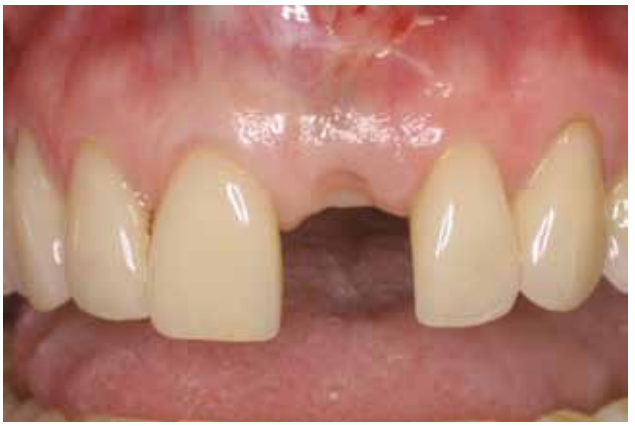

Figure 4: Post extraction of #9 after failed endodontics and periapical surgery. Bone grafting was performed to rebuild the dento-alveolar ridge.

Figure 5: Implant placement to manage implant biologic width after the bone graft healed in three months.

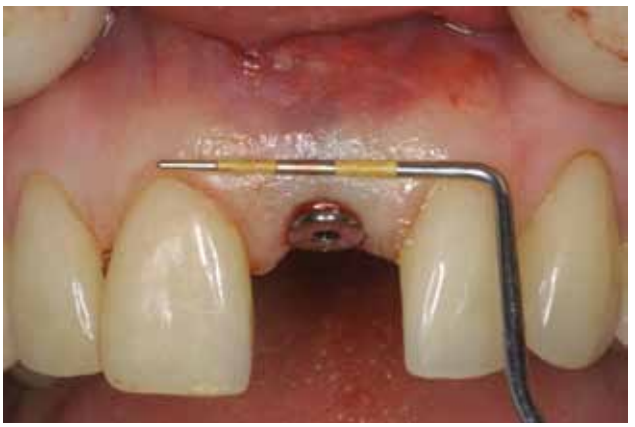

Figure 6: A 3-mm tall healing abutment with periodontal probe indicating approximate correct vertical depth of the fixture abutment junction 2 to 3 mm apical to the anticipated facial free gingival margin.

Fabricating a Screw-Retained Provisional

The healing cap must be removed and either an impression of the implant position needs to be fabricated, or the temporary abutment can be placed intraorally directly on the implant. In this case, we chose to fabricate the provisional on the cast. A maxillary cast of #9 was fabricated from an impression of the implant utilizing an open tray, hexed impression coping (PYNDC, BioHorizons), and an implant analog (PYIA, BioHorizons). The desired emergence profile was carved around the implant site. An opposing cast also was fabricated to verify the occlusal contacts. A diagnostic wax-up was made of the definitive contour of the proposed restoration, and a silicone index (Sil-Tech, Ivoclar Vivadent; Amherst, NY) of the tooth contour was fabricated and adapted in a pressure pot at 2.5 bars of pressure. The silicone index was filled with Bis-GMA provisional composite resin (Telio C S C&B, Ivoclar Vivadent) to make a shell **(Fig 7)**. The shell was contoured to fill the edentulous space by removing excess material, giving consideration to incisal edge position, mesial-distal contacts, and overall length of the tooth to mimic the contralateral tooth; and to develop the correct intrinsic proportion and occlusion **(Figs 8 & 9)**. The shell also was hollowed out to enable it to fit over a hexed provisional abutment: a 3-in-One abutment, a hexed titanium temporary abutment or a PEEK temporary abutment (PYRTA, BioHorizons).

Temporary Abutment

The temporary abutment should be selected based upon the needs of the case. Metal abutments are better if the provisional is going to be in the mouth for an extended period of time or if the provisional will be utilized as the impression coping to transfer the emergence profile. The plastic temporary coping creates a more esthetic provisional as there is no metal to mask with opaquers.

The temporary abutment selected was secured on an implant analog (PYIA) on the cast or intraorally **(Fig 10)**. The provisional abutment was prepared like a tooth to fit within the confines of the definitive contour of the shell. Then the shell was fitted over the temporary abutment to make sure it could fit in its proper orientation and that occlusion was unimpeded by the temporary abutment **(Fig 11)**. The axis hole of the temporary abutment was filled with gutta percha, which was used not only to prevent blocking the access hole with composite but also because of its orange color, which makes it easy to find the axis hole when drilling through the shell after bonding the

Figure 7: Silicone index of the proposed restoration's definitive contour filled with Bis-GMA composite provisional material.

Figure 8: Gross removal of excess provisional shell material with an acrylic bur.

Figure 9: Refining the shell contour and free gingival margins to establish intrinsic proportion with a soft-flex disc.

shell to the abutment in the following step **(Fig 12)**. It is also easy to remove the gutta percha from the axis hole with a hot endodontic instrument that is cooled intraorally with water, allowing the gutta percha to be pulled out quickly. This enables the restorative dentist to unscrew the provisional easily, and screw it back into position later when making alterations to the provisional.

The shell that is within the proper dimensions for the tooth is fused to the temporary abutment by filling it with unfilled resin and a hybrid composite resin (Heliobond & Tetric EvoCeram, Ivoclar Vivadent) in order to position it in the proper orientation and cure it into place **(Fig 13)**. Once the provisional shell is cured to the temporary cylinder, it has to be removed from the mouth or cast to develop the root shape of the provisional that ultimately grooms the soft tissue. A round carbide bur is used to cut through the shell and the hybrid composite to locate the screw access hole, as previously described.

As the composite material is removed, the orange color of the gutta percha serves as a target to locate the access hole **(Fig 14)**. The gutta percha also prevents composite from filling the screw access hole. The gutta percha is removed by placing an endodontic hot instrument into it. The dental assistant then cools it rapidly with water. The gutta percha is lifted out of the access hole **(Fig 15)** to allow a driver to be placed into the screw head and the provisional removed. The provisional comes off the cast or out of the patient's mouth, and can either be placed on an implant analog or on a special handle designed for various manufacturers' implant systems. The subgingival contour of the provisional remains unfinished and has many voids **(Fig 16)**. The root form of the provisional needs to be developed with a flowable composite (Tetric EvoFlow), and gives proper soft tissue support to mimic the root of a tooth **(Figs 17-19)**. Then, the provisional can be placed intraorally to compress and blanch the soft tissue, essentially pushing it into the shape for the proper emergence profile for the tooth. The soft tissue is like a wet sponge that is compressed to alter its form and push the fluid to other spaces. The provisional is used as a matrix to shape the tissue during healing similar to creating ovate pontic sites.[16] Here we are aiming for similar gingival heights of the soft tissue, similar scalloped form, and papillary type height, compared with the contralateral tooth.

Evaluation, Modification, and Definitive Bonding

After approximately a month of soft tissue grooming, the provisional may be removed and the tissue evaluated **(Figs 20 & 21)**. If the goals of developing soft

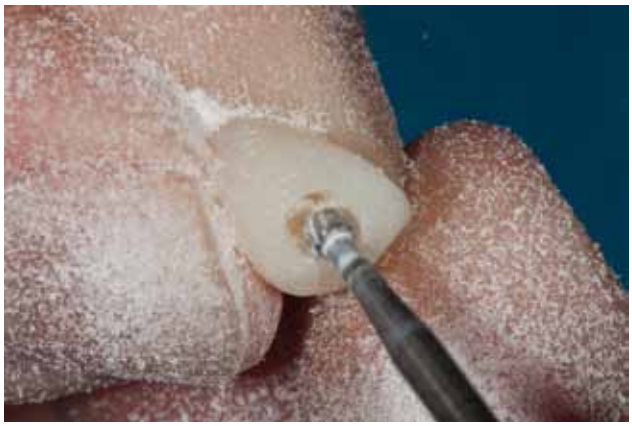

Figure 10: Hollow grinding provisional shell to fit over abutment.

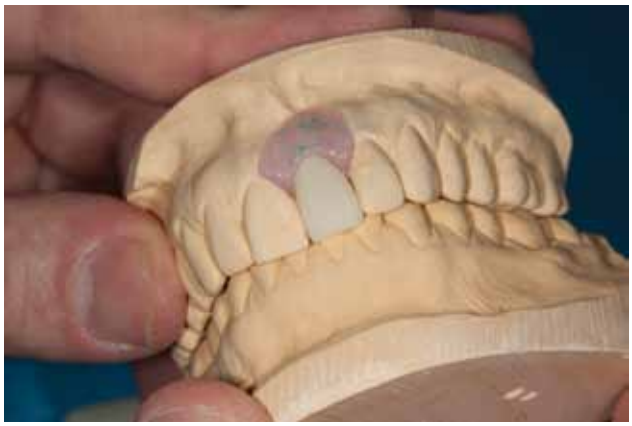

Figure 11: Gutta percha in access hole of provisional abutment adjusted for incisal/occlusal reduction on cast carved with ideal emergence profile. The technique may be performed intraorally without pre-carving the tissue.

Figure 12: Passive fit of provisional shell over prepared abutment for intrinsic proportion, occlusion, interproximal contacts, incisal position, and free gingival margin.

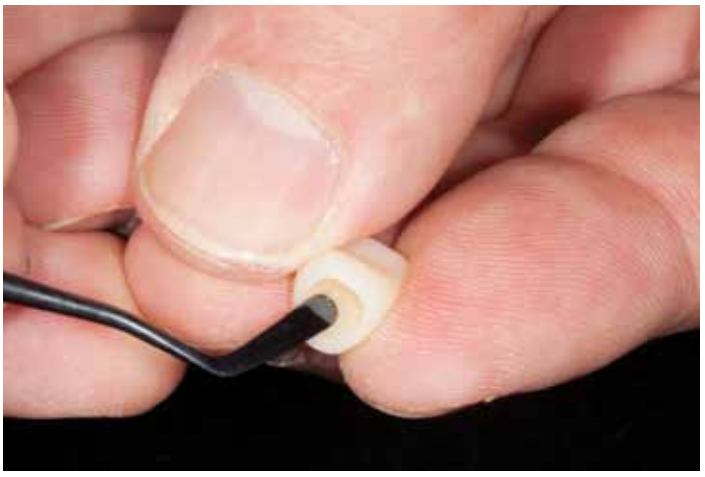

Figure 13: Hybrid resin Bis-GMA composite placed in the provisional shell prior to seating on provisional abutment and curing into position.

Figure 14: Gutta percha in the access hole creates an orange "target" through the provisional shell when searching for the access hole with a 2-mm endodontic shank-length round bur, when fabricating the screw-retained provisional.

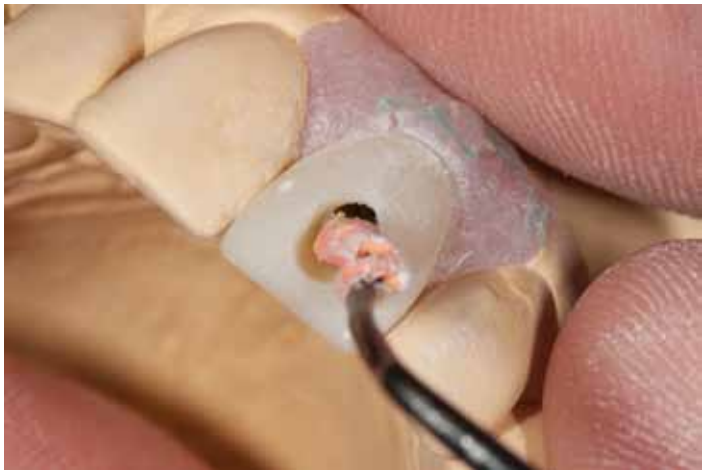

Figure 15: Gutta percha is easily removed by using an endodontic hot instrument pushed into the gutta percha and rapidly cooled with water.

Figure 16: Screw-retained provisional removed from the cast or intraorally to reveal lack of emergence profile when seated on an implant analog or handle. In the mouth, the contour deficiency has collapsed tissue in the area bounded by the free gingival margin of the provisional shell apical to the fixture abutment junction.

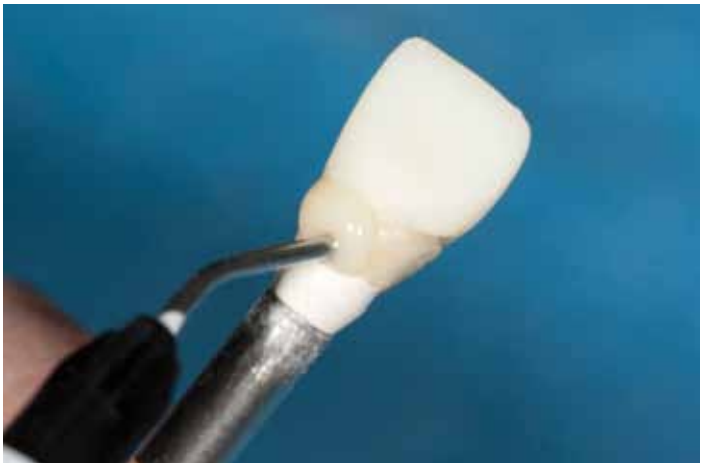

Figure 17: Flowable composite developing subgingival emergence profile to groom, support, and shape soft tissue.

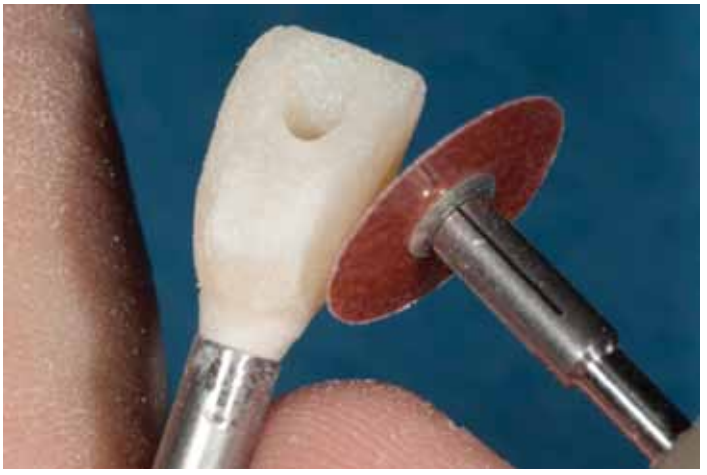

Figure 18: Definitive emergence profile contoured after curing flowable composite resin.

