6.7 Bilateral SFE with Transcrestal and Lateral Window Technique using Various Composite Grafts

R. A. Levine

A 53-year old woman, a non-smoker, presented with failing crown and bridge restorations in both maxillary posterior segments. In addition, she was dissatisfied with the esthetics of her mandibular anterior sextant (Figs 1 to 4). She had recently lost the distal abutment (tooth 16) of a three-unit fixed partial denture (FPD) to dental caries, whereupon the bridge structure was sectioned distal to site 15. The patient's medical history was noncontributory.

The following periodontal risk factors were identified and discussed with the patient:

- Familial history of periodontal disease.
- Poor/erratic compliance with preventive care.

Clinical Examination

Periodontal probing depths ranged up to 3 mm in the maxilla and 4 mm in the mandible, with generalized bleeding upon probing. Only tooth 14 was found to be significantly mobile (class 1 mobility). Inadequate attached keratinized gingiva was noted at teeth 33 and 43, including 7–10 mm of facial attachment loss and 0 mm of attached gingiva (Fig 1). The patient was made aware that the mandibular anterior segment was hopeless. It was decided to address this situation upon completion of the maxillary restorations. A severe ridge defect was noted, which was due to trauma when the patient had lost her four mandibular incisors.

The width of the maxillary posterior ridge seemed adequate but was significantly reduced in height because of sinus pneumatization. Occlusal relations were Angle class 1 with 4 mm of overbite and 2 mm of overjet. The patient expressed a strong desire to have a fixed provisional restoration installed during the healing phase to avoid a transitional removable denture.

Diagnosis

- Inadequate vertical bone height in the posterior maxilla.
- Localized advanced attachment loss at teeth 33 and 43 with inadequate attached keratinized gingiva.
- Localized advanced periodontitis at teeth 33 and 43.
- Vertical and horizontal ridge defect extending from tooth 33 to tooth 43.

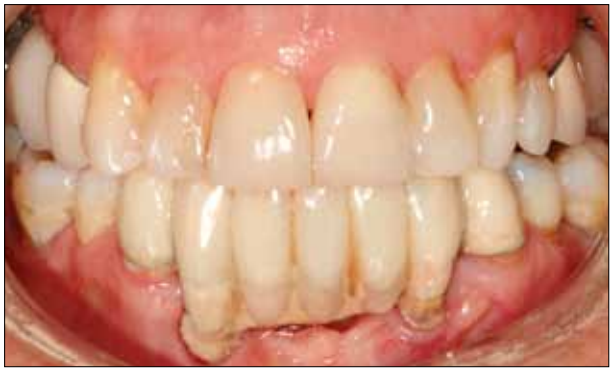

Fig 1 Initial presentation.

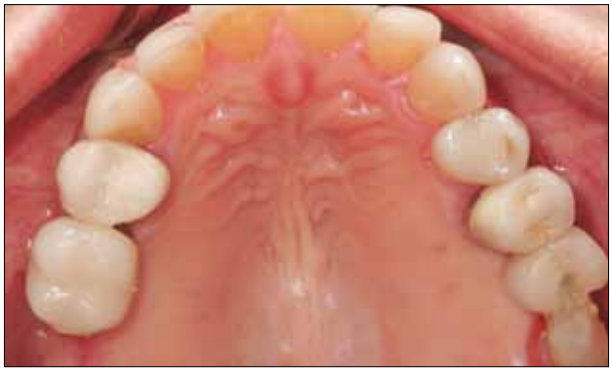

Fig 2 Pretreatment occlusal view.

Fig 3 Baseline view of the maxillary left segment.

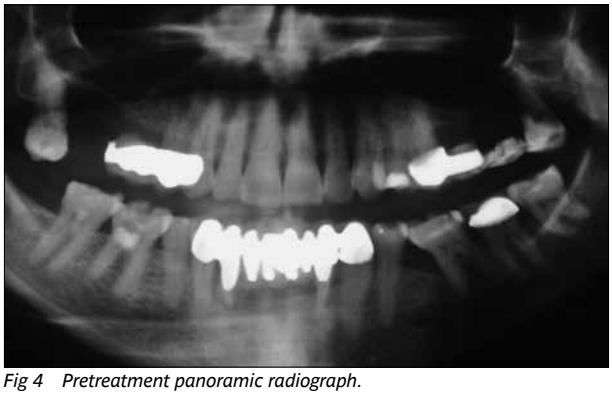

Fig 4 Pretreatment panoramic radiograph.

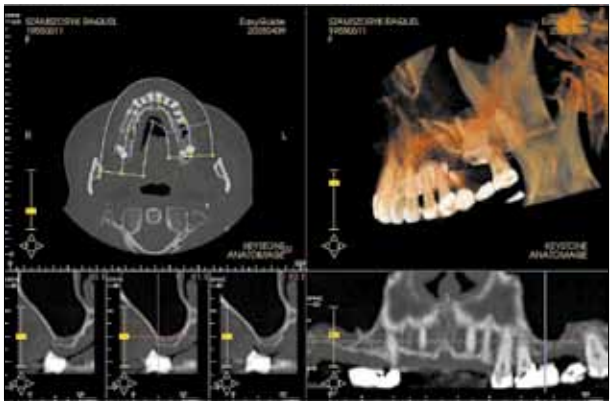

Fig 5 Pretreatment CBCT scan of site 26.

