The area of soft tissue and teeth displayed when a patient smiles is often referred to as the esthetic zone and usually includes the teeth in the maxillary arch anterior to the second premolar. Tooth replacement in this area presents challenges for the clinician that are especially difficult when the loss includes significant amounts of the residual ridge and the accompanying soft tissue. Designing a method for obtaining optimal esthetics in this area can be demanding, but, at the same time, most rewarding, when a successful treatment plan is developed.

Restoration of esthetics, comfort, and function should be the major focus of oral rehabilitation when replacing missing teeth. With the introduction of osseointegrated implants, the possibility of providing fixed restorations in areas where multiple teeth are missing has improved. Successful esthetic results with implant-supported restorations in the esthetic zone require advance planning for accurate and adequate placement of the implants. Ultimately, the placement should be based upon the position of the future restorations. In some situations, augmentation of the hard and soft tissues prior to or during implant placement is a required part of the overall treatment plan. The term esthetic refers to the theory and philosophy that relate to beauty and the beautiful, and, in dentistry, this term applies especially to the appearance of the dental restoration, as achieved through form and/or color. Developments in esthetic implant components, ceramic materials, computer-aided design/computer-aided manufacturing (CAD/CAM) technology, and increased sophistication in planning and surgical procedures have enabled the provision of more esthetic restorations. Currently, implant manufacturers offer a wide variety of components designed to manage esthetic demands. In many published clinical reports, the initial patient presentations described are ideal situations, and the authors do not offer suggestions for managing the difficulties of a compromised patient anatomy. Goodacre et al identified the major complications reported in clinical dental implant studies. The mechanical complications cited included screw loosening, screw fractures, implant fractures, and prosthetic fractures. Poorly fitting frameworks were consistently cited as reasons for these complications. The authors reported the primary causes of fractures of implants to be framework misfit and occlusal overload. Metal framework fracture was attributed to inadequate metal thickness, poor solder joints, and improper framework design.

The milled implant fixed partial denture (Procera Implant Bridge; Nobel Biocare AB, Göteborg, Sweden) is reported to provide for a consistently accurate method of fabricating a strong substructure for fixed complete and partial dentures and may be fabricated in either titanium or zirconia. The CAD/CAM and milling technology used for these frameworks means that there is no longer a need to cast and solder frameworks, eliminating the inherent inaccuracies that accompany these laboratory procedures. The implant-supported fixed partial denture is milled from a single block of titanium or zirconia to either the implant level or the abutment level. Al-Fadda et al compared 9 conventionally cast frameworks to 9 one-piece titanium machined frameworks for precision of fit. The authors used a contact-type coordinate measuring machine and a computer program developed specifically for the study to match the surfaces of the frameworks for the purpose of evaluating the accuracy of the fixed partial dentures. The milled implant-supported...
fixed partial denture provided a consistently better precision of fit compared to that of cast frameworks. The present clinical report demonstrates the use of a 1-piece zirconia implant framework, together with single units of all-ceramic zirconia crowns, in the management of a patient with severe resorption of hard and soft tissues.

**CLINICAL REPORT**

A 40-year-old white man with no relevant dental history other than trauma in the maxillary anterior area presented for treatment at the University of Michigan, School of Dentistry. While his general dental health was excellent, the maxillary anterior quadrant in the area of his chief complaint revealed significant functional and esthetic concerns. Dental examination in the area of the chief complaint revealed a previously lost left maxillary central incisor as well as maxillary left lateral incisor (Figs. 1 and 2). The patient presented wearing an interim removable prosthesis replacing the missing dentition.

A treatment plan was completed and informed consent was signed by the patient. The limiting feature was that the patient had refused additional surgical procedures except for implant placement. The treatment options for this patient consisted of a removable partial denture or a fixed restoration. While a removable prosthesis was unacceptable to the patient, so too was the required grafting which might have compensated for the rather large ridge defect. When faced with this dilemma, the restorative dentist needed a treatment option that would allow for successful rehabilitation while taking into consideration the anatomical limitations. In this situation, a 1-piece zirconia fixed partial denture with gingival porcelain and individual crowns enabled the replacement of missing hard and soft tissues with a functional prosthesis. The treatment plan included the placement of 2 endosseous implants and the fabrication of a CAD/CAM milled zirconia bar with individual ceramic crowns cemented onto the bar. A disadvantage of this treatment plan was the potential difficulty the patient could have with hygiene access under the prosthesis. The bar was designed with the goal of placing the zirconia and porcelain as closely as possible to the soft tissue, reducing the amount of food impaction. Another method of completing the tissue portion of the prosthesis was to add porcelain directly to the zirconia bar. While this technique would provide the same esthetic result, it has disadvantages in terms of long-term maintenance. If the veneering porcelain is placed directly onto the bar and a fracture occurs, then all of the porcelain on the entire bar must be removed and replaced. Repairing a prosthesis with veneering porcelain added directly to the zirconia bar would thus require the removal of the bar and fabrication of an interim removable prosthesis, and would be considerably more expensive.

