Single Maxillary Anterior Tooth Restoration

Case to replace a non-restorable maxillary left canine illustrates a team approach.

By Steven Present, DMD | Robert A. Levine, DDS

The loss of a tooth in the esthetic zone has a profound effect not only on the patient's appearance, but also on function and speech. To quote the late Dr. Leonard Abrams, "There is a direct relationship between a person's physical beauty and self esteem." Therefore, the goal of successful esthetic implant therapy not only involves the replacement of the missing tooth, but also to restore the osseous contours and the gingival envelope to mimic the contralateral tooth as it emerges into the oral cavity through the transmucosal region. According to ITI Treatment Guide Consensus Statement C.1 Standards for an Esthetic Fixed Implant Restoration: *"An esthetic implant prosthesis was defined as one that is in harmony with the peri-oral facial tissues of the patient. The esthetic peri-implant tissues including health, height, volume, color, and contours, must be in harmony with the healthy surrounding dentition. The restoration should imitate the natural appearance of the missing dental unit(s) in color, form, texture, size and optical properties."*[1-5] To best accomplish this and to better serve our patients, a team approach using the specialized talents and expertise of many individuals is required, all working together for a common goal. Generally, the restorative dentist formulates the preliminary treatment plan with sequencing. Other team members (periodontist, oral surgeon, orthodontist, endodontist, laboratory technicians, etc.) will add and revise. Then the final treatment plan is formulated and presented to the patient for approval. The following case to replace a nonrestorable maxillary left canine illustrates this team approach.[6,7]

A 57-year-old woman presented for replacement of the upper left canine (tooth No. 11) with a dental implant. The tooth previously had root canal therapy but had fractured and was nonrestorable. As a result, the tooth was extracted in 2006. Her medical history was unremarkable. Clinical examination revealed missing teeth Nos. 1, 4, 5, 11, 15, 16, 19, and 30. There was a Class 1 occlusion with normal overjet and overbite. However, she had a left crossbite from teeth Nos. 10 through

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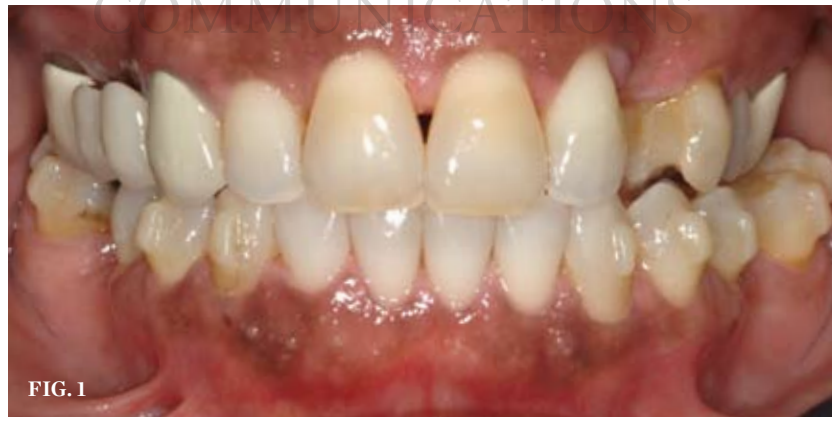
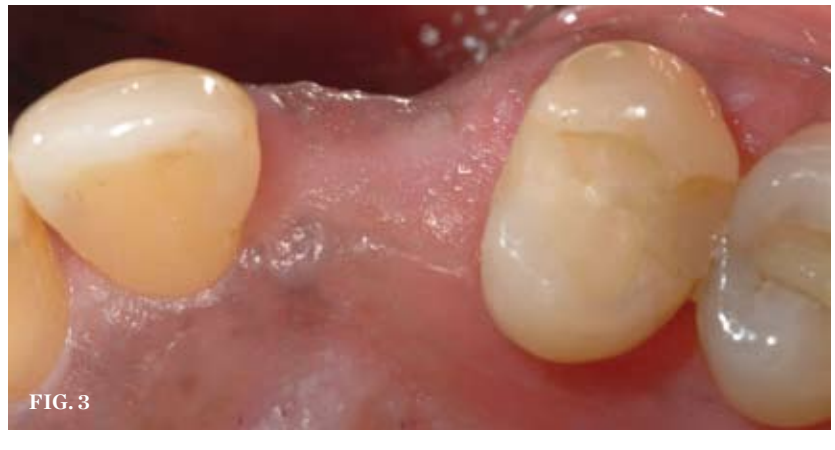