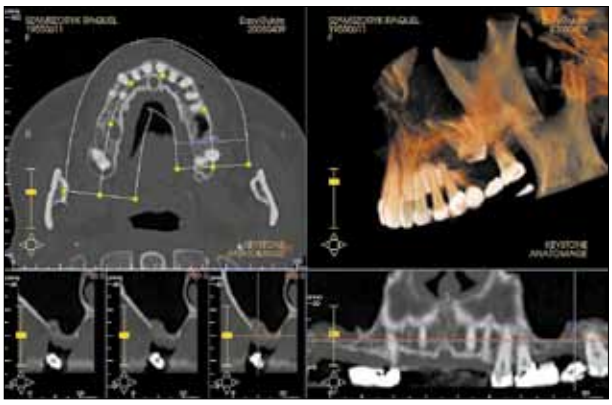

Fig 6 Pretreatment CBCT scan of site 27.

Prognosis

Tooth 14 was considered hopeless; 25, 28, 38, 33 and 43 were guarded. The following treatment sequence was recommended:

1. Full-mouth periodontal scaling in one visit with plaque control reinforcement.
2. Maxillary CBCT scan to evaluate sinus health and bone volume (Figs 5 and 6).
3. Prosthetic planning to restore teeth 17, 13, 24, 28 and replace 16 (small tooth cantilever), 15, 14, 25, 26 and 27 with dental implants. Fabrication of a surgical guide template on the basis of mounted study casts.
4. Delivery of a temporary fixed denture to the maxillary right quadrant (sites 18 to 13).
5. Extraction of tooth 14, followed by immediate implant placement at sites 15 (including sinus floor elevation using the transcrestal osteotome technique) and 14. Sinus floor elevation through a lateral wall approach was planned in the maxillary left quadrant.
6. Provisionalization of the maxillary left segment (sites 24 to 28) with a surgical guide fabricated for implant placement at sites 25, 26 and 27. Initiation of the restoration of the maxillary right quadrant with a single crown at site 17 and a cantilever FPD at sites 14, 15 (16), to be performed 4 months after surgery.
7. Another 8–9 months later: surgical extraction of tooth 25 with placement of implants at sites 25, 26 and 27.
8. Another 2–3 months later: restoration of the maxillary left segment with single crowns at sites 24 through 28 (including a night guard).
9. Periodontal maintenance alternating between offices at 3-month intervals.
10. CBCT-based treatment planning for the mandibular anterior segment.

Treatment

Elevation of the maxillary left posterior sinus floor following a lateral wall approach. Prior to commencing the procedure and applying local anesthesia, blood was drawn from the patient in the office to collect plasma-rich growth factors (PRGF). Three fractions were extracted: fraction 1 was used as a membrane; fraction 2 was mixed with bone graft material, and fraction 3 served as liquid PRGF for delivery through a syringe. Sulcular incisions were made with crestal incisions over the edentulous site 26.

Following vertical releasing incisions on the mesiobuccal aspects of 24 and 28, a full-thickness flap was raised by blunt dissection to extend the flap into the vestibule to beyond 15 mm from the ridge. The flap was then sutured to the buccal mucosa of the cheek to improve surgical vision/access and to protect it against excessive trauma. A window into the sinus floor was created, with the apical border 15 mm and the coronal border just 2–3 mm apical to the sinus floor. Using a size 4 round high-speed diamond, the window was created to a point at which the membrane could just be visualized. It was then completed with OT5 and OT1 piezosurgical instruments tips (Mectron Piezosurgery; Mectron, Carasco, Italy) to help avoid tearing of the sinus. Further dissection was initiated with the EL1 instrument tip and completed with special hand instruments designed for sinus procedures.

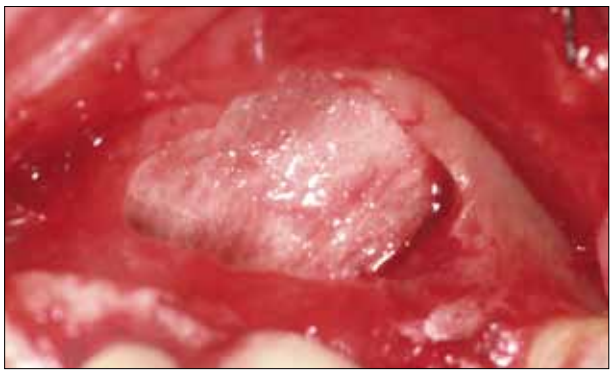

Fig 7 Lateral wall preparation at sites 25 to 27. A customized collagen membrane was placed over the elevated sinus membrane.

Fig 8 DBBM with a 1 : 1 ratio of large to small particles was mixed with PRGF and loaded into a syringe for easy delivery.

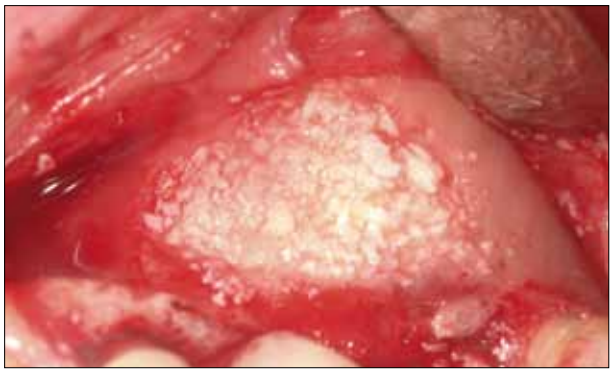

Fig 9 Completion of sinus grafting.