The plan of treatment was divided into 2 phases. The first phase of treatment began after again discussing with the patient the benefits of additional grafting and obtaining the patient’s written refusal. Two 4.0 x 13-mm endosseous implants (NobelSpeedy Groovy; Nobel Biocare AB) were placed in the position of the maxillary left central incisor and the maxillary left lateral incisor in a 1-stage procedure. After a 4-month healing and osseointegration period, phase 2 of the treatment plan was initiated. The fabrication of the prosthesis began with a closed custom tray (Triad Custom Tray Material; Dentsply Intl, York, Pa) implant-level impression made with vinyl polysiloxane material (Extrude; Kerr Corp, Orange, Calif). Prior to making the impression, the seating of the impression copings was verified radiographically (Fig. 3).
A definitive cast was fabricated from die stone (Hard Rock; Whip Mix Corp, Louisville, Ky) with a soft tissue moulage (Gingitech; Ivoclar Vivadent AG, Schaan, Lichtenstein). Using an autopolymerizing resin (GC Pattern Resin; GC America, Alsip, Ill) and nonengaging titanium temporary abutments (Nobel Biocare AB), a verification index was fabricated and placed onto the implants intraorally to verify the accuracy of the definitive cast. The accuracy was confirmed visually and with a series of periapical radiographs. Maxillomandibular relationship records and a facebow record were obtained using wax (Aluwax Bite and Impression Wax; Aluwax Dental Products Co, Allendale, Mich, and Shur Wax X-Hard; Heraeus Kulzer, Armonk, NY) and transferred to a semi-adjustable articulator (Model 3040; Whip Mix Corp). Using the existing removable prosthesis as a reference, a diagnostic waxing was completed to serve as the positioning guide for development of the implant-supported framework. The zirconia bar pattern was developed from acrylic resin (GC Pattern Resin; GC America), and the connection position was directly taken from the verified cast of the implant locations.

The acrylic resin pattern of eventual zirconia fixed partial denture was digitized by means of a touch probe which records the position of the analog in the definitive cast. After the cast was digitized, the acrylic resin pattern was placed within the coordinate space in the scanner and separately digitized to record the shape of the implant-supported fixed partial denture. The software then matched the scanned model to the scanned acrylic resin pattern to complete the design of the prosthesis. The data obtained were sent via Internet to the production facility (Nobel Biocare, Mahwah, NJ), where the designed framework was made for the fabrication of the single crowns, and the dies were poured using a die stone (Hard Rock; Whip Mix Corp). The excess cement was removed and the canine protected area of the framework, and veneering porcelain was added to the copings to complete the crowns. The framework was milled from the bar and to completely replicate the interim removable partial denture, including the gingival area as well as the replacement teeth. The acrylic resin pattern was then reduced to form the shape of conventional crown preparations with a circumferential chamfer margin and round internal line angles as well as adequate space for the eventual all-ceramic zirconia crowns (Fig. 4).

Using a scanner (Procera Forte; Nobel Biocare AB), the definitive cast was digitized by means of a touch probe which records the position of the analog in the definitive cast. After the cast was digitized, the acrylic resin pattern was placed within the coordinate space in the scanner and separately digitized to record the shape of the implant-supported fixed partial denture. The software then matched the scanned model to the scanned acrylic resin pattern to complete the design of the prosthesis. The data obtained were sent via Internet to the production facility (Nobel Biocare, Mahwah, NJ), where the designed framework was milled from a single block of zirconia. After its return, the framework was evaluated intraorally for accuracy (Fig. 5). Shade selection was accomplished for both the crowns and gingival portion of the prosthesis, with the patient’s approval.

An impression of the zirconia framework was made for the fabrication of the single crowns, and the dies were poured using a die stone (Hard Rock; Whip Mix Corp). The dies were trimmed and digitized using the same touch-probe scanner used to shape the zirconia substructure. The digitized files of the dies and crown substructures were sent to the production facility for manufacturing the porcelain and individual cemented porcelain and individual cemented crown is being fabricated. The acrylic resin pattern of eventual zirconia fixed partial denture.

The definitive cast was fabricated to first compensate for the missing hard and soft tissue and, secondly, to provide a substructure for the eventual individual ceramic crowns. Using nonengaging temporary abutments (Nobel Biocare AB) as the matrix, resin was added to form an intimate contact surface at the cervical area of the bar and to completely replicate the interim removable partial denture, including the gingival area as well as the replacement teeth. The acrylic resin pattern was then reduced to form the shape of conventional crown preparations with a circumferential chamfer margin and round internal line angles as well as adequate space for the eventual all-ceramic zirconia crowns (Fig. 4).