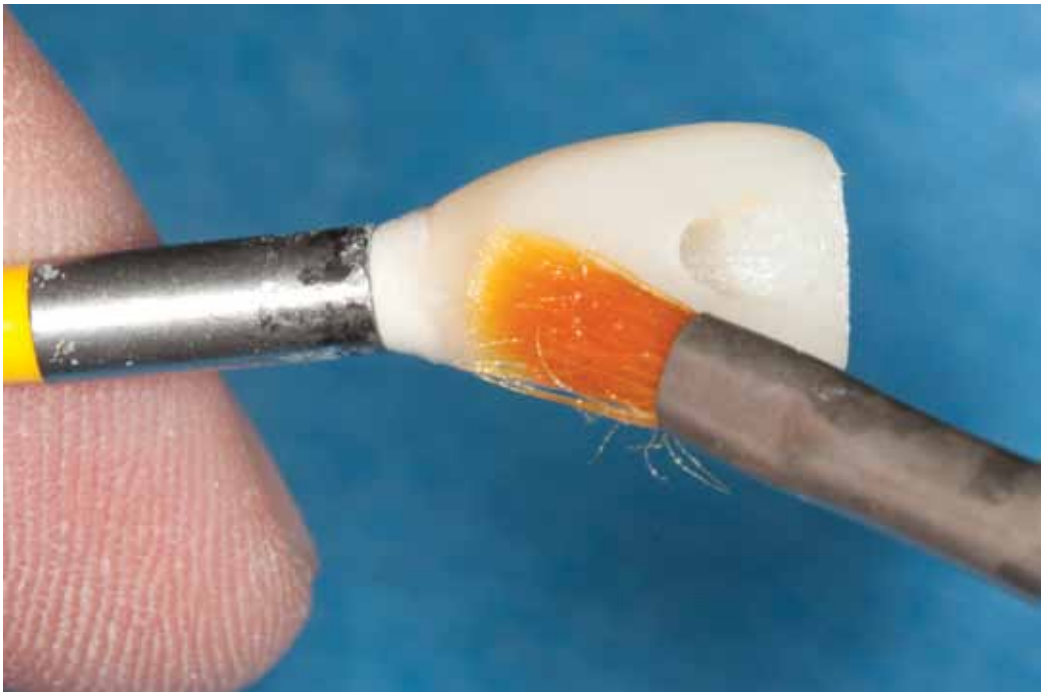

Figure 19: Unfilled resin painted on the surface and polished with a dry rag wheel to remove the oxygen-inhibited layer.

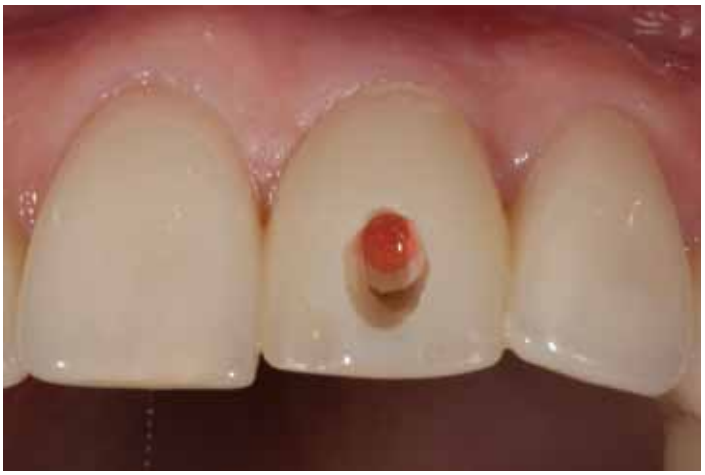

Figure 20: Screw-retained provisional utilized to displace soft tissue into desired emergence profile. Screw tightening may need to be done in increments to allow gingival tissue displacement and seat the provisional abutment. A metal or radiopaque abutment allows verification of complete seating with a radiograph. The shaping of soft tissue is possible only with screw-retained provisional restorations.

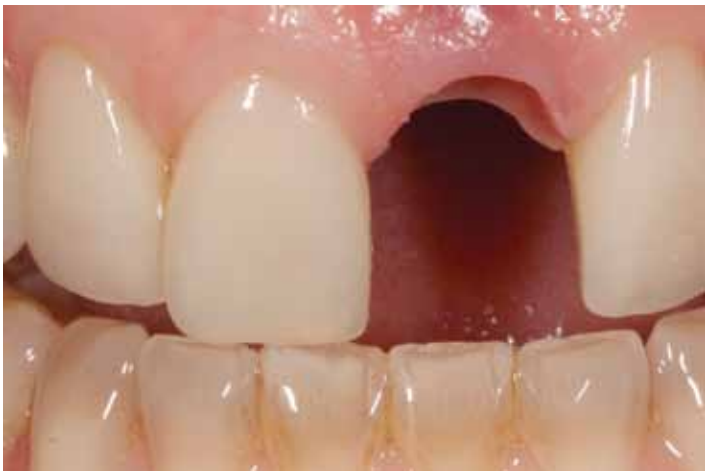

Figure 21: Free gingival margin and papillae developed after one month of soft tissue grooming with symmetry to contralateral #8. Free gingival margins/papillae that are apical to the contralateral tooth reduce support of soft tissue by reducing the facial/interproximal emergence profile. Conversely, free gingival margins/papillae that are coronal to the contralateral tooth increase support of soft tissue by increasing the facial/interproximal emergence profile.

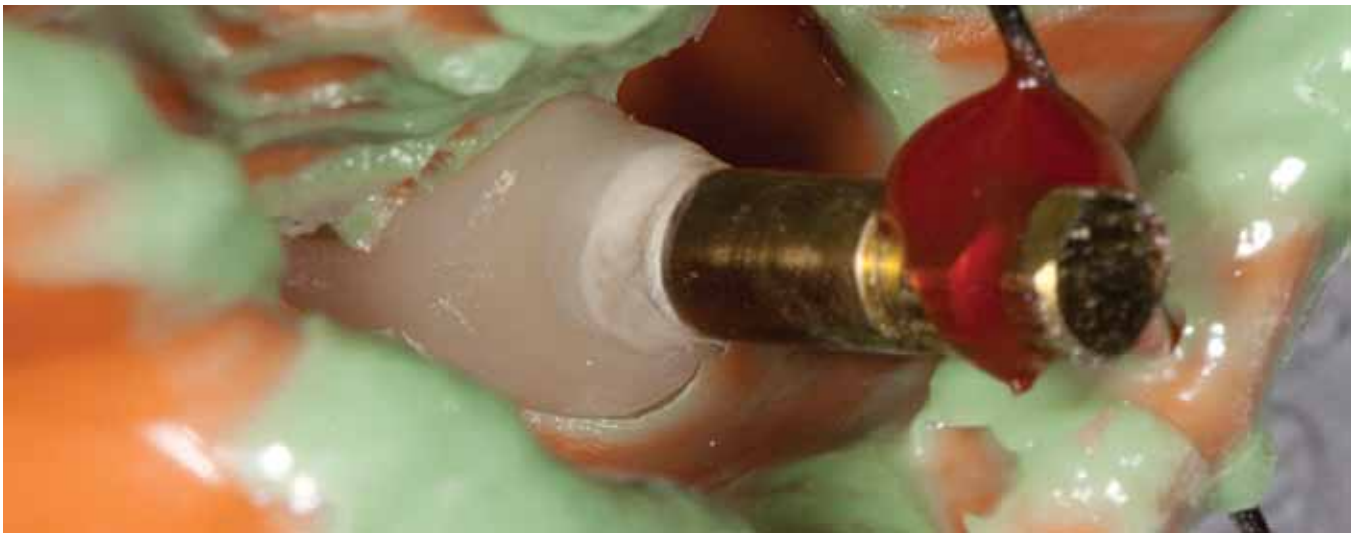

Figure 22: Emergence profile communicated to the laboratory technician by fabricating an impression of the provisional and seating provisional coated with a thin layer of petroleum jelly into the impression, secured, and poured up. An alternative technique with a custom impression coping is used if the dentist does not want to pour up the cast.

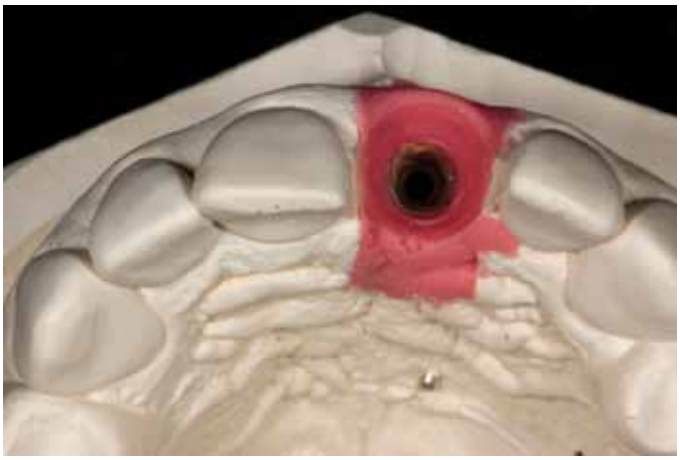

Figure 23: Cast of soft tissue emergence profile supported by the provisional or custom impression coping communicates exact support of soft tissue to replicate free gingival margin height and contour as well as papillary height.

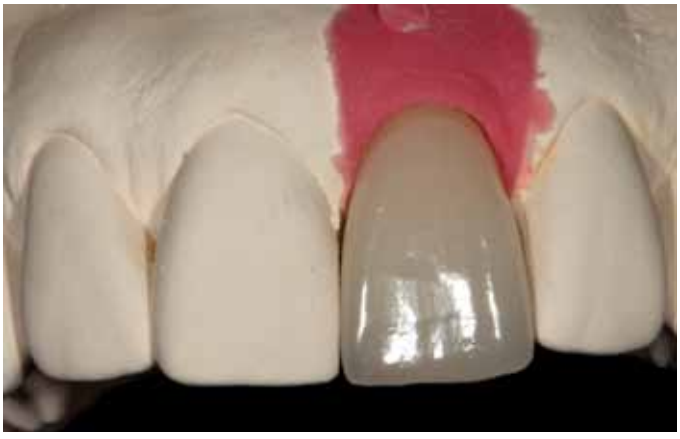

Figure 24: Definitive restoration on cast after cast was altered with a soft tissue mask of the final soft tissue contour.

Figure 25: Custom zirconia abutment fabricated by CAD-CAM and tightened with a torque driver to the appropriate Ncm to prevent screw backout from embedment relaxation.

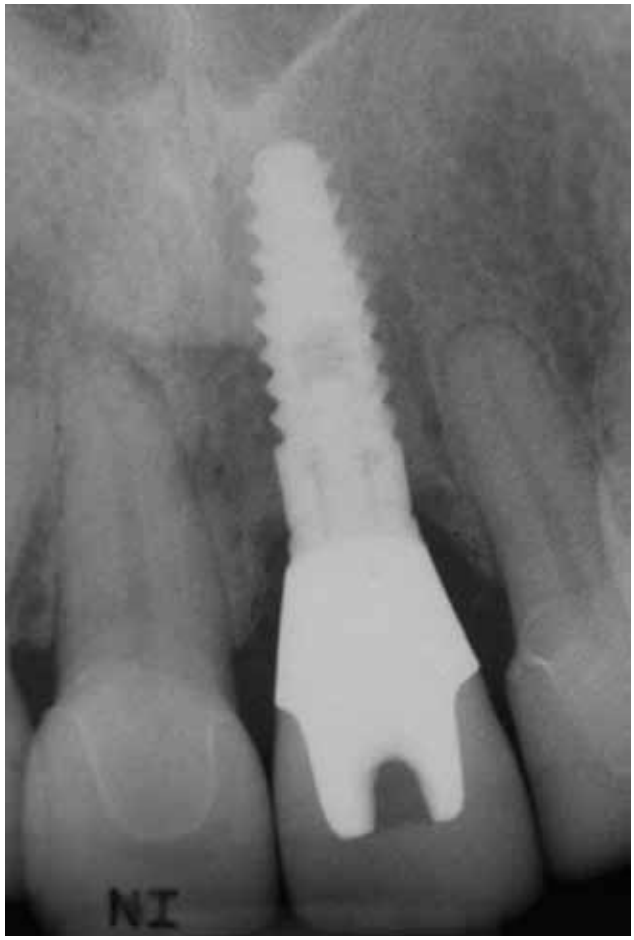

Figure 26: Radiograph demonstrating biologic width with bone maintained to fixture abutment junction, complete seating of abutment and crown. Excess cement must be controlled around the implant to maintain implant and soft tissue health.

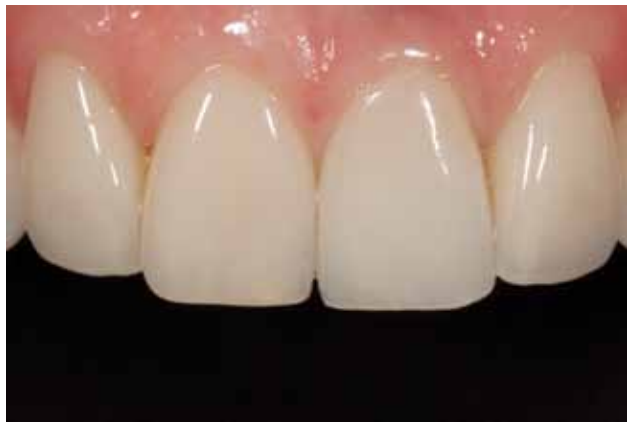

Figure 27: Definitive implant restoration of #9 with acceptable esthetics by executing currently accepted biologic principles.

tissue have been reached, the provisional can be used as an impression coping or a custom impression coping may be fabricated intraorally, or by duplicating the contour of the provisional. In this case, we chose to use the provisional as the impression coping. Then, an impression was made with the provisional in place intraorally. The provisional was removed from the patient's mouth and an implant analog was screwed into the provisional. The provisional was painted with a thin layer of petroleum jelly and placed back into the impression. The implant analog was secured using an orthodontic wire and acrylic resin **(Fig 22)**. The impression was poured up with stone **(Fig 23)**. After that, the provisional was removed from the cast and placed back into the patient's mouth. The dental laboratory modified the cast to include a soft tissue mask **(Fig 24)**. A zirconia custom abutment (Aadva Zr Abutment, GC America; Alsip, IL) was fabricated to follow the same gingival contours developed in the provisional restoration and transferred to the laboratory via the above technique **(Fig 25)**. The definitive all-ceramic lithium disilicate restoration (e.max, Ivoclar Vivadent) was fabricated and tried in the patient intraorally to verify esthetics and function. The definitive restoration was bonded definitively over the screw-retained abutment with a translucent dual-cure composite resin luting cement (Variolink II, Ivoclar Vivadent) and cured. Special care was taken to prevent excess luting cement from getting around the implant **(Figs 26 & 27)**.