FIG. 1



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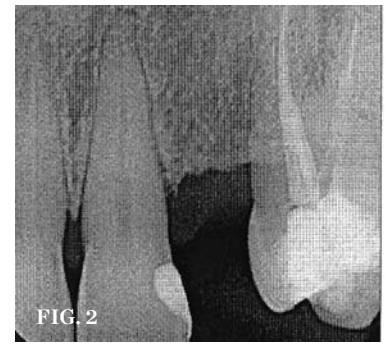
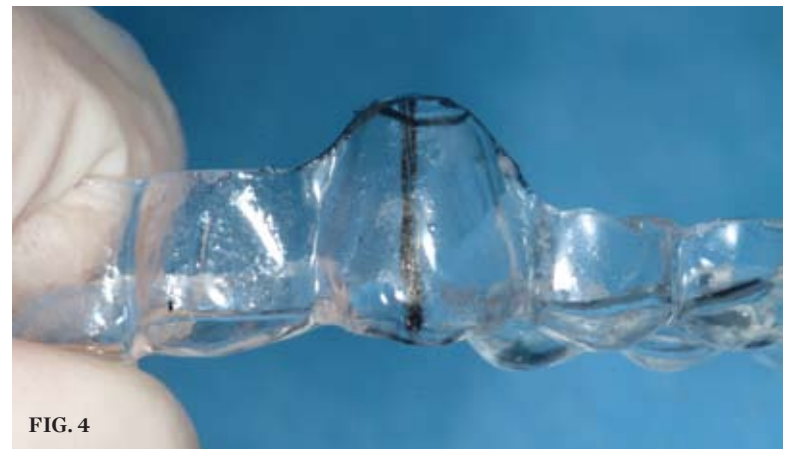


FIG. 2

CASE PRESENTATION (1.) Postorthodontics of the maxillary jaw with correction of tooth No. 10 crossbite and presentation to periodontist office. Orthodontics in the mandibular jaw was still in progress. A buccal concavity of tooth No. 11 can be seen in this view compared to normal contours seen buccal to tooth No. 6. (Orthodontic therapy by Dr. Hal Hershman, North Wales, PA.) **(2.)** Preoperative periapical radiograph.**(3.)** Preoperative treatment of site No. 11. Note the buccal concavity related to loss of hard tissue profile upon extraction of tooth No. 11 2 years prior. Adequate attached keratinized gingiva was present in the site. Orthodontic therapy in the maxillary jaw was completed; is still in progress in the mandibular jaw.



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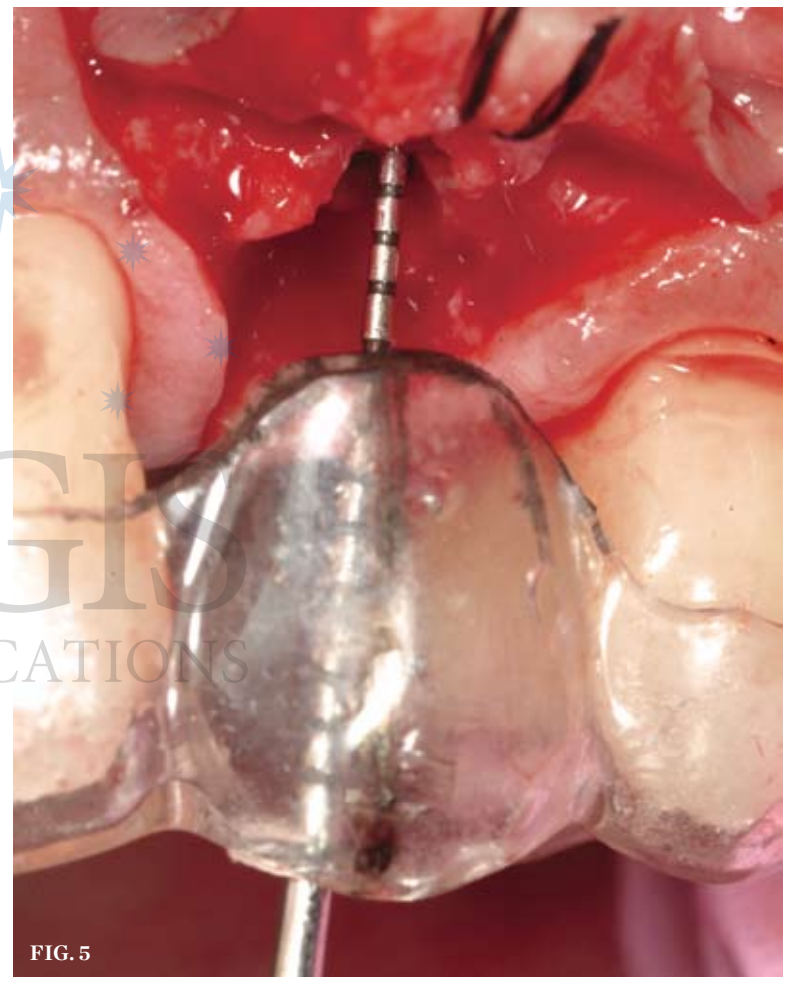