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sually and with a series of periapical

cast. The accuracy was confirmed vi-

placed onto the implants intraorally

ary abutments (Nobel Biocare AB), a

Pattern Resin; GC America, Alsip, Ill)

Using an autopolymerizing resin (GC

Vivadent AG, Schaan, Lichtenstein).


tissue moulage (Gingitech; Ivoclar

Mix Corp, Louisville, Ky) with a soft

from die stone (Hard Rock; Whip

Shur Wax X-Hard; Heraeus Kulzer, Ar-

monk, NY) and transferred to a semi-

production facility (Hard Rock; Whip

Mix Corp). Using the existing

Whip Mix Corp). The

opposing arch impression was made

A definitive cast was fabricated

from acrylic resin pattern to complete the

denture. The software then matched

the implant-supported fixed partial

denture. The data obtained were sent via Internet to the

design of the prosthesis. The data ob-

acrylic resin pattern to complete the

pattern was fabri-

production facility for manufacturing

of zirconia copings. Gingiva-shaded

porcelain (NobelRondo; Nobel Bio-
care AB) was added to the soft tissue

area of the framework, and veneering

porcelain was added to the copings to

complete the crowns.

Insertion of the prosthesis con-

sisted of screwing the framework into

place until 35-Ncm torque in the im-

plants was achieved, then covering the screw access holes with wax (Util-

ity Wax Strips; Coltène/Whaledent

GmbH, Langenau, Germany) (Fig.

6). The individual all-ceramic crowns

were then placed onto the framework,

and the desired occlusal contacts con-

firmed. Cementation of the 2 crowns

was completed using a resin-modified

glass ionomer cement (FujiCEM; GC

America). The excess cement was re-

moved and the canine protected arti-

culation was verified prior to giving

the patient postoperative instruc-

tions for care and maintenance (Figs.

7 and 8). The patient was instructed

in the use of dental floss and other

hygiene aids, and he has been suc-

cessful in maintaining good hygiene. The patient has been recalled every 6 months for routine evaluation, and during the last year he has successfully functioned with this prosthesis.

If there is ever a fracture of the ve-

neering porcelain on the crown por-

tion of the prosthesis, a new crown

may be fabricated using conventional

fixed prosthodontic techniques. The

impression of the crown portion can

be made without removing the entire

prosthesis, and an interim restora-

tion may be used during the time the

crown is being fabricated.

SUMMARY

A technique for restoring the se-

verely resorbed anterior maxillary

edentulous area with a fixed partial

denture supported by implants is

presented. The restoration consisted

of a milled zirconia bar with gingival

porcelain and individual cemented

all-ceramic crowns. The outcome of

the described treatment met the pa-

tient’s expectations without addition-

al surgical intervention. While there is

a possibility the esthetic result could

have been improved through surgic-

al procedures, the restorative dentist

must have options when more ideal

treatment plans are not feasible. The

treatment presented here provides

one such option when faced with ex-

tensive hard and soft tissue loss.

REFERENCES

1. Belser UC, Mericske-Stern R, Bernard JP,

Taylor TD. Prosthetic management of the

partially dentate patient with fixed implant


2. Tischler M. Dental implants in the esthetic

zone. Considerations for form and func-


3. The glossary of prosthodontic terms. J

Prosthet Dent 2005 July;94:36.
The effect of strip, tray and office peroxide bleaching systems on enamel surfaces in vitro


Improvement of the appearance of teeth by whitening systems is one of the goals of modern esthetic dentistry. Vital tooth bleaching is administered in a variety of forms including trays, strips and paint-on gels. The concentrations and conditions of bleaching systems vary considerably between these treatment forms.

Objectives: This study compared surface changes associated with exposure of human premolar teeth to topical cycling treatments with three different bleaching systems: Opalescence X-Tra Boost (OPXB), Opalescence 20% PF (OP20PF) and Crest Whitestrips Supreme (CWSS), respectively.

Methods: Extracted human premolars were prepared in Durabase blocks and measured for tooth color, surface microhardness and roughness. Teeth were cycled in a regimen including a pre-test period, test bleaching treatment and 7 days post-bleach period. Bleaching was segmented to 0 h for untreated control group (UC); 42 h for CWSS, 42 h for OP20PF and 45 min with OPXB. Following treatment specimens were re-measured as before.

Results: Bleaching treatments produced significant tooth lightening (yellow reduction). Hardness of enamel specimens from control and bleaching groups were unchanged during cycling; ΔVickers hardness number (VHN): UC (18 ± 11S.D.) a; CWSS (7.0 ± 29nsd) a; OP20PF (19 ± 15S.D.) a; OPXB (25 ± 13S.D.) a (nsd = non-significant difference post-cycle-treat vs. initial Student’s t; ANOVA p < 0.05 a = b between group comparison post-treat). With respect to surface roughness, two-dimensional analysis showed no changes with bleaching: ΔRq (roughness) 2D = UC (0.06 ± 0.06nsd) a; CWSS (0.02 ± 0.07nsd) a; OP20PF (-0.14 ± 0.08nsd) a; OPXB (0.00 ± 0.12nsd) a.

Conclusion: Office administered, prescribed and OTC/prescribed bleaching systems were demonstrated as similarly safe to enamel surfaces including maintenance of both hardness and roughness in vitro.

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