Summary

This case study illustrates the reality of restorative failures in a restorative dental practice. Implants play an important role in contingency plans for failed dentistry in limiting the extent of the dentistry that has to be replaced. This article has outlined a technique to manage the soft tissue to allow for ideal function and esthetics.

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Implants play an important role in contingency plans for failed dentistry in limiting the extent of the dentistry that has to be replaced.

Dr. Vence maintains a private practice in West Dundee, Illinois.
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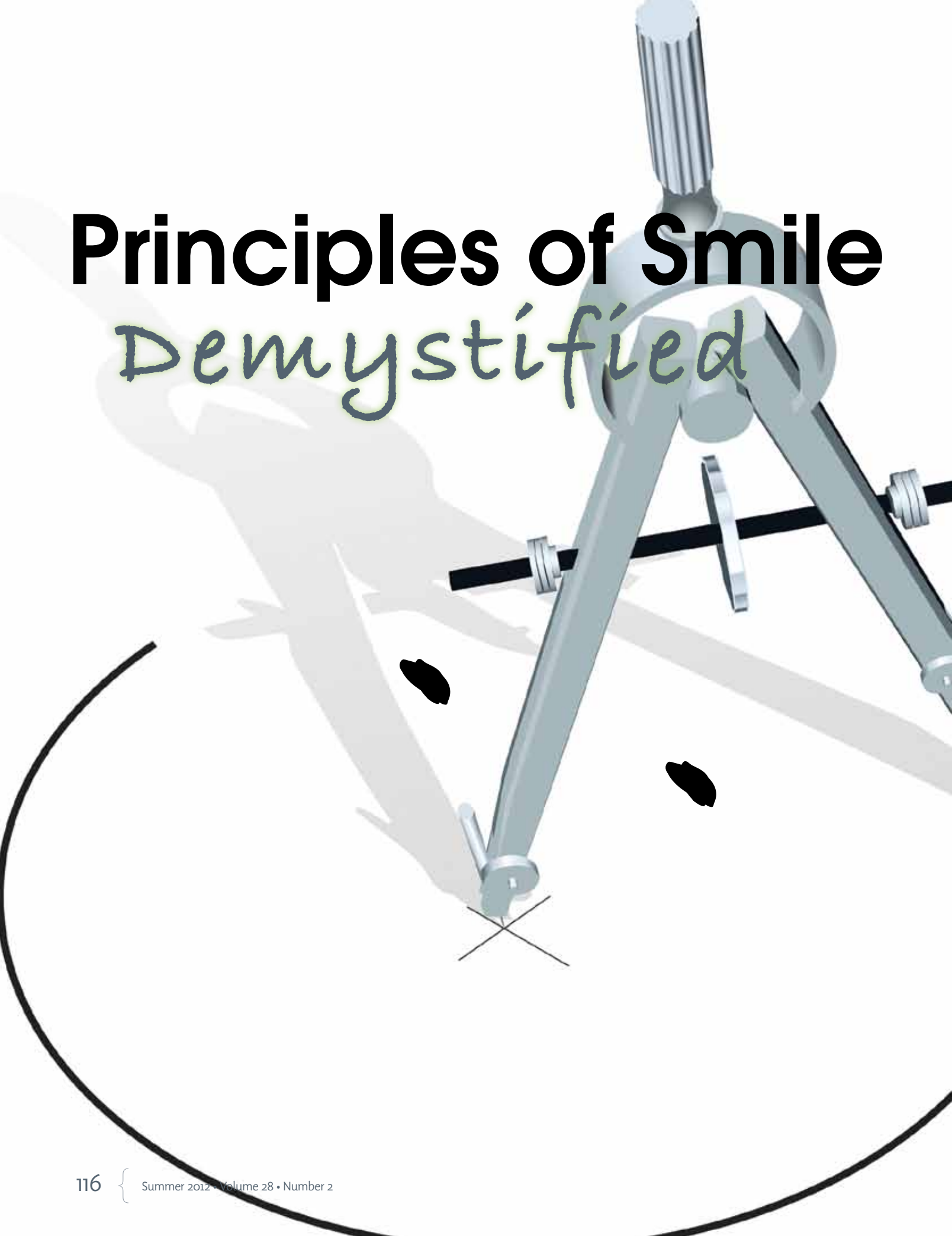
Principles of Smile Demystified



Design—

Saiesha Mistry, BDS, MSc
Illustrations by Zach Turner

Abstract

A comprehensive treatment plan is incomplete without an esthetic analysis or smile design defining the end point of the treatment. To obtain consistently high-quality results, it is necessary to methodically analyze the features that the evaluation comprises. Collection of data and precise utilization of various parameters helps to provide a systematic and guaranteed result. This article discusses details of facial analysis and offers a step-by-step sequence for smile design to provide predictable, esthetic results.

Key Words: smile design, facial analysis, esthetic parameters

Introduction

Esthetic dentistry has gone beyond the realm of pure esthetics to become an integral part of the treatment plan. Esthetic analysis or smile design that defines the end point of the treatment is critical. This helps to ensure that the outcome we provide will not only be biologically and functionally successful, but esthetically successful as well.

Today a smile design not only means designing teeth, but also creating a smile that truly complements the patient's face and personality. Following this philosophy, smile design starts with an analysis of the face, then moves to the smile and to the teeth themselves.[1]

Keeping this principle in mind, recreating a smile need not be limited to the six anterior teeth, but may extend to include the posterior teeth. The number of teeth involved in the esthetic treatment plan will depend upon the patient's facial and dental esthetic analysis. It is therefore imperative to integrate the esthetic parameters with the functional parameters of the occlusion. The incisal edge and the occlusal plane must be symmetrical and pleasing in appearance, and the form should follow the principles of occlusion to ensure overall health of the dentition. The design of the maxillary and mandibular anterior teeth must attempt to establish an anterior guidance, which will disclude the posterior teeth during protrusive and lateral excursive movements. This is important to ensure longevity and success of the anterior restorations.

Figure 1: Facial analysis in the frontal plane, relating the facial midline with the midline of the central incisors.

Figure 2: Facial analysis in the frontal plane, showing horizontal parameters relating the inter-pupillary line to the incisal edge position.

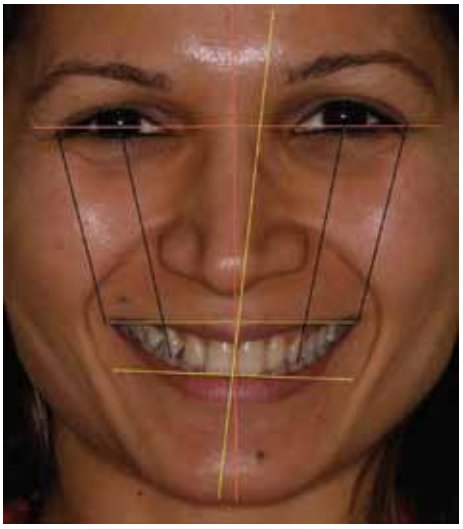


Figure 3: A full-facial analysis using lines to assess parallelism and hence synergy in the various components of the face as related to the smile.

Facial Analysis

The facial analysis involves an assessment of the face as a whole. This analysis is done in two planes: the frontal and the sagittal. In the frontal view the main feature we look at would be the facial midline, which aids in evaluating the symmetry of the face or the lack thereof. There are a number of different opinions on how the midline should be plotted, the most common one being from the glabella to the middle of the philtrum. This is connected to the midline of the smile, creating a relationship between the face and the smile **(Figs 1-3)**. In the sagittal plane we look at the Ricketts esthetic plane (E-plane), formed between the tip of the nose and the tip of the chin **(Fig 4)**. Another parameter is the nasio-labial angle, formed by the base of the nose and the upper lip **(Fig 5)**. These parameters provide information regarding the prominence of the anterior segment and the premaxilla and are instrumental in determining the position of the incisors in the labio-lingual plane while designing the smile. Thus we evaluate the relationship of the features to each other and to the smile.

Figure 4: Facial analysis in the sagittal plane: The Ricketts E-plane connects the tip of the nose to the chin prominence. Average distance from the upper lip is 4 mm; and from the lower lip, 2 mm.

Figure 5: Facial analysis in the sagittal plane: The nasio-labial angle is determined by the base of the nose and the upper lip. The average angle for males is 90 to 95 degrees; for females, 100 to 105 degrees.

Today a smile design not only means designing teeth, but also creating a smile that truly complements the patient's face and personality.

Smile and Dental Analysis

The smile analysis comprises details of the lips and the teeth and gums as a unit. The dental analysis provides insight into characterization and individuality of the teeth.

Details of the factors that come into play in these various analyses have been well documented and can be found in articles and books on esthetic dentistry.[2]

What often becomes confusing (and therefore, haphazard) is how to use all the data. By following the systematic approach detailed below using the parameters that have been observed during the various analyses, dentists will have a technique to consistently execute a successful smile design.

Figure 6: The full face—the starting point of the smile design.

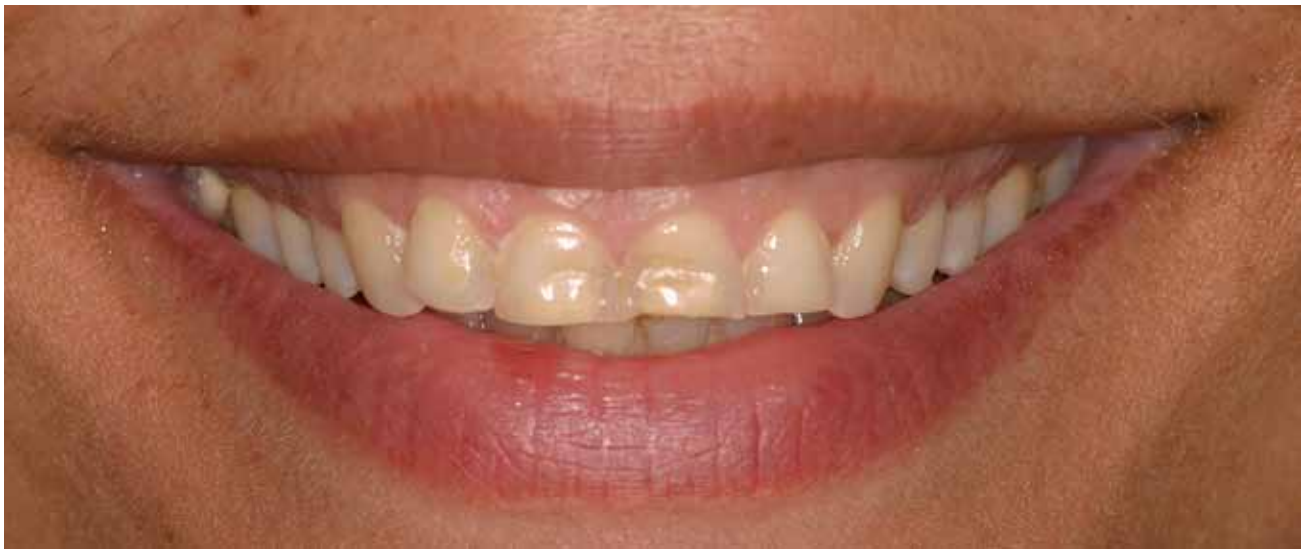


Figure 7: Dentofacial view. The focus is now on the smile itself.

Figure 8a: Define the lips, which form the framework of the smile to be designed. The components are filled in per the smile analysis.

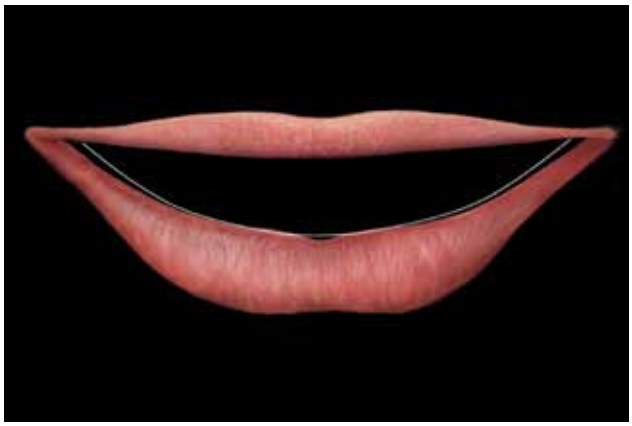


Figure 8b: Establish the Incisal edge position using the interpupillary line, phonetics, and the lip line as guides.

Smile Design Sequence

Start with the full face **(Fig 6)** and then narrow it down to the smile **(Fig 7)**. Now eliminate all the elements within the smile and use the lips as a frame for a clean slate. Then start designing the smile **(Fig 8a)**.

Step 1: Establish the Incisal Edge Position

The incisal edge position determines the actual shape of the incisal edge and is the best place to start designing the smile. To connect this smile parameter with the face, the incisal edges of the centrals should be made parallel to the inter-pupillary line, so as to relate the smile to the patient's overall facial esthetic. The curve then created by the incisal edges of the lateral incisors and canines should follow the contour of the lower lip. This provides synergy in lines and hence a more attractive picture **(Fig 8b)**.

When considering the incisal edge, we also need to determine the length of the teeth (called tooth reveal). The greater the amount of tooth visible while the lips are at rest, the younger looking the smile will appear.[3,4] Having the patient repeat the "M" sound will provide an insight into the amount of tooth visible, and the amount that can be increased so as to provide the appearance of youth **(Fig 9)**.

The labio-lingual plane positioning of the labial surface of the anterior teeth provides the lip support. Increase in the cervical third of the labial surface bulks out the maxillary lip and is dependent upon the sagittal analysis done of the face. The incisal edge position is determined using phonetics. The patient's use of the "F" and "V" sounds helps place the incisal edge in the correct relationship to the vermilion border of the lips so

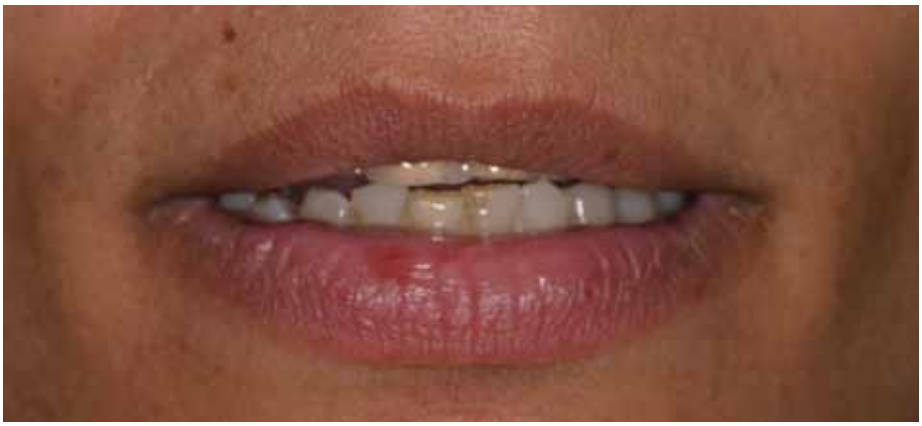


Figure 9: The use of phonetics and the "M" sound help to determine the position of the lips at rest. The amount of tooth visible in this position is important as a baseline for designing the smile. The more tooth visible, the younger the look.