FIG. 5

SURGICAL GUIDE AND RIDGE SCALLOPING (4.) Anatomical surgical guide template fabricated from mounted study casts. A black line indicates the mid-buccal aspect. A lingual cut-out is noted. The buccal-cervical aspect helps orient the surgeon to the proper apical position of the restorative platform. **(5.)** Ridge scalloping completed and a 4-mm distance created from the mid-buccal of the surgical guide template to the new osseous crest. This is the recommended distance for the emergence profile for a bone-level implant. Papillary-sparing incisions are used routinely by the author to prevent unnecessary postoperative recession of adjacent teeth.

14, a crossbite between teeth Nos. 7 and 27, and the lower molars had drifted mesially into the edentulous spaces from teeth Nos. 19 and 30. Tooth No. 12 previously had root canal therapy but was not restored with a crown.

The treatment plan consisted of:

- Orthodontic therapy.
- Periodontal evaluation with appropriate nonsurgical therapy.
- Implant surgical placement in tooth No. 11.
- Implant screw-retained provisional restoration to help in tissue "sculpting."
- Completion of final crown on tooth No. 11, 3 months after provisionalization.

- Completion of tooth No. 12 crown.
- Future implant placement and restorations of teeth Nos. 19 and 30.
- Periodontal maintenance phase alternating between offices.

The patient did not want to wear a fixed orthodontic appliance. Invisalign® (Align Technologies, www.invisalign.com) was chosen to provide the necessary correction. Treatment began with a series of 29 aligners. The appliances made the correction of the crossbite easier as the teeth were disarticulated during the entire process. A pontic was fabricated to fit in the space of tooth No. 11 as it was extracted before treatment. This satisfied the patient's esthetic demands during treatment. After the initial set of trays, a refinement was required involving 10 additional aligners.

Presentation to the Periodontist's Office

The patient presented upon referral from the restorative office for evaluation of site No. 11 for a single implant (Figure 1 through Figure 3). As noted, her medical history was uneventful and there were no contraindications to surgical therapy. She was very compliant to her periodontal maintenance schedule with her previous general dentist, was a nonsmoker and did not admit to any parafunctional habits. Periodontal and occlusal examinations revealed posterior areas of 4 mm to 5 mm probing depths with bleeding upon probing. Teeth Nos. 19 and 30 were missing and future implants were discussed for these edentulous areas. The Angle classification was a Class 1 occlusion with 2-mm overbite and overjet. No significant mobilities were recorded. Site evaluation of tooth No. 11 revealed a moderate buccal concavity/ridge defect resulting from the natural loss of the facial hard tissue postextraction, which can be anticipated when a ridge preservation technique is not completed at the time of extraction.[8-12] An Implant Esthetic Risk Profile[1] was reviewed with the patient and a medium esthetic risk was determined. The following "finalized" team treatment plan was developed:

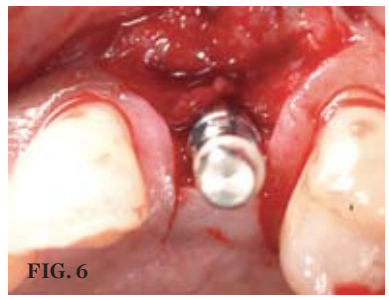
1. Nonsurgical periodontal therapy consisting of scaling/root planing with subgingival antibiotic placement in conjunction with 20-mg doxycycline therapy to help in healing soft and hard tissues with reduction of bleeding upon probing. This patient's main periodontal risk factor for future implant loss would be her present periodontal disease if left untreated. In addition, the concerns with periodontal inflammation and its systemic health risks were also reviewed with the patient. The treatment and reduction of her pathologic periodontal pockets with generalized bleeding upon probing (inflammation) had systemic health benefits as well. The multipronged approach that was presented to the patient has been used successfully in the authors' office for more than 10 years as part of phase 1 periodontal therapy.[13]
2. Anatomically correct surgical guide template fabricated by the restorative dentist to aid in 3-dimensional placement of the implant (Figure 4).[3,14]
3. Implant surgical placement with evaluation for bone regenerative and reconstructive therapy (bone graft with membrane). When placing dental implants (especially in the esthetic zone) the treating "surgeon" needs to think and treat like a periodontal plastic surgeon. It requires wide knowledge of all phases of periodontal plastic surgery, ie, connective tissue grafting, reconstructive bone grafting surgery (guided bone regeneration/guided tissue regeneration), "gummy smile" correction, orthodontic extrusion/forced eruption, and osseous surgery since most esthetic zone cases require at least one or more of these procedures for a successful esthetic outcome.[9-16] Treating in the esthetic zone is an "advanced" or "complex" procedure according to the SAC Classification and should never be looked at as a "routine" or simple procedure.[17-22]
4. Provisionalization of site No. 11 with timing based on initial torque values and need for guided bone regeneration/reconstructive soft and hard tissue surgery at the time of placement. The screw-retained provisional will act as the "blueprint" for the final crown. The patient would be wearing the provisional for at least 3 months.[2,4,9,23,24]
5. Completion of the final crown on tooth No. 11 using a CAD/CAM fabricated zirconia abutment.
6. Periodontal maintenance every 3 months alternating between offices with future discussions for tooth replacement for site Nos. 19 and 30 with dental implants.[25]

Implant Surgical Phase

The patient was treated using local anesthesia and was premedicated with a nonsteroidal anti-inflammatory drug, an antibiotic (amoxicillin) and a surgical rinse of CHG 0.12%. Incisions included a mid-crestal with mesial and distal vertical releasing which aided in reflection with a goal of papillary sparing so as to help prevent any postoperative recession of the adjacent natural teeth. The surgical guide template was positioned and used throughout the procedure to judge proper positioning of the implant in three dimensions. For tissue-level implants, a 2-mm to 3-mm distance is recommended from the mid-buccal of the guide template as is a 3-mm to 4-mm distance with a bone-level implant. The co-author (Levine) desires a 4-mm distance for bone-level implants which was used in this case. To create this necessary distance for an emergence profile of 4 mm, osseous crest reduction was required and was performed by scalloping the ridge with a high-speed round bur under copious sterile saline irrigation (Figure 5).

The oral plastic surgeon needs to look closely at the site once the implant is properly positioned with the aid of the surgical guide. The desire was also to re-create what the patient had lost in soft and hard tissue contours and to try to create symmetry with the contralateral tooth No. 6. Considering that there was no deficiency in the amount and thickness of attached keratinized gingiva at presentation for site No. 11, the surgeon needed to then determine based on the osseous present to the facial and/or lingual whether a soft or hard tissue graft or both are necessary. This decision is usually made after the implant has been placed or by evaluation of presurgical CT scans of the site.

The co-author, as part of the discussions with the patient preoperatively, routinely reviews the possibility of either or both procedures needed after implant placement and reevaluation of the site. The palatal soft tissue is routinely anesthetized on the same side of all esthetic zone implant procedures in anticipation of using the thick premolar palatal tissues as a donor site for connective tissue grafting. The desired osseous thickness was noted to be less than 0.5 mm on the facial and a bone graft was decided to be the choice of reconstructive surgery for the site. A slowly resorbing anorganic bone graft was mixed with sterile calcium sulphate powder (4:1 ratio) and was covered with a customized resorbable collagen membrane to aid in membrane-protected guided bone regeneration (Figure 6 through Figure 8). The area was sutured with fine periodontal plastic surgical resorbable sutures (6-0 vicryl) which aids in excellent approximation of the vertical releasing incisions to help reduce the incidence of postoperative scarring of the incision lines. The surgeon needs to avoid any large diameter sutures (4-0, 3-0) in especially the vertical incision lines to prevent any unwanted scarring and trauma to the flap with its compromise of its blood supply. An undercontoured 6-mm bottleneck healing abutment was placed to prevent any pressure on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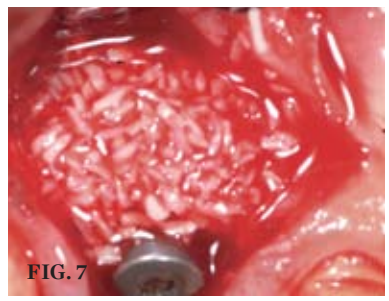
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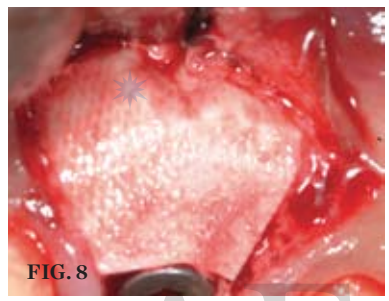
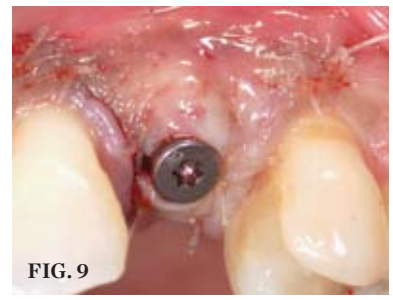