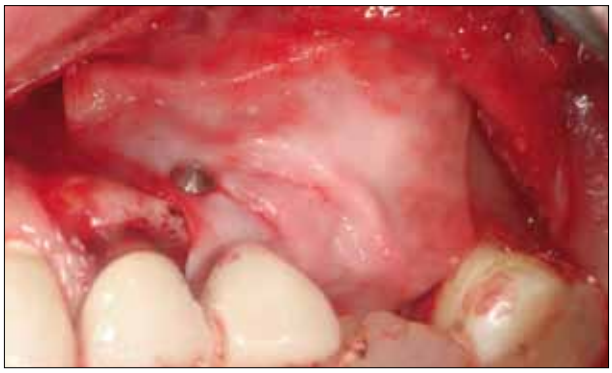

Fig 10 A resorbable collagen membrane was stabilized over the prepared window with a single surgical tack.

Upon completion of membrane elevation, the new sinus floor was covered with a resorbable membrane (Bio-Mend; Zimmer Dental, Carlsbad, California, USA) (Fig 7). Fraction 2 of the collected PRGF was mixed with small and large particles of DBBM (Bio-Oss; Geistlich Pharma, Wolhusen, Switzerland) in equal parts to a total of 3 grams. This mixture was then delivered with a plastic carrier and packed thoroughly with condensing sinus instruments starting medially and anteriorly until the sinus cavity was completely filled (Fig 8). A resorbable collagen membrane (Bio-Gide; Geistlich Pharma, Wolhusen, Switzerland) (Fig 9) was anteriorly secured with a single surgical tack (Fig 10) to cover the window. The membrane extended at least 3 mm in all directions from the lateral wall preparation.

Fraction 3 of the PRGF was liberally applied under the flap before closure, which was accomplished by replacing and suturing with a combination of 4-0 silk and 4-0 chromic gut, also including 6-0 vicryl to suture the releasing incisions (Fig 11). Postoperative care included 10 days of antibiotic coverage (Augmentin), hydrocodone with paracetamol/acetaminophen as needed, a steroid pack for 6 days, and rinsing with chlorhexidine 0.12% for 2 weeks. The patient was seen for postoperative care 1 week later.

Fig 11 Closure of the surgical flap.

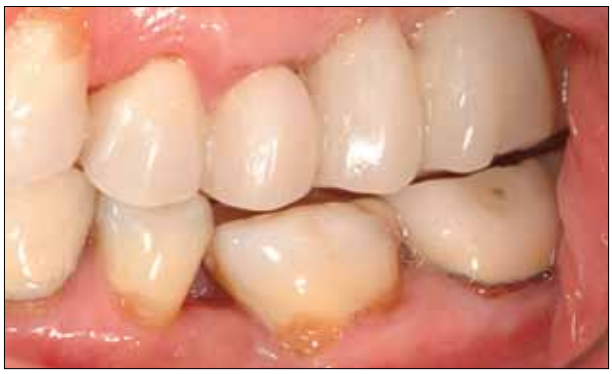

Fig 12 Clinical view 8 months after surgery. A laboratory-processed temporary prosthesis was used to replace 24 to 28 in anticipation of extraction and implant surgery at 25 and placement of implants at 26 and 27.

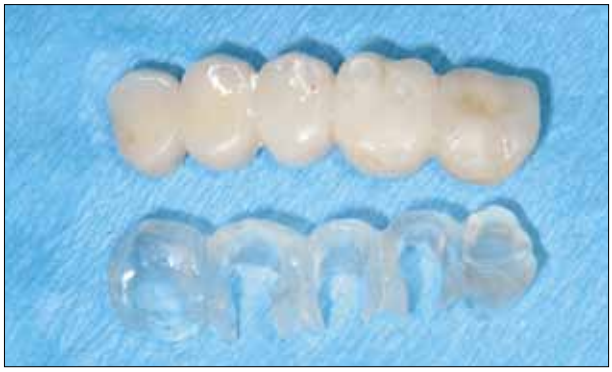

Fig 13 Surgical guide template mimicking the temporary FPD. Note the small mesiodistal diameters of the teeth to be replaced.

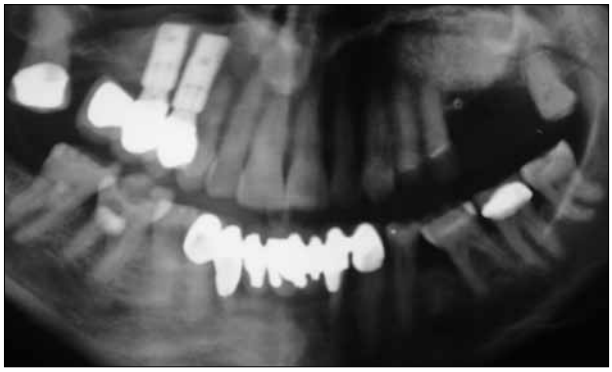

Fig 14 Presurgical panoramic radiograph taken 8 months after sinus grafting. The maxillary right quadrant was restored with a cantilevered cemented FPD (sites 16 to 14) and a single crown (site 17).