Figure 10a: Use of phonetics to evaluate the location of the incisal edge position. The incisal edges of the maxillary anterior teeth should fall on the vermilion or wet/dry border of the lower lip.

Figure 10b: Develop midline symmetry and align the dental midline to that of the face. This line should be perpendicular to that of the incisal edge position.

as to enhance esthetics without affecting function **(Fig 10a)**.

Step 2: Develop Midline Symmetry

The next parameter to plot is the midline **(Fig 10b)**. This determines where the central incisors should be located. The midline between the centrals is related to the facial midline. An ideal esthetic situation is one where the midline of the face and the teeth are coincident. However, Kokich has shown that as long as the lines are parallel, a displacement of up to 4 mm is not noticeable to the layperson. The least esthetic look is when the dental midline is canted and at an angle to the facial midline.[5]

Step 3: Establish the Gingival Margin

The gingival margin becomes the third parameter in the smile design process. Calculating the tooth dimensions plots the location of the gingival margin. We use individual tooth proportions and the width:length ratio for the teeth **(Fig 11)**. An ideal tooth would have a width that is 78% that of the length. For smile design purposes, teeth with a 75 to 80% ratio fall well within the esthetic category. During the smile analysis, the space calculation is done depending upon whether we need to eliminate crowding or close spaces. Based on the widths determined, we can calculate the most appropriate length. With the incisal edge position already determined, the gingival margin forms the other dimension at the length calculated. Using the concept of the gingival esthetic line, the gingival zenith of the canines and centrals are plotted along the same plane and those of the laterals kept a millimeter shorter for the most esthetic appearance **(Fig 12)**.[6]

Figure 11: Based on the space available, calculate the length of the teeth using the width:length ratio of 78%.

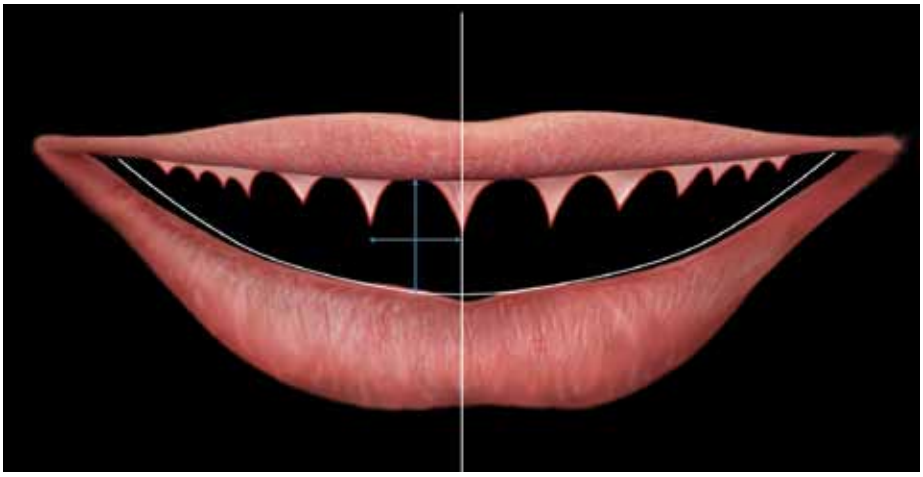


Figure 12: Once the gingival zenith of the central incisors has been plotted, design the gingival esthetic line based upon the esthetic parameters.

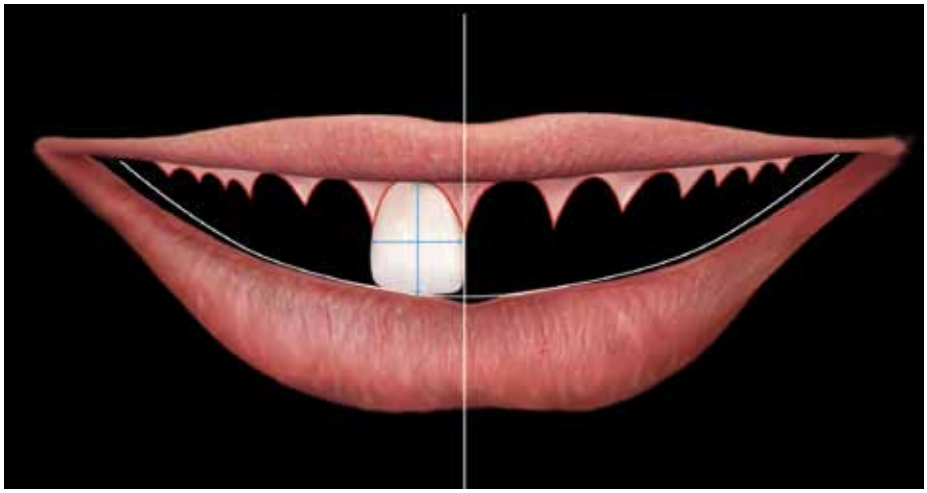


Figure 13: The position of the central incisors is determined using the facial midline as a guide. The size depends on the space analyses and the tooth proportions of 78%.

Step 4: Create Silhouette Form of the Central Incisors

Having established the three parameters for the location and size of the central incisors, we now create the silhouette form of the teeth. The centrals being the most dominant part of the esthetic zone should provide symmetry in the midline **(Fig 13)**. Having calculated the size of one of the centrals, we duplicate that and create a mirror image for the other central, thus creating symmetry in the midline for effective balance of the two sides **(Fig 14)**.

Step 5: Develop Relative Proportions of Lateral Incisors and Canines

This step involves designing the other components of the anterior esthetic zone. Here we use proportion tools, which have been discussed in various journals.[7,8] The "golden proportion" provides an approximately 62% ratio between the centrals, laterals, and canines (with only the mesial aspect of the canines being taken into consideration). The "recurring esthetic dental proportion" ensures that a consistent proportion exists between all the teeth. The "golden percentage" uses the entire esthetic segment as 100% and places the centrals at 50%, the laterals at 30%, and the canines at 20% of the whole **(Figs 15a & 15b)**. Any number of rules can be followed to ensure that this relevant segment fits in with the golden proportion for the most esthetic relationship between the teeth.

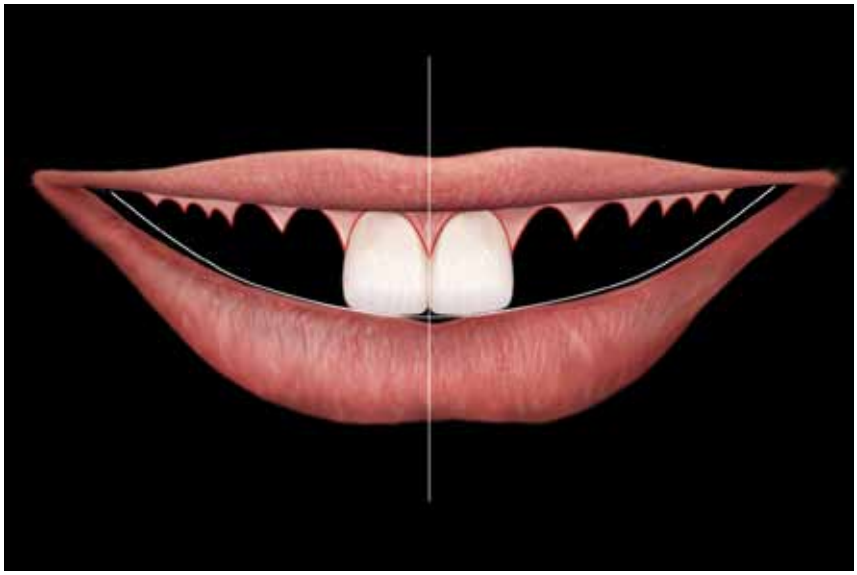
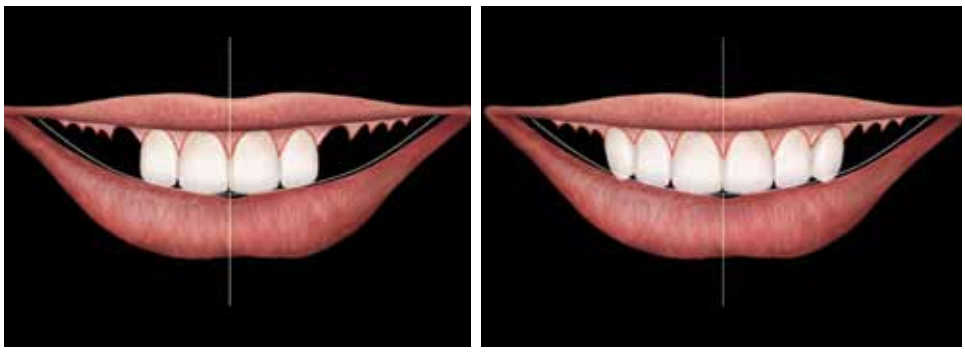


Figure 14: In order to create midline symmetry, the central incisors should be mirror images of each other.



Figures 15a & 15b: The size of the lateral incisors and canines are determined so as to maintain relative proportions to each other and the centrals. We can use principles of tooth proportions, the "golden proportion," and the various other proportion tools defined for the anterior segment. The aim is to create radiating lateral harmony.

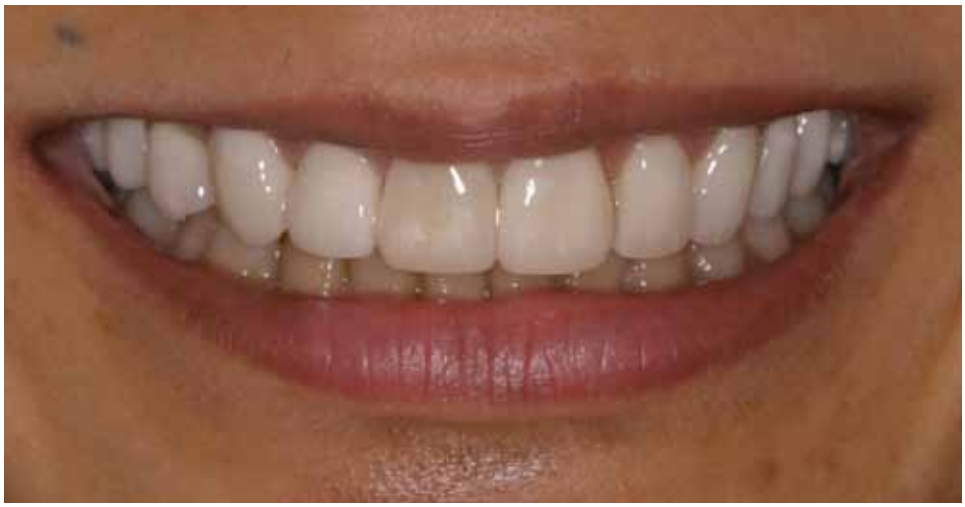


Figure 16: Buccal corridor encroached upon by the teeth, leaving no contrast in color between the teeth, tissues, and space.

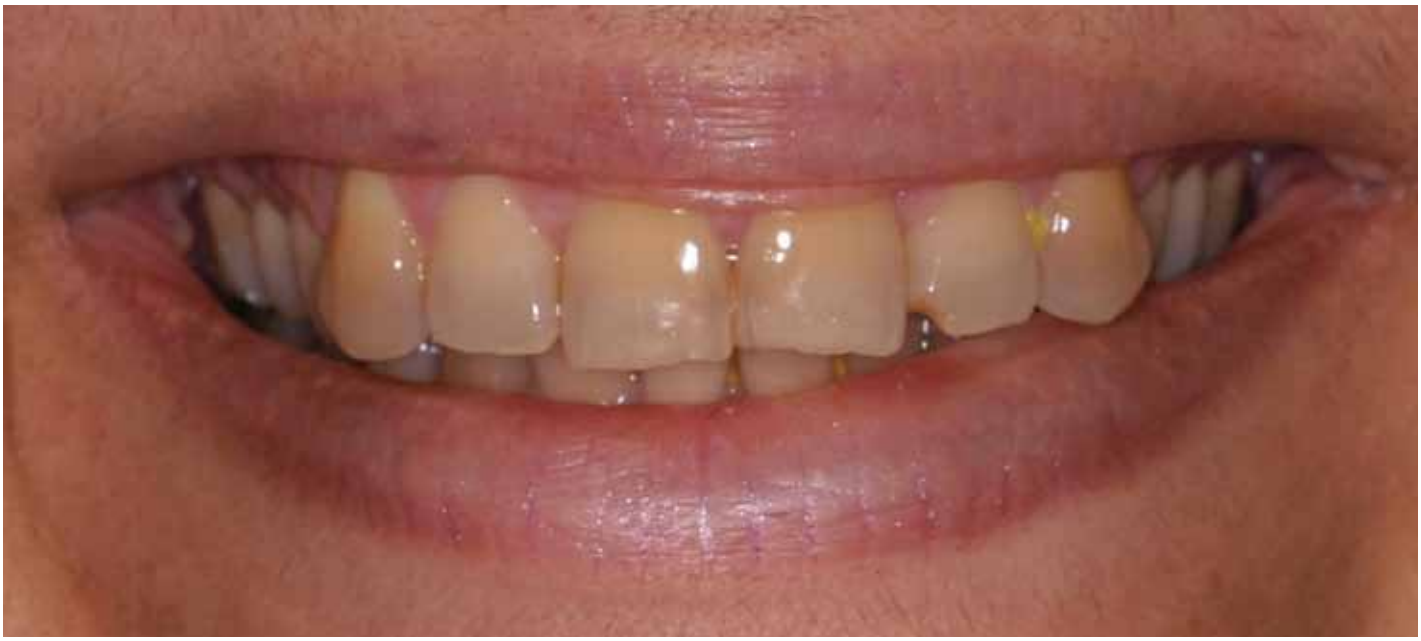


Figure 17: Prominent anterior segment with depressed posteriors gives the impression of an empty, "hollow" smile.