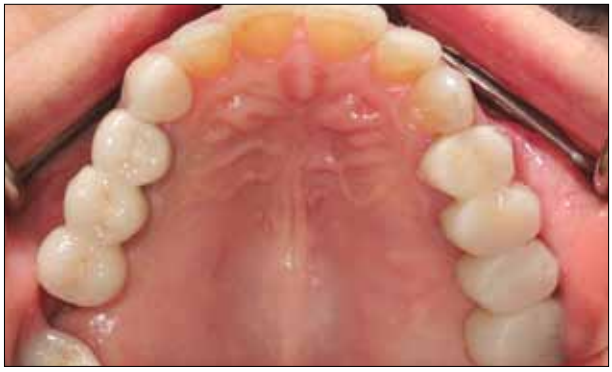

Fig 15 Completed prosthesis in the maxillary right quadrant, along with a temporary prosthesis covering sites 24 to 28.

After a healing period of 4 months, the final restoration of the maxillary right quadrant was initiated along with removal of the bridgework in the maxillary left quadrant, fabrication of a surgical guide, and completion of a laboratory-processed temporary fixed prosthesis covering sites 24 to 28 (Figs 12 to 15). At 8 months after sinus grafting, a follow-up panoramic radiograph was obtained and the patient scheduled for implant surgery.

Surgical procedure for implant placement at sites 25 to 27 (Fig 16). After local anesthesia , lingual crestal incisions were made, extending sulcularly to the distal buccal of 23, maintaining the full papillae with a mesiodistal horizontal incision. Piezosurgery tips (EX1, EX2, EX3) were used to create a trough circumferentially around tooth 25 under copious water irrigation, such that the tooth could be easily removed with minimal trauma while preserving the buccal plate (Figs 17 to 19). Small surgical spoon excavators and an OT4 tip were used to debride the socket. This was followed by multiple intramarrow penetrations with the OP4 tip, taking care to avoid the thin buccal plate.

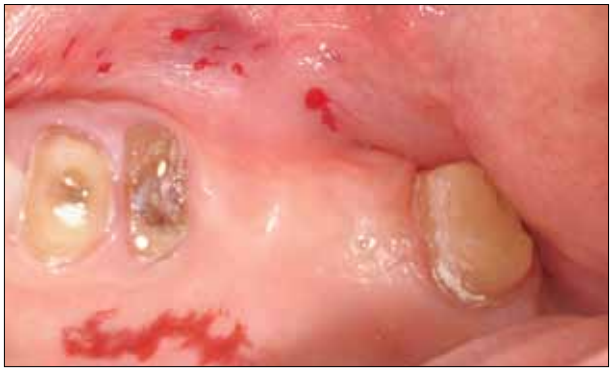

Fig 16 Maxillary left quadrant at the day of implant surgery. Tooth 25 was deemed hopeless.

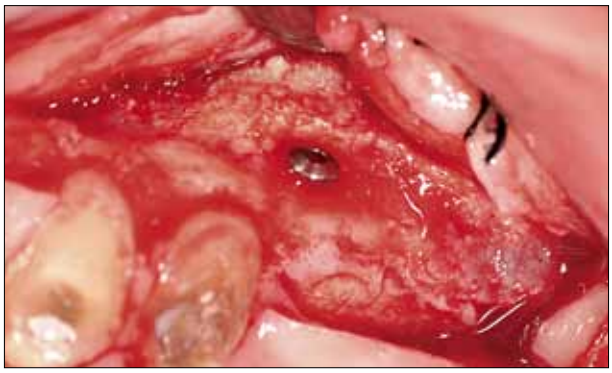

Fig 17 Elevated flap revealing solid bone fill of the prepared window site.

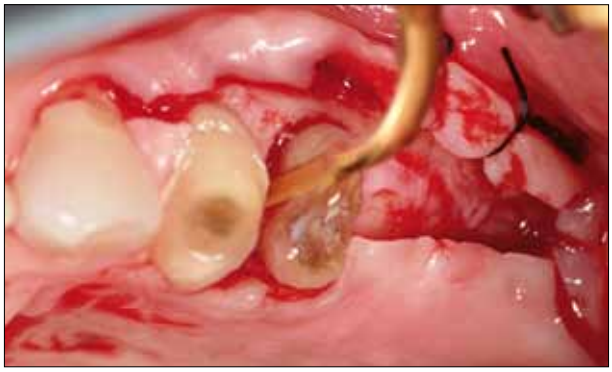

Fig 18 Extraction of tooth 25 assisted by a piezosurgical device. A trough is created around the tooth to allow for minimally traumatic removal.

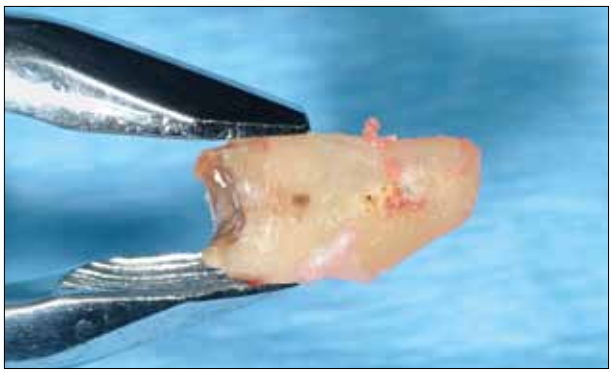

Fig 19 Tooth 25 following extraction. Note the short root length with removal of the periodontal ligament into the apical third as a result of using piezosurgical instrumentation.