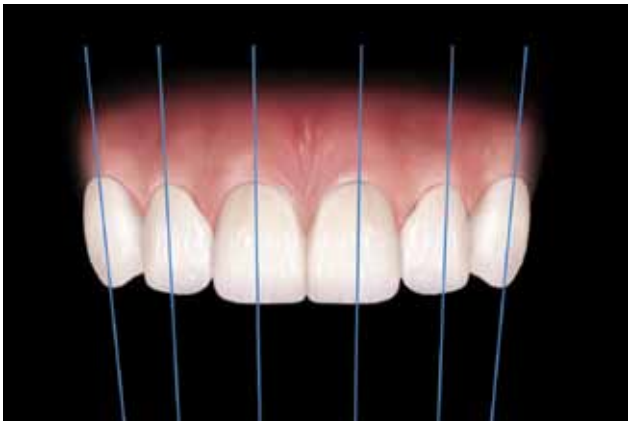


Figure 18: Axial inclinations of the teeth should be medially directed for a more esthetic and pleasing appearance.

Figure 19: Eliminate the dark corridors of the smile, paying attention to the vertical parallelism and medial axial inclinations.

Step 6: Extend the Smile Into the Corners

Once the esthetic zone has been designed to fit a patient's face, we move posteriorly and fill in the corners of the mouth. The dark buccal corridors are evaluated and filled in so as to create a perfect balance between the white of the teeth, the pink of the tissues, and the black of the space. Over-filling these spaces creates a very toothy appearance **(Fig 16)** and excess space gives the impression of an empty smile **(Fig 17)**. The teeth are also aligned and their axial inclinations are modified so as to be inclined toward the midline for a more cohesive appearance to the full mouth **(Figs 18 & 19)**.

Step 7: Design the Shape and Texture of Individual Teeth

Once all the teeth have been placed and sized correctly, we can design the finer points of the esthetics as well as the teeth themselves.

Here we establish the contact points or areas and design embrasures to create a smile that suits the individual's age, gender, and personality. Shade and characterization of the teeth are determined to create a result **(Fig 20)** that can be "Hollywood white" or more natural, depending upon the patient's wants and needs.

Summary

By following the systematic approach described here, designing a smile becomes predictable and easy. The details are in the collection of data and then using the data exactly where required to achieve a beautiful smile **(Fig 21)**. Once this has been accomplished, it is a matter of interacting with practitioners from the various disciplines of dentistry to create a plan that will realize the end point we have already designed.

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Dr. Mistry has a private practice in Mumbai, India.

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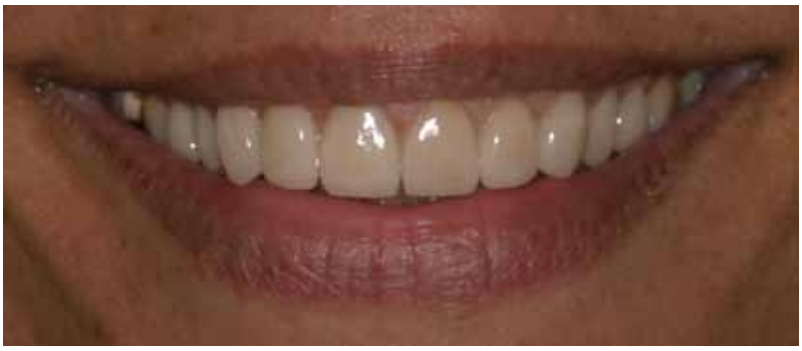

Figure 20: Characterization of the teeth is now developed. Embrasure spaces, contact points and contact areas, color, and translucency are all finalized to complete the smile.

Figure 21: All the features of the smile coming together to complement the patient's face.

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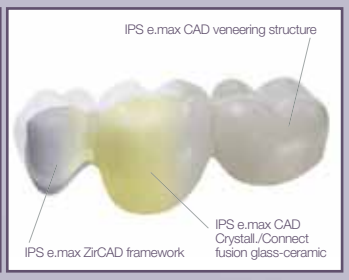

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A "NO BONE"

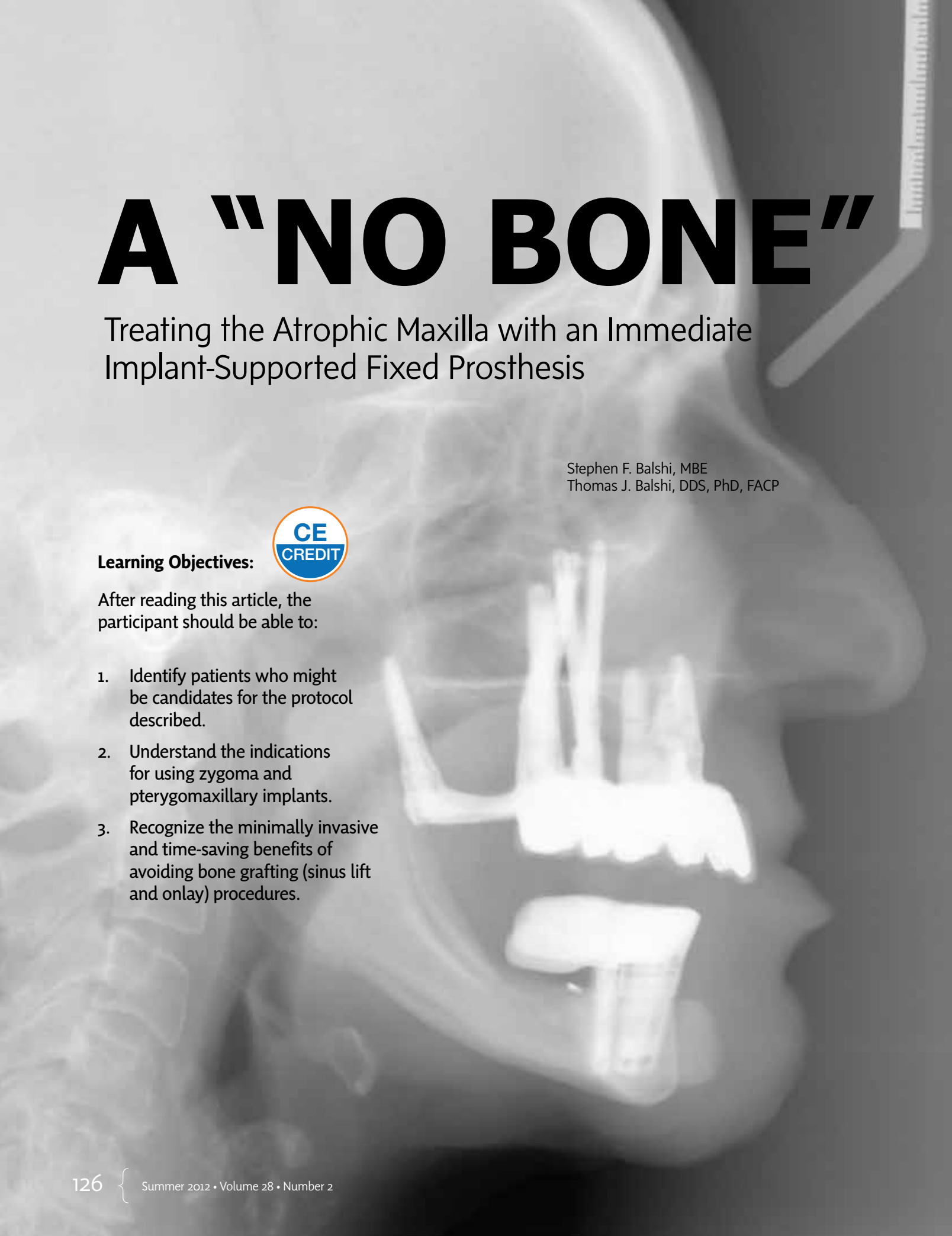
Treating the Atrophic Maxilla with an Immediate Implant-Supported Fixed Prosthesis

Stephen F. Balshi, MBE
Thomas J. Balshi, DDS, PhD, FACP

Learning Objectives:

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

1. Identify patients who might be candidates for the protocol described.
2. Understand the indications for using zygoma and pterygomaxillary implants.
3. Recognize the minimally invasive and time-saving benefits of avoiding bone grafting (sinus lift and onlay) procedures.



SOLUTION

Abstract

Rehabilitation of the severely atrophic maxilla presents significant challenges for the restoring dental team. Inadequate bone volume often results in augmentation procedures that delay treatment and delivery of the final prosthetic solution. This article discusses the use of implant anchorage in extra-maxillary sites for the support of an immediately loaded screw-retained prosthesis.

A 71-year-old Caucasian female with an unremarkable medical history presented for treatment of her severely atrophic maxilla. She was treated with a combination of computer-guided standard-length implant placement as well as freehand zygomatic implant placement. A total of nine implants were placed to support an all-acrylic provisional prosthesis immediately after surgery. The final prosthesis was delivered five months after the initial implant placement.

The treatment plan, including implant placement and provisional prosthesis delivery, took less than four hours to complete under general anesthesia. The final prosthesis consists of a milled titanium framework that supports individual ceramic crowns, providing the patient with an excellent functional and esthetic result. The patient has been followed for four years since initial implant placement; there have been no postoperative complications to report.

The combination of the computer-guided and freehand implant placement to treat the atrophic maxilla provides the maxillary atrophied patient with an alternative to bone augmentation. This protocol provides the definitive solution for the patient in an expeditious yet predictable manner.

KEY WORDS: dental implant, osseointegration, atrophic maxilla, zygoma, pterygoid

Introduction

Originally described by Brånemark and colleagues,[1] prosthetic rehabilitation with dental implants and tissue-integrated prostheses has been a widely accepted treatment option for the edentulous arch. Patients who have been edentulous for many years or patients with extensive periodontal conditions may present a challenge to the practitioner for traditional implant placement due to limited bone quality and quantity. Several techniques have been used to successfully restore the atrophied maxilla by creating more bone volume. The techniques employed have included iliac block grafting procedures,[2] sinus augmentation,[3] and Le Fort I osteotomies with interpositional bone grafting.[4] In patients where bone atrophy and paranasal sinus pneumatization is less advanced, the use of tilted implants[5,6] anterior and posterior to the maxillary sinus may provide predictable alternatives for the edentulous maxilla.

This article describes the rehabilitation of the severely atrophic maxillary arch using a combination of standard length endosseous implants in the anterior maxilla or in the pteryogomaxillary region[7,8] and longer implants placed in the zygomatic bone.[9-12] The implants were immediately loaded following the Teeth in a Day (PI Dental Center, Fort Washington, PA) protocol,[13,14] using the conversion prosthesis technique[15,16] of adapting an immediate removable denture to an all-acrylic resin screw-retained provisional prosthesis. This treatment, termed the No BoneZ Solution (PI Dental Center), uses remote implant anchorage to immediately rehabilitate the oral invalid to an all-acrylic resin screw-retained provisional prosthesis in a single surgical appointment. The total treatment time for patients

with this protocol typically is 12 to 18 weeks. This is routinely more efficient than grafting treatment options, which may be 12 to 18 months in duration. The cumulative survival rates of implants in the No BoneZ Solution protocol are higher than implants placed in grafted maxillae.[17] And because there is no donor site in this protocol, there is no concern for donor site pain, trauma, swelling, or other forms of morbidity.

This article discusses a typical patient and her journey though the No BoneZ Solution protocol. The diagnosis and treatment planning are highlighted, along with the subsequent in-office visits until the delivery of the final prosthetic reconstruction.

Patient History

A 71-year-old Caucasian female presented to a private practice specializing in implant prosthodontics (Pi Dental Center). She was completely edentulous in both the maxillary and mandibular arches but had implant rehabilitation completed in the mandibular arch **(Figs 1a & 1b)**. She presented with a maxillary removable complete denture and a screw-retained mandibular acrylic resin-to-metal prosthesis **(Fig 2a)**. Both maxillary and mandibular prostheses had gold occlusal inlays on the bicuspids and molars **(Figs 2b & 2c)**. The maxillary denture had a radiographic registration embedded in it by her previous dentist for the purpose of three-dimensional (3D) evaluation **(Figs 1a & 1b)**. The patient stated she had been wearing a maxillary complete denture since she was 17 years old (54 years) and realized she had a significant amount of bone loss as a result. Her chief complaint was "constant jaw pain with ringing in the ears." She believed her jaw relationship "opened her up too

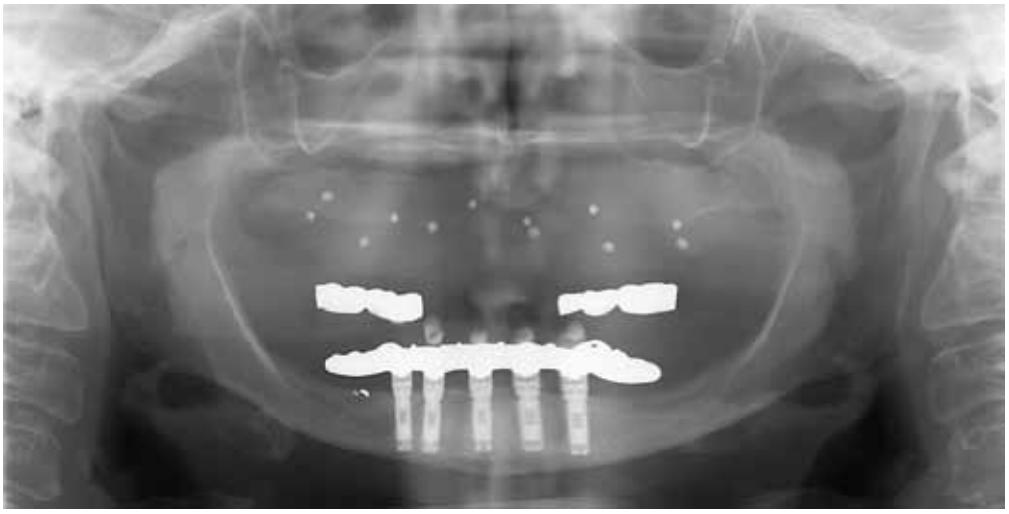


Figure 1a: Panoramic radiograph at initial presentation.

Patients who have been edentulous for many years or patients with extensive periodontal conditions may present a challenge to the practitioner for traditional implant placement due to limited bone quality and quantity.