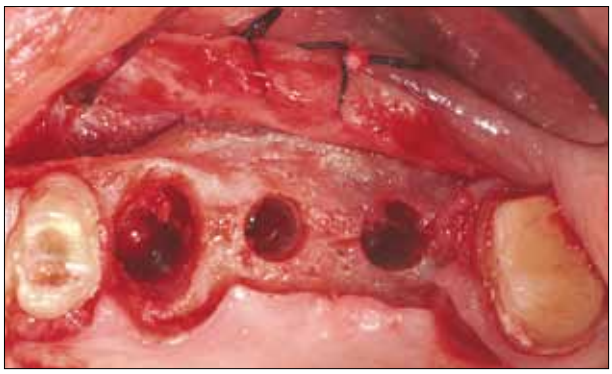

Fig 20 Osteotomies completed at sites 25, 26, and 27.

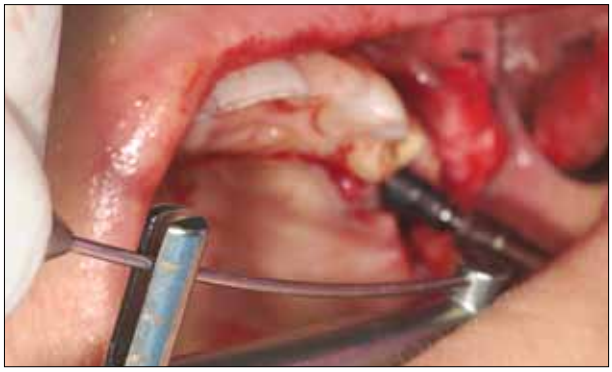

Fig 21 Insertion torque values were measured and recorded for each implant site.

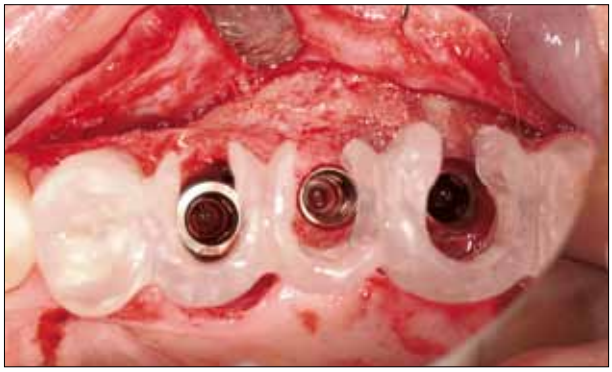

Fig 22 Clinical view after implant placement with the surgical guide in situ.

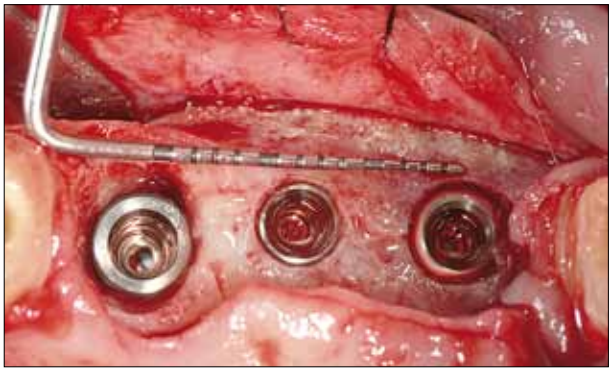

Fig 23 Favorable biological inter-implant distances.

Fig 24 Bone graft consisting of an equal-part mixture of Cerasorb (small particles), DFDBA, and calcium sulfate, which in turn was mixed with the patient's blood from under the palatal flap.

Fig 25 Two bottle-shaped 4-mm RC healing abutments at sites 26 and 27. RC cover screw at site 25. The buccal and lingual horizontal defects were packed with the bone graft material.

As the teeth to be replaced were reduced in mesiodistal width, it was necessary to respect the inter-implant distances to allow for proper emergence profiles of the final restorations. The use of bone-level implants offered additional space. The presurgical plan had been to use bone-level implants (Straumann Bone Level, Regular CrossFit, SLActive; site 25: Ø 4.8 mm, length 14 mm; site 26: Ø 4.1 mm, 12 mm; site 27: Ø 4.8 mm, 12 mm). Type 2 bone density was noted throughout the preparation. Insertion torque values were 35 Ncm at sites 25 and 26, 25 Ncm at site 27 (Figs 20 to 23).

A horizontal defect dimension to the facial of implant 25 was measured as 3 mm, and a procedure of guided bone regeneration was completed after placing the cover screw, using an equal-part mixture of Cerasorb (Riemser Arzneimittel, Greifswald, Germany), decalcified freeze-dried bone allograft (DFDBA; LifeNet Health, Virginia Beach, Virginia, USA), and sterile calcium-sulfate powder, which in turn was mixed with the patient's blood (Fig 24). This mixture was thoroughly condensed to the buccal and lingual surfaces (Fig 25).

A resorbable collagen membrane (Bio-Gide; Geistlich Pharma, Wolhusen, Switzerland) moistened with saline was used for coverage (Fig 26). A connective-tissue graft was harvested from the undersurface of the palatal flap at sites 24 and 25 (Fig 27). The graft was then placed over the membrane and under both (the buccal and lingual) flaps for unimpeded healing, prevention of early membrane dissolution, and improved esthetics by facial contour enhancement.