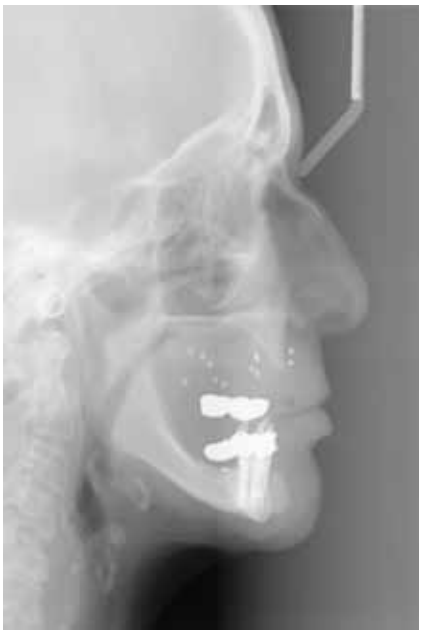


Figure 1b: Lateral cephalometric radiograph at initial presentation.

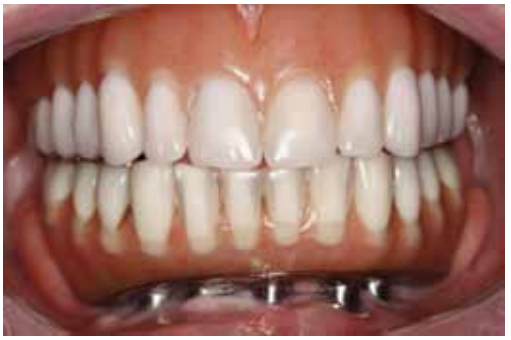


Figure 2a: Frontal view at initial presentation with maxillary complete denture and mandibular screw-retained acrylic-metal prosthesis.

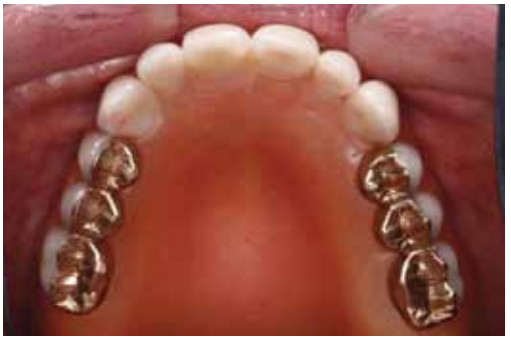


Figure 2b: Occlusal view of maxillary complete denture at initial presentation.

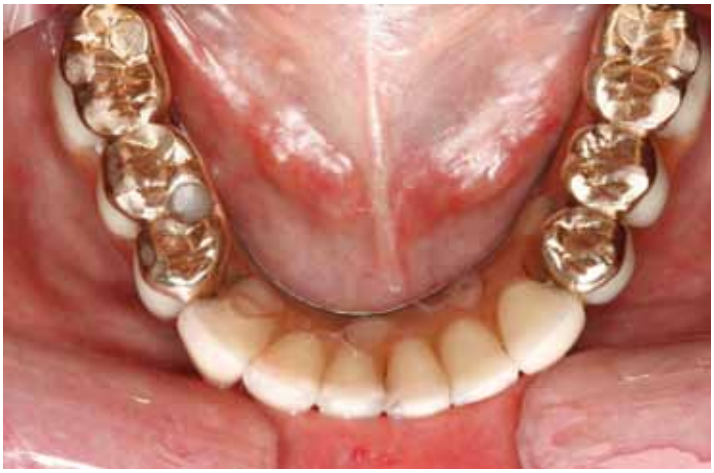


Figure 2c: Occlusal view of mandibular screw-retained acrylic-metal prosthesis at initial presentation.

much." The patient reported good general health, suffering only from mitral valve prolapse, low blood pressure, and mild bouts of arthritis. She was previously prescribed 0.125 mg Synthroid, 100 mg Zoloft (for depression), and 400 mg Meprobamate (for jaw pain).

Treatment Plan

The traditional clinical and radiologic initial patient evaluation was performed. The lateral cephalometric radiograph **(Fig 1b)** revealed a "knife-edged" ridge in the maxilla. Advanced bone loss was also noted in the posterior maxilla **(Fig 1a)**. A comprehensive treatment plan was presented to the patient that included the following:

1) A crestal incision in the maxillary arch with little mucosal reflection to reduce the alveolar ridge in the anterior maxilla, which would provide a more ideal platform for implant placement.
2) A reline of the current maxillary removable denture after the reduction of the alveolar ridge.
3) A cone-beam computed tomography (CBCT) scan, which would be used to virtually plan the implant placement.
4) Fabrication of a surgical template for standard-length implant placement.
5) Fabrication of an all-acrylic resin provisional prosthesis based on the virtual implant placement.
6) Surgical placement of five standard-length Brånemark System implants (three in the anterior maxilla and one in each pterygomaxillary region bilaterally) and four zygomatic implants (two each side bilaterally).
7) Connection of the prefabricated all-acrylic resin provisional prosthesis to the nine implants.
8) Delivery of the final prosthesis approximately 20 weeks after implant placement.

The patient agreed to this comprehensive treatment plan.

Treatment

Preoperative Clinical Procedure

The authors believe that all dental implant treatment must be prosthetically driven. In other words, the first step in the process is to determine (with the patient's agreement) the final prosthetic solution. It was explained to the patient that the ideal final prosthesis for the maxilla would be a milled titanium framework constructed to support individual porcelain crowns, and a customized gingival veneer to compensate for the lost vertical dimension that had resulted from 54 years of denture wearing. To complement this ideal final prosthetic solution in the maxilla, it was suggested to the patient that a new mandibular definitive reconstruction be fabricated that consisted of a milled titanium framework supporting acrylic resin denture teeth and the same customized gingival veneer. In addition to material preferences, a new mandibular prosthesis would allow an Angle's Class I occlusal relationship to be established.

A small crestal incision was made and the appropriate amount of alveoplasty was performed in the maxillary arch to establish a bone platform for implant placement and the spatial requirements for the definitive prosthesis. The flaps were sutured and a chair-side hard reline was completed. A polyvinyl siloxane centric occlusal index was taken to record this relationship for the laboratory and also to stabilize the prostheses during the forthcoming CBCT scanning procedures. An open-tray abutment level impression was taken in the mandibular arch and the resulting mandibular master cast was articulated using the existing mandibular prosthesis opposing a model of the maxillary removable denture. Additionally, a stone model of the existing mandibular screw-retained prosthesis was cross-articulated.

The specific guided surgery protocol that would be employed (NobelClinician; Nobel Biocare; Yorba Linda, CA) requires a dual CT scan technique.[18-20] The first scan is of the patient with the removable prosthesis, which contains the radiographic registration. The second scan is of the removable prosthesis alone. The digital imaging and communications in medicine (DICOM) files were exported to the diagnostic and virtual treatment-planning software (NobelClinician). The 3D virtual working environment allows the clinician and the laboratory to collaborate on the ideal placement of the implants with consideration to biomechanics, prosthesis design, and esthetics.

The maxillary virtual implant planning was designed with three external connection implants (NobelSpeedy Groovy; Nobel Biocare) in the anterior

region, one external connection implant in each pterygomaxillary region bilaterally, and two zygomatic implants (Brånemark System Zygoma, Nobel Biocare) on each side bilaterally **(Figs 3a-3d)**.

The computer-assisted design (CAD) files of the maxillary virtual planning were transmitted through the Internet to the production facility (NobelProcera; Mahwah, NJ), where those files dictated stereolithic construction of the surgical template. At the same time, a stereolithic copy of the patient's maxillary removable complete denture was fabricated to assist the laboratory in fabrication of the screw-retained prostheses.

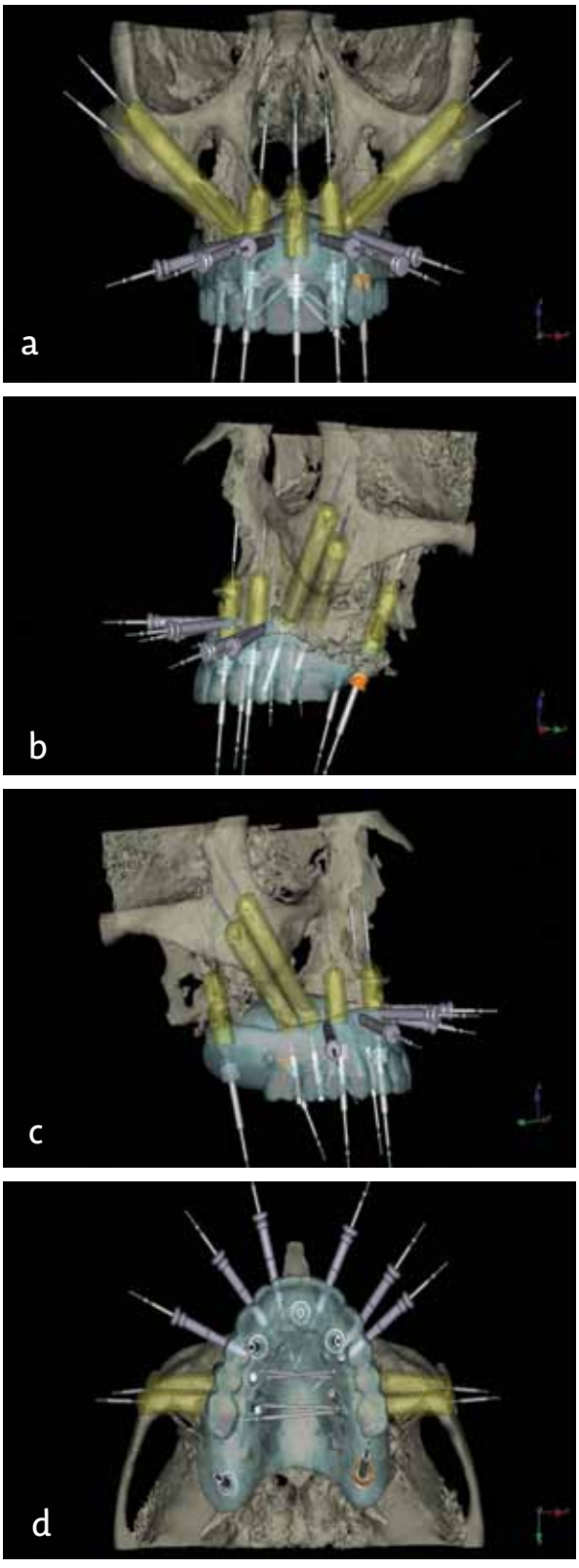
Preoperative Laboratory Procedures

Following this specific guided surgery protocol,[18-20] the laboratory retro-engineered an implant-level master cast with a soft tissue replication. Because of thread timing issues associated with the zygomatic implants, those replicas were not incorporated into the master cast. Using the centric occlusal index taken before the CBCT scan, the maxillary master cast could be articulated with the stereolithic duplicate of the patient's denture against the previously articulated stone model of the existing mandibular prosthesis. Appropriate transmucosal abutments were installed onto the maxillary master cast **(Fig 4)** on which the all-acrylic resin screw-retained provisional prosthesis could be fabricated. Since there were only replicas present in the model for the standard length implants, just five prosthetic cylinders could be processed into the acrylic in the laboratory. The remaining four prosthetic cylinders for the zygomatic implants would be connected intraorally during the surgical procedure immediately after implant placement.

Since the mandibular abutment level master cast was cross articulated, it was possible for the laboratory to fabricate the aforementioned new mandibular acrylic-to-titanium prosthesis at the same time as the maxillary all-acrylic resin prosthesis **(Figs 5a-5c)**. Additionally, the laboratory could provide the clinician with a surgical index. This index would reference the maxillary surgical template to the newly fabricated definitive mandibular prosthesis **(Fig 6)** and would stabilize the surgical template in the patient during the clinical procedures.

Implant Placement and Prosthesis Delivery

It is the authors' preference to administer general anesthesia with nasal intubation to patients undergoing zygomatic implant placement. The surgical template was carefully delivered to the patient with the surgical index. Using the specific guided surgery drilling system, the five standard-length external connection implants were placed in a flapless manner. Once those implants were placed, the surgical template was removed and the tissue reflection commenced for placement of the zygomatic implants. These implants range from 30 to 52.5 mm in length, have a rounded apex, and a 45° bend at the coronal aspect to correct the prosthetic access for the palatally inclined implant **(Fig 7)**. The implants have dual anchorage at the remainder of the max-



Figures 3a-3d: Screen capture from NobelClinician software of the completed virtual planning from (a) a frontal view, (b) a left lateral view, (c) a right lateral view, (d) an occlusal view.

The 3D virtual working environment allows the clinician and the laboratory to collaborate on the ideal placement of the implants with consideration to biomechanics, prosthesis design, and esthetics.

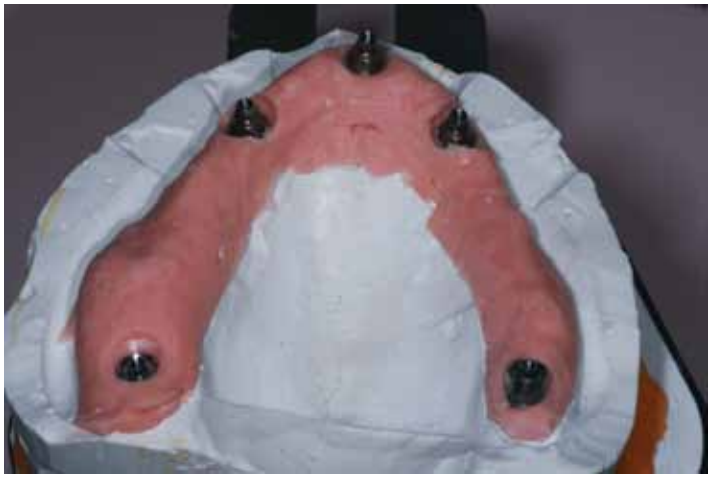


Figure 4: Retro-engineered implant-level master cast from the surgical template. The master cast has transmucosal abutments placed on the implant replicas, bringing the prosthetic platform to a more desirable relationship with the soft tissue.

Figure 5a: Occlusal view of the prefabricated all-acrylic resin provisional prosthesis connected to the standard-length Brånemark System implants.

Figure 5b: Occusal view of the new definitive mandibular screw-retained prosthesis. A milled titanium framework supports the acrylic resin denture teeth.

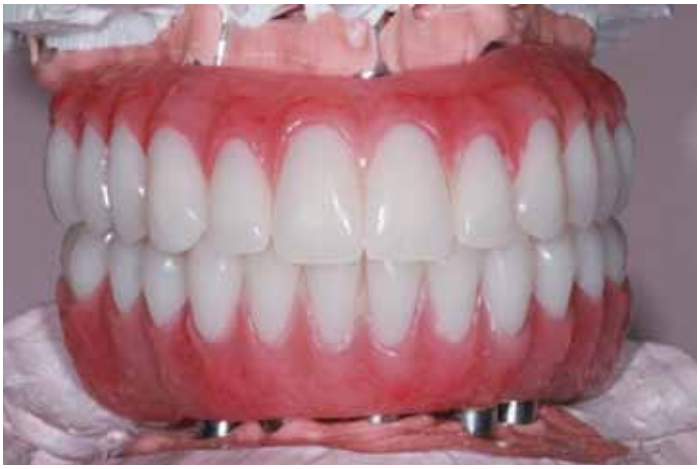


Figure 5c: Frontal view of the prefabricated maxillary provisional prosthesis and mandibular definitive prosthesis.

Figure 6: Right lateral view of the surgical index. This index will be used to position the surgical template in the patient with relation to the new mandibular definitive prosthesis.

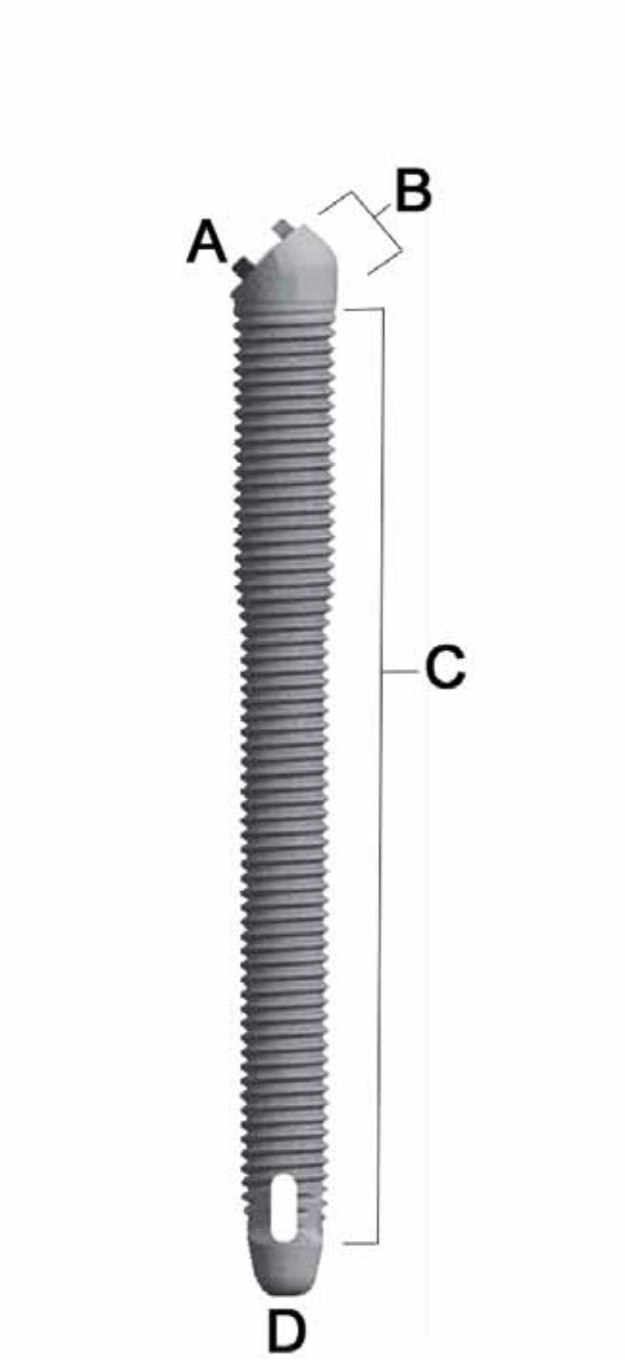


Figure 7: The Brånemark System Zygoma Implant: (a) regular platform external hex connection, (b) prosthetic access is at a 45° angulation from the long axis of the implant, (c) the implant body consists of two diameters [4.6 mm at the coronal or maxillary end; 3.9 mm at the apical or zygomatic end], (d) the apex is a rounded tip to prevent sharp edges when the implant penetrates the lateral wall of the zygoma.

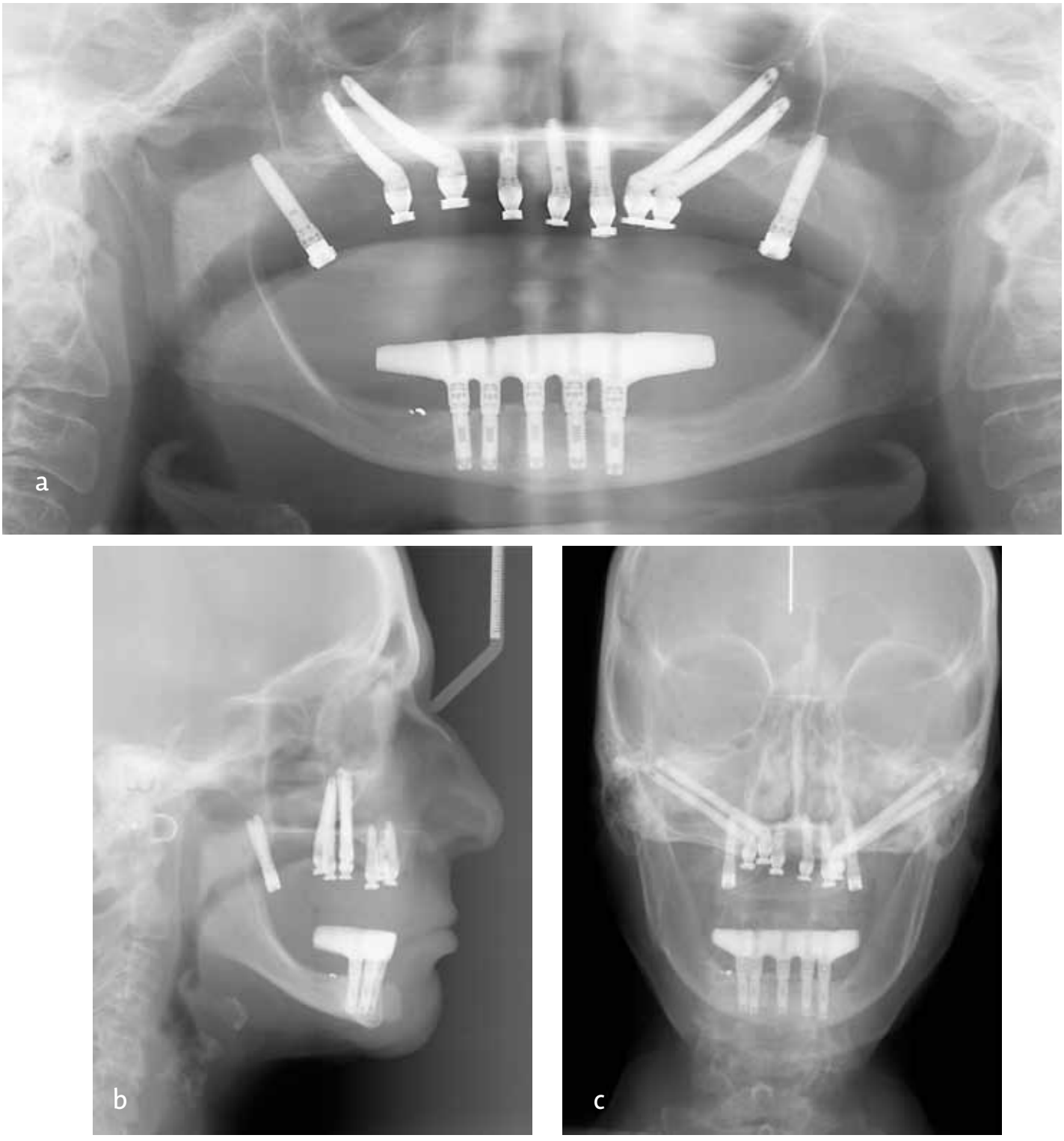
Figure 8: Occlusal view of the maxillary all-acrylic resin provisional prosthesis connected to all nine implants (five standard length, four zygomatic).

illa and at the zygoma, oftentimes transecting the maxillary sinus. When the implants were at their desired depth and orientation, the implant mounts were removed and the appropriate transmucosal abutments were connected. Following the Teeth in a Day protocol as described in the literature,[12-14] the maxillary all-acrylic resin provisional prosthesis was modified to pick up the position of the temporary prosthetic cylinders for the zygomatic implants **(Fig 8)**. Any occlusal adjustments were made and the access holes were filled with a firmly packed gauze strip or Teflon tape, followed by a light-cured provisional resin (Fermit LC, Ivoclar Vivadent; Amherst, NY). The patient was then extubated and allowed to recover from the general anesthetic. Postoperative panoramic, lateral, and anteroposterior cephalometric radiographs were made **(Figs 9a-9c)**. The patient was asked to return to the office the next day for a healing check and to discuss all pertinent postoperative instructions. After 12 weeks or more of healing, she would present to initiate the construction of the maxillary definitive prosthesis.

Prosthetic Procedures

The patient returned 13 weeks after implant placement for final impression of the maxillary arch. Following the Teeth in a Day protocol,[12-14] the provisional prosthesis was used as an impression splint to obtain a verified master cast. After the master cast was fabricated, the provisional prosthesis was used to articulate the master cast against a model of the mandibular definitive restoration.

The articulated models were sent to the laboratory for the fabrication of the definitive prosthesis. The patient elected to proceed with the authors' recommendation and receive the prosthesis that was built with individual porcelain crowns, all of which were supported by an underlying robotically milled titanium framework. A resin pattern designed from an approved tooth setup



Figures 9a-9c: Postoperative radiographs with maxillary provisional and mandibular definitive prostheses delivered: (a) panoramic, (b) lateral cephalometric, (c) anteroposterior cephalometric.

(Fig 10) was constructed in the laboratory; it would be copy-milled in titanium. The framework was opaqued and individual all-porcelain crowns were fabricated on each titanium preparation. Once the crowns were cemented onto the titanium framework, the appropriate customized gingival resin veneer was applied and the completed prosthesis **(Fig 11)** was returned to the prosthodontist. The patient presented eight weeks after final impression for delivery of the maxillary definitive prosthesis **(Fig 12)**. A maxillary occlusal guard was also fabricated for use at night. Post-delivery panoramic, lateral, and anteroposterior cephalometric radiographs were made **(Figs 13a-13c)**. The patient was instructed to have professional hygiene on a three-month recall until further notice. The patient has had unremarkable follow-up for four years.

Discussion

The No BoneZ Solution protocol provides comprehensive patient care for the fixed reconstruction of the severely atrophic maxilla in the fewest number of clinical sessions. Using the patient example described above, the following clinical sessions should be noted:

- **Session 1.** Diagnosis, treatment planning, consultation, jaw relationships recorded; minor alveloplasty to eliminate the knife edge ridge, hard reline of maxillary denture, and CBCT dual scan for virtual planning.
- **Session 2.** Implant surgery and delivery of a fixed screw-retained, all-acrylic provisional prosthesis.
- **Session 3.** Thirteen weeks after implant placement surgery, final impressions and occlusal records are complete and the laboratory prosthesis construction is initiated.
- **Session 4**. Delivery of the final definitive prostheses with an occlusal guard.

Comprehensive prosthodontic rehabilitation can be accomplished in as few as these four clinical treatment sessions. This treatment protocol is highly dependent on the accuracy of the prosthetically driven virtual plan, the precision of the laboratory procedures prior to implant surgery, and the ability to combine computer-guided implant surgery and full-flap zygomatic implant surgery in one session, which includes the connection of the zygomatic implants to the previously constructed screw-retained provisional prosthesis.

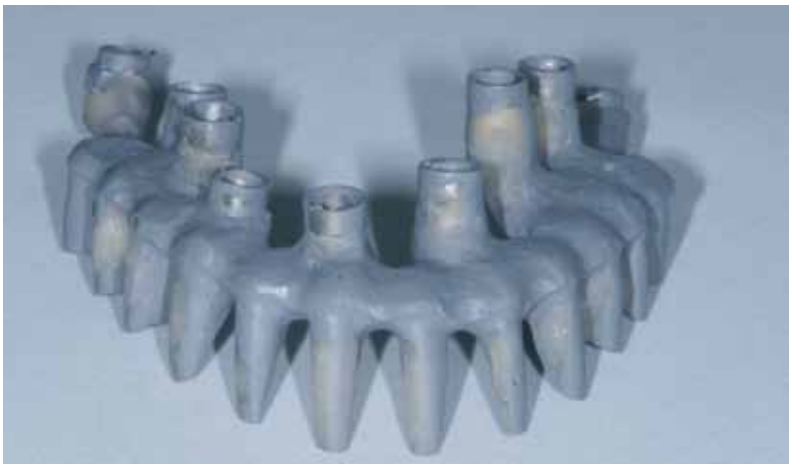


Figure 10: Resin pattern for maxillary definitive prosthesis designed to support individual ceramic crowns.

Figure 11: Completed maxillary definitive prosthesis consisting of a milled titanium framework supporting individual zirconia crowns and a customized gingival veneer.