The original incisions were located on the palatal aspect of the ridge, thus requiring the facial keratinized gingiva to be reduced before flap closure, preserving the tissue and positioning it anteriorly so that interproximal papillae were present immediately after the procedure. Prior to suturing, the lengths were reduced by approximately half to establish a butt joint with the palatal flap (Figs 27 and 28). Bottle-shaped healing abutments 4 mm in height were inserted at sites 14 and 15. Postoperative medications were similar to the first surgical visit, except that amoxicillin was given.

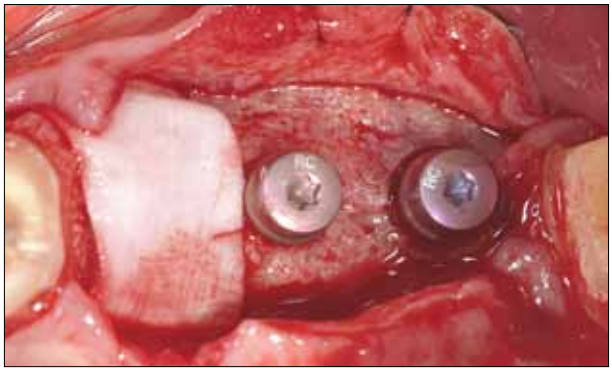

Fig 26 A moistened resorbable collagen membrane was customized for guided bone regeneration (full coverage of site 25).

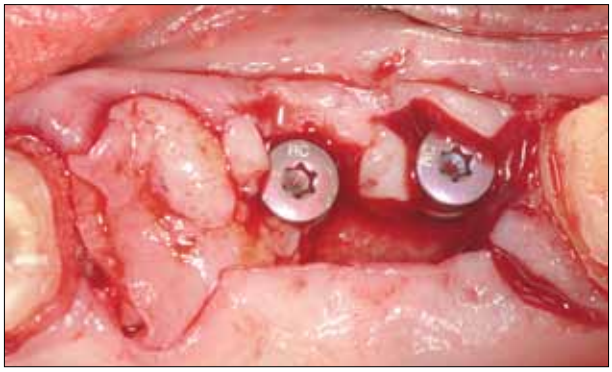

Fig 27 A palatal CT graft was harvested from the bottom surface of the palatal flap and was positioned over the collagen membrane and under the flaps. Interproximal papillae were created from the scalloping of the buccal flap.

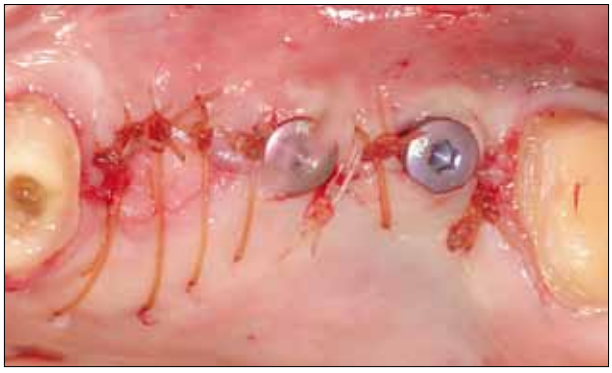

Fig 28 Final suturing.

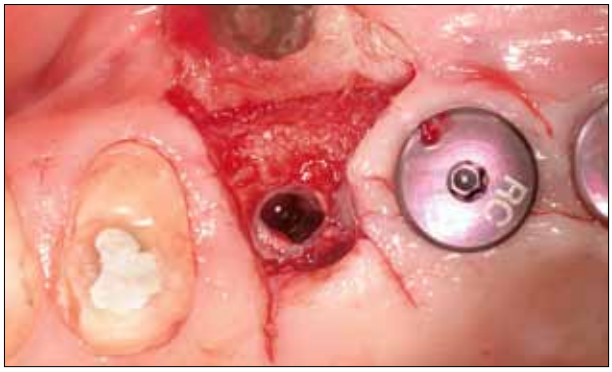

Fig 29 Second-stage surgery to expose the implant at site 25, conducted 11 weeks after placement. Papilla-sparing incisions were used. During the same visit, a reverse-torque test at 35 Ncm was successfully completed.

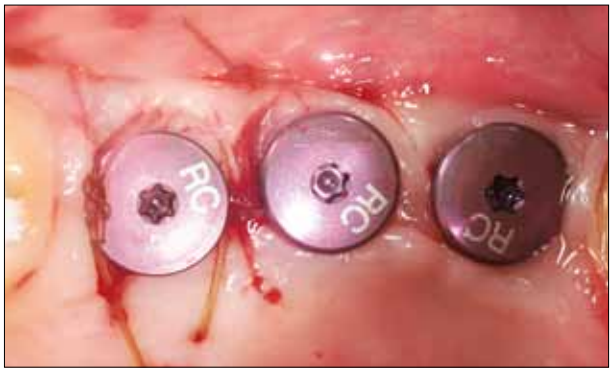

Fig 30 After attaching an RC conical healing abutment (6 × 6 mm) to the implant at site 15, the tissue was sutured. Impression-taking was scheduled for 3–4 weeks later.

After a healing period of 11 weeks, a second-stage procedure was conducted to expose the implant at site 25. At the same visit, the bottle-shaped healing abutments were replaced with conical (6 × 4 mm) ones to "stretch" the tissue to develop the "transition zone" for final impressions. Papilla-sparing incisions were used mesially and distally, with an additional palatocrestal incision to maintain keratinized gingiva on the facial aspect. Prior to placing the healing abutments, the bone was tested for each implant, using the reverse-torque test at 35 Ncm with Regular CrossFit (RC) sterile implant carriers and a Straumann torque driver (Figs 29 and 30). The soft tissue around implant 25 was closed with a 4-0 resorbable chromic gut suture. The radiographic assessment confirmed final bone healing. A waiting period of 3 to 4 weeks would permit adequate soft tissue healing for the final impressions.

Prosthetic Phase

The patient returned to her restorative dentist 4 weeks after the second-stage procedure. This visit was used for final impressions using a closed tray technique. Subsequently the laboratory-customized stock abutments for 25 and 26 plus the waxed 27 were scanned for custom abutments using CAD/CAM technology (Figs 31 to 33). The case was inserted as single crowns and cemented with permanent cement (Figs 34 to 39).

Fig 31 Scanned laboratory wax-up of customized milled abutment for 27 (Etkon; Straumann, Basel, Switzerland).

Fig 32 Prosthetic abutments: 25 and 26 were customized stock RC abutments; 27 was a custom abutment based milled on the basis of a wax-up (far right) which was fabricated (Etkon; Straumann AG, Basel, Switzerland).

Fig 33 Good restorative position of the final abutments; non-reflective scan paste was applied to all abutments for scanning of the final case (Etkon; Straumann, Basel, Switzerland).

Fig 34 A restoratively driven surgical guide facilitated the establishment of appropriate emergence profiles and implant depths.

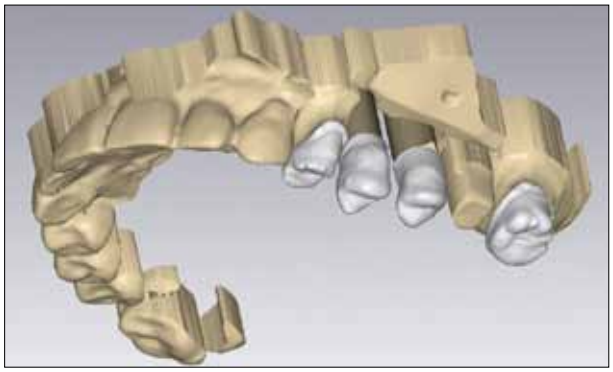

Fig 35 Final design with zirconia copings at sites 24, 25, 26 and 28. Ceramic veneers were to be added in the laboratory. The restoration at site 27 was custom-milled after being designed as noted above.

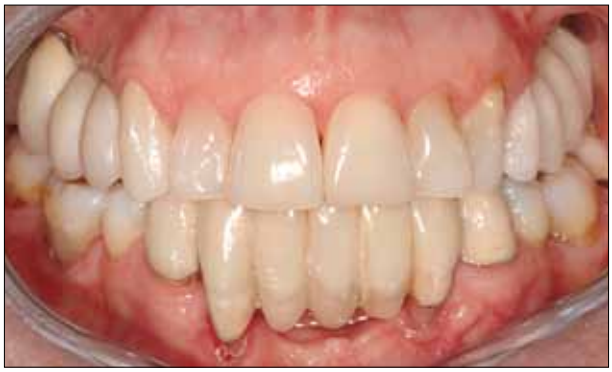

Fig 36 Final restorations in the maxillary posterior segments.

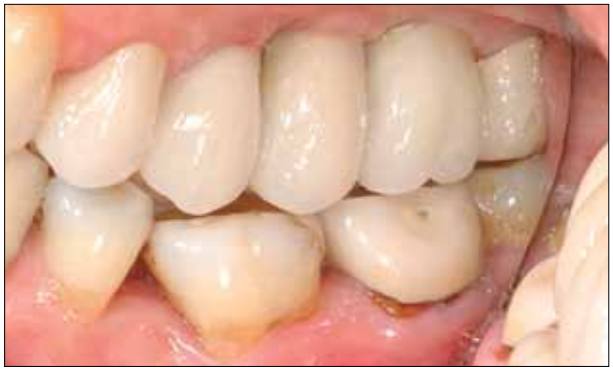

Fig 37 Final clinical view of the single crowns at sites 24, 25, 26, 27, and 28.

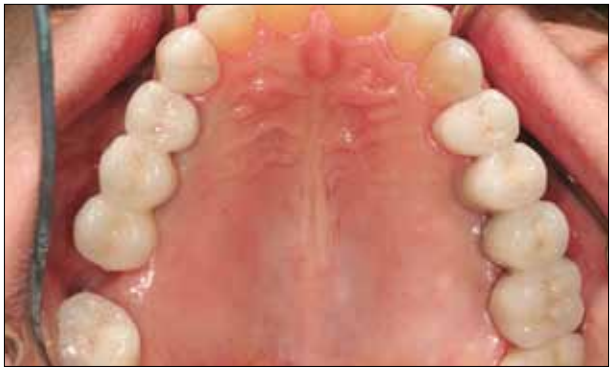

Fig 38 Occlusal view of the final outcome.