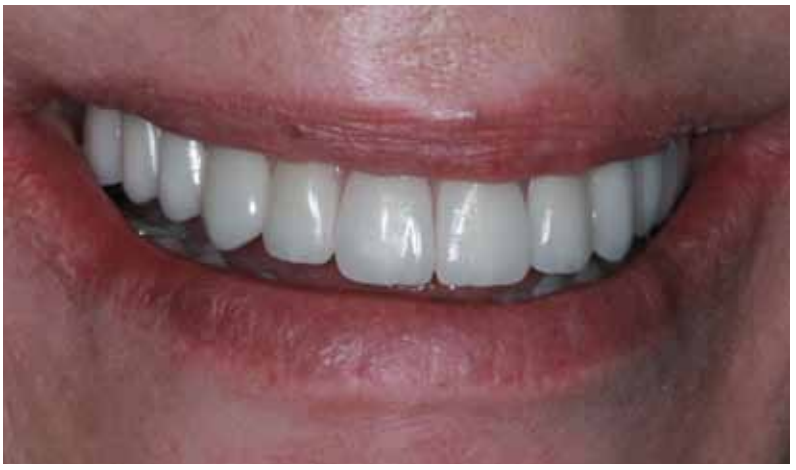
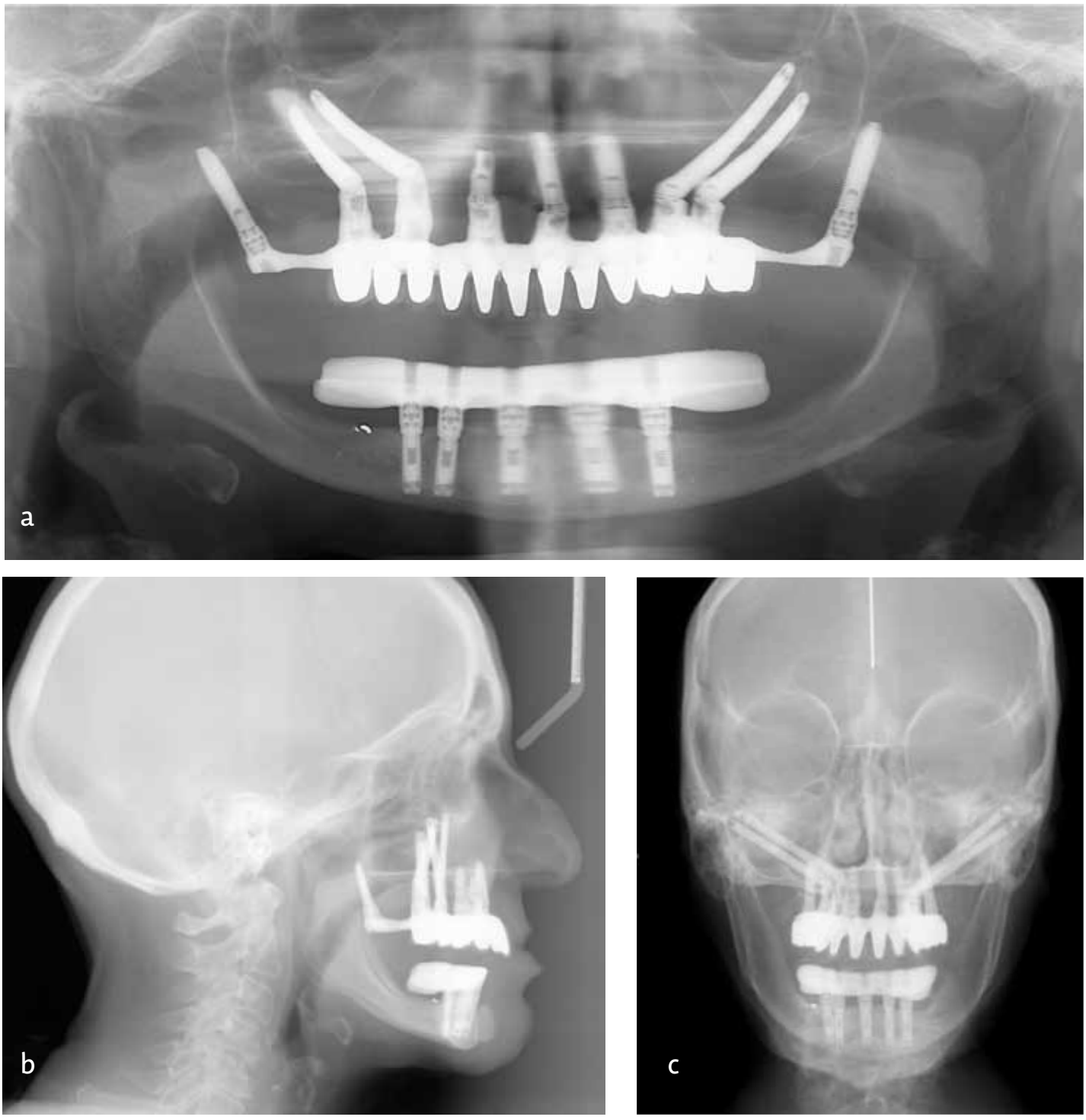


Figure 12: Frontal view following delivery of definitive maxillary prosthesis.



Figures 13a-13c: Postoperative radiographs with maxillary and mandibular definitive prostheses delivered: (a) panoramic, (b) lateral cephalometric, (c) anteroposterior cephalometric.

To achieve optimal esthetics for the severely atrophic maxillary rehabilitation, one must take into account aspects of restoring the lower third of the face. The principles of facial and lip support used in complete denture fabrication appropriately apply to this protocol. Prior to initiating surgical implant placement, the clinician needs to study facial form and select denture teeth of the appropriate mold and size that complement the patient's facial features. Although the current societal trend leans heavily toward the "whiter and brighter" smile, the atrophic maxilla patient may be better cosmetically restored with more natural shade selection. Choosing a variety of shades for the anterior and bicuspid teeth creates a color palate that works in harmony with nature.

Because the No BoneZ Solution protocol uses a fixed implant-supported provisional prosthesis, there is a three-month healing period during which both clinician and patient can evaluate the overall facial and dental esthetics before construction of the final prosthesis is initiated. When the dental esthetics are approved in the provisional prosthesis, replication of the dental anatomy can be captured digitally and reproduced in a variety of ceramic materials.

The accuracy of the impression procedure emanating from the Teeth in a Day protocol permits the total construction of the final prosthesis as described above without the need for try-in visits. Additionally, the No BoneZ Solution protocol is much less invasive than sinus elevation, bone grafting, or inlay or onlay bone grafting usually using the iliac crest as the donor site. When bone grafting to the maxilla is used, there is a delay in the treatment until the graft has stabilized and is mature enough for implant placement. This often requires the patient to function without a maxillary denture, so as not to put occlusal loading pressure on the healing bone graft.

Summary

The No BoneZ Solution protocol provides a restorative option for patients with severely atrophic maxillary bone. This protocol does not require bone augmentation and significantly reduces total treatment time for the patient compared to alternative procedures.

Aknowledgments

The authors thank Dr. Glenn Wolfinger and the staff of the Pi Dental Center (Fort Washington, PA) for their kind and gentle treatment of this patient; Mr. Dan Delaney and Dr. Brian Wilson for general anesthesia support; and Dr. Chantal Malevez and Prof. Per-Ingvar Brånemark for guidance and inspiration.

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This treatment protocol is highly dependent on the accuracy of the prosthetically driven virtual plan, the precision of the laboratory procedures prior to implant surgery, and the ability to combine computer-guided implant surgery and full-flap zygomatic implant surgery in one session.

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Disclosure: The authors have financial arrangements with PI Dental Center and Nobel Biocare. Dr. Balshi developed the Teeth in a Day Protocol and the No BoneZ Solution.

AACD Self-Instruction Continuing Education Information

3 Hours Credit

General Information

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

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

Testing and CE

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

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

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

Academy of General Dentistry PACE Program Approval for Continuing Education

ADA C·E·R·P Continuing Education Recognition Program

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CDT CONTINUING APPROVED EDUCATION

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

(CE) Exercise No. jCD08

Implant Restorations (Prosthodontics/Fixed) AGD: Subject Code: 616

The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article, "A 'No-Bone' Solution: Treating the Atrophic Maxilla with an Immediate Implant-Supported Fixed Prosthesis," by Mr. Stephen F. Balshi and Dr. Thomas J. Balshi. This article appears on pages 126-137.

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 that 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. In the case presented, the reason for the severe atrophy of the maxilla was which of the following?

a. age-related bone loss of the maxilla
b. trauma to the upper jaw
c. extensive periodontal disease
d. extraction of maxillary teeth when the patient was young

2. Which of the following techniques for restoring the atrophic maxilla was utilized for the case presented?

a. iliac block grafting
b. sinus augmentation
c. tilted implants
d. Le Fort I osteotomy

3. By not using bone augmentation,

a. a more predictable result is achieved although there is an increase in treatment time.
b. the cumulative survival rate of the implants remains the same as those placed in augmented bone.
c. the chance of increasing the vertical dimension of occlusion is greatly reduced.
d. there is no concern for donor site pain, trauma, and swelling.

4. What does the "conversion prosthesis technique" discussed refer to?

a. Altering the existing denture from an end-on-end occlusion to a Class I occlusion.
b. Adapting an immediate removable denture to a screw-retained provisional prosthesis.
c. Modifying the existing denture by eliminating the gold onlays that were present posteriorly.
d. Modifying the alveolar ridge as well as the existing denture to improve the bite.

5. What is the biggest challenge facing dentists when placing implants in patients with extensive periodontal conditions or who have been edentulous for many years?

a. poor cumulative survival rates of implants placed in grafted maxillas
b. limited bone quality and quantity
c. medical and health issues of elderly patients
d. inability to graft bone due to extensive sinus pneumatization

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

Cement Selection for Cement-Retained Implant Prostheses

Plus Implant Cement Product Reviews

Sabiha S. Bunek, DDS

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

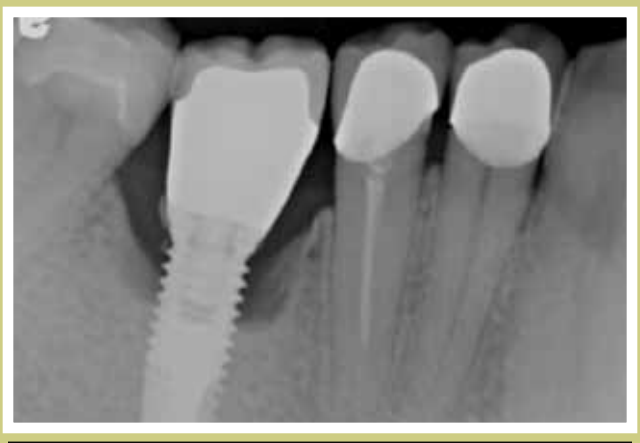

Figure 1: Radiograph showing residual cement resulting in peri-implantitis (distal of #30).

As patients request more esthetic restorations, clinicians are moving toward cement-retained implant prostheses.

Introduction

The decision to restore a dental implant with a screw- or cement-retained prosthesis is complex and not well defined. While there is no universal answer as to which is best, an understanding of the indications and drawbacks of each technique will assist clinicians in selecting an ideal prosthesis.

Screw-Retained Prostheses

Traditionally, most dental implants were screw-retained to facilitate the clinician's ability to retrieve parts (retighten or replace abutment screws, replace failed or fractured components, etc.). Consequently, many clinicians found the final restoration esthetically compromised due to the screw access opening. Although esthetic considerations determine many decisions, there are some indications for which the use of screw-retained prostheses is recommended:

- in areas where the crown margin will be submerged deeply and it would be difficult to clean up excess cement
- in situations where more retention (short abutments or limited inter-occlusal space) is needed
- in certain multi-unit cases where the path of insertion would be difficult to obtain with a cemented prosthesis.

Cement-Retained Prostheses

As patients request more esthetic restorations, clinicians are moving toward cement-retained implant prostheses. There are a variety of permanent and temporary cements available today. Although permanent cements often are used for retaining crowns on implant abutments, many practitioners prefer temporary cements in the event that they would later need to retrieve the implant or abutment. There are a number of temporary cements based on resin or non-eugenol zinc oxide formulations available for crown and bridge applications, but only a few of these cements are recommended by the manufacturer for implant cementation. Products recommended by *The Dental Advisor* for implant cementation include Implant Link Semi and Forte (DETAX GmbH; Ettlingen, Germany), Premier Implant Cement (Premier Dental Products; Plymouth Meeting, PA), Telio CS Cem Implant and Multilink Implant (Ivoclar Vivadent; Amherst, NY), and TempoSIL2 (Coltène/Whaledent; Cuyahoga Falls, OH).

One of the biggest drawbacks of cemented restorations is the potential for leaving excess cement subgingivally, resulting in gingival inflammation and bone loss around the implant (peri-implantitis) **(Fig 1)**. More than 70% of peri-implantitis has been shown to be associated with residual cement.[1] If noticed early, peri-implantitis can be addressed with a variety of nonsurgical and surgical techniques. However, if it is caught too late, it may require removal of the dental implant. Proper cementation and cleanup is extremely important to the future health of the implant periodontium. **jCD**

Reference

1. Wilson TG Jr. The positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study. J Periodontol. 2009 Sept;80(9):1388-92.

Ideal Features of Implant Cement

- Low film thickness for easy seating
- Low solubility
- High tensile and compressive strength
- Radiopaque
- Dual-cured for easy removal of cement

Clinical Tips for Cementing Implant Crowns

- Do not overload the crown with cement. The fit between an implant abutment and crown is intimate; therefore, little cement is required.
- To increase crown retention when using a temporary cement, consider air-abrasion of the abutment.
- Gently pack cord to keep cement from extruding subgingivally.
- Dispense cement inside implant crown and then immediately place it on analog outside the mouth, removing excess cement quickly. Then place the crown in the mouth onto the abutment. Excess cement should be minimal.
- Ideally, the abutment margins should be between 1 to 2 mm subgingival, following the contours of the gingivae to facilitate easy cleanup.

Product Reviews from *The Dental Advisor*

Premier Implant Cement (Premier Dental Products) ++++

Premier Implant Cement is a eugenol-free, elastic polymer cement with a two-stage cure—an initial gel-phase in 2.5 minutes for removal of excess cement, and a rigid final set. Premier Implant Cement was highly rated for its easy removal and cleanup of excess cement. The automix feature provides neat, quick mixing and easy placement into the restoration. The light viscosity of the cement allows complete seating of restorations without excessive pressure. Consultants favored the retentive quality of the material, although a few found it difficult to remove restorations when necessary.

Thirty consultants evaluated Premier Implant Cement in the cementation of 175 crowns. One hundred percent of the consultants found the cement to be equivalent to or better than their current cement. Sixty percent would switch, while 93% would recommend this product, which received a 91% clinical rating.

Implantlink semi (DETAX GmbH) ++++1/2

Implantlink semi is a dual-cured, eugenol-free temporary resin cement designed to have very low displacement resistance and a low film thickness of less than 10 m. It is available in a natural opaque color for screening metallic abutments. Implantlink semi is easy to use from the automix syringe. The low-viscosity resin spreads easily inside the restoration, and the thixotropic nature of the cement allows complete seating of the restoration with pressure. Tack curing allows easy removal of excess cement at the margins during the gel phase. While Implantlink semi is designed for semi-permanent cementation, some consultants experienced retention problems with crowns coming off during the three-month evaluation period.

Twenty-three consultants evaluated Implantlink semi in the cementation of 185 crowns. Forty-four percent of the consultants reported that Implantlink semi was better than their current temporary cement and 35% reported that it was equivalent. Seventy percent would switch, while 78% would recommend this product, which received a 91% clinical rating.

Note: Implantlink semi Forte is available for cases in which more retention is required.

The Dental Advisor Evaluation Process

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

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

The rating is based on a scale of 1 to 5:

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

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Dr. Bunek practices in Ann Arbor, Michigan.
Disclosure: Dr. Bunek is editor-in-chief of *The Dental Advisor*.

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