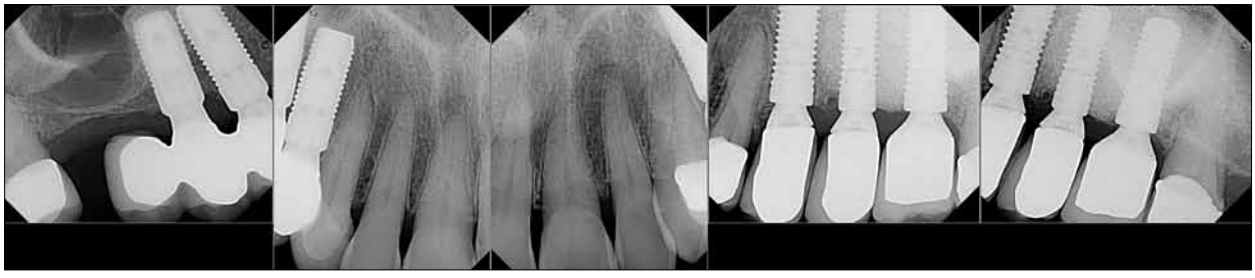

Fig 39 Final radiographs obtained after 3 months.

Fig 40 Final case at 12 months.

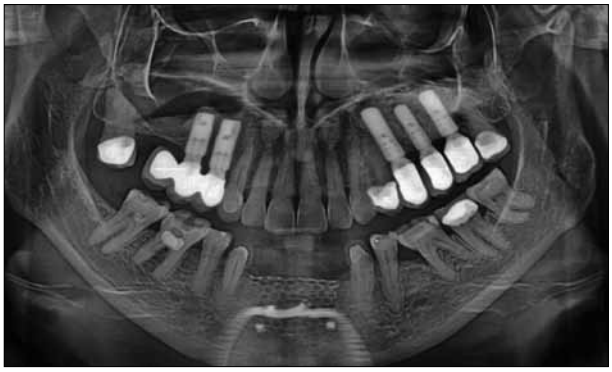

Fig 41 Final radiograph at 12 months.

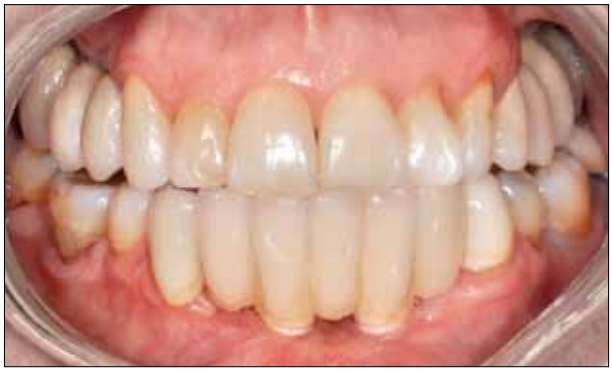

Fig 42 Completed case one year after bone augmentation using titanium mesh in the mandibular anterior sextant. Two NCx12 mm implants were placed to support a 5-unit fixed bridge using CAD/CAM technology and custom zirconium abutments. Single crowns were placed on 34 and 44. Compare with Fig 1.

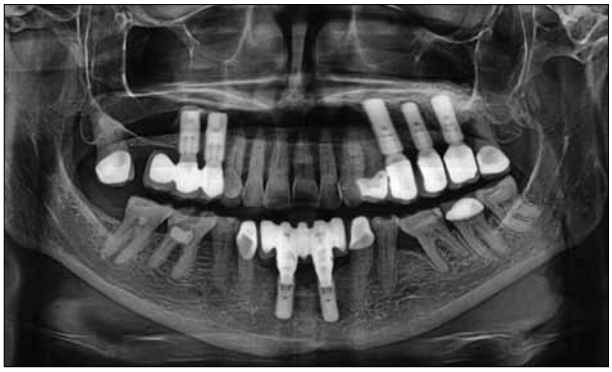

Fig 43 Final radiograph upon case completion 12 months after mandibular anterior ridge reconstruction and 19 months after completion of the maxillary left reconstruction.

Treatment Outcome

The esthetic treatment outcome is shown in Fig 40. Horizontal and lateral ridge augmentation had been completed 4 months previously using titanium mesh and bone grafting. A fixed provisional 34 to 44 was placed prior to GBR (Fig 41). The final restoration consisted of single crowns on 34 and 44 plus a FDP from 33 to 43 supported by two NCx12 mm implants (Figs 42 and 43). Only 5 teeth are present on the FDP due to a tooth arch-size discrepancy.

Maintenance Phase

After completion of the maxillary case, an alternating 3-month protocol was instituted with the patient's restorative dentist and the patient's compliance history to preventive care has been excellent.

Conclusion

A team approach to complex surgical-restorative cases encourages proper sequencing of care based on a restoratively driven approach. This will facilitate appropriate three-dimensional surgical positioning of implants for the desired esthetic outcome. The use of "new technologies" such as the ones applied in SLActive surfaces, bone-level implants, piezoelectric bone surgery, plasma-rich growth factors (PRGF) and CAD/CAM-assisted prosthetics will ensure improved patient esthetics, morbidity and patient outcomes.

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Restorative Procedures
Dr. Zola Makrauer – Private practice in advanced restorative dentistry, Huntingdon Valley, Pennsylvania, USA; Fellow of the International Team for Implantology (ITI)

Laboratory Procedures
Robert Burns, MDT – Benchmark Dental Studio, Southampton, Pennsylvania, USA