FIG. 8

IMPLANT PLACEMENT AND BONE GRAFTING (6.) Implant carrier device in place showing a restoratively driven position by use of the surgical guide template. Note the papillary-sparing incisions to prevent any interproximal periodontal attachment loss and recession. The buccal contours are still concave and the bone facial to the implant is less than 0.5 mm, requiring hard tissue "contour augmentation." **(7.)** A slowly resorbing anorganic bone graft material mixed 25% with CaS was added facially to augment the deficient bony wall and to help in re-establishing a buccal convexity to the site. The bone graft will protect the thin buccal plate of bone over the long term. A 6-mm height bottleneck healing abutment was placed so as not to put any pressure on the buccal flap upon closure. Flap closure is more easily accomplished with a smaller-diameter or undercontoured initial healing abutment. **(8.)** A resorbable collagen membrane was placed over the graft to aid in membrane protection for the graft material and prevention of spreading of the material into the tissues.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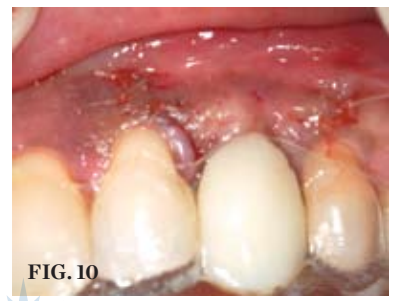


FIG. 10

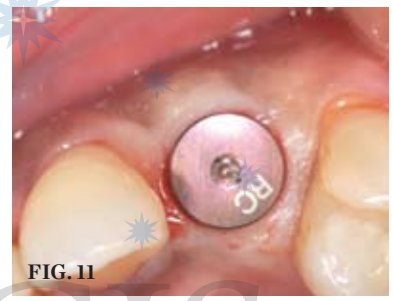
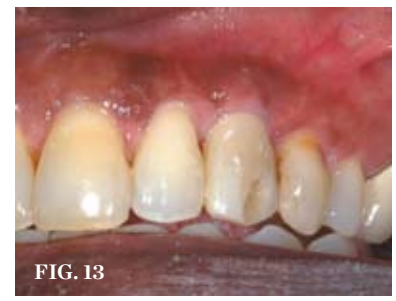


FIG. 11

CLOSURE AND HEALING (9.) Final closure with 6-0 Vicryl resorbable sutures. **(10.)** The patient's last Invisalign tray was used as a removable appliance postsurgery with an added denture tooth for No. 11. There was no contact at all with the soft tissues. **(11.)** At 3 months postsurgery, the bone was tested at a 35-Ncm reverse torque test and a 6X6 mm conical healing abutment was placed to start "stretching" the soft tissues to enable the placement of a properly contoured screw-retained fixed provisional which would be placed shortly by the restorative dentist.


FIG. 12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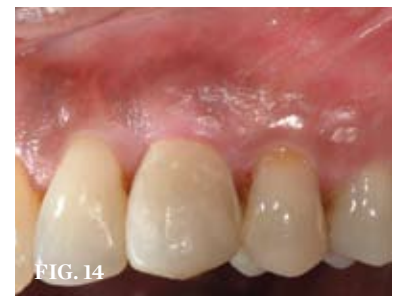
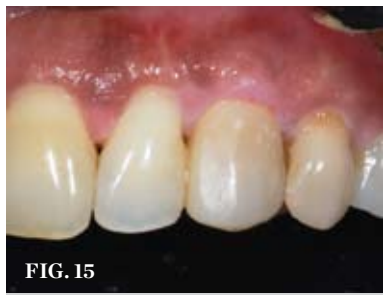


FIG. 14

PROVISIONALIZATION (12.) Provisional restoration reflecting a flat buccal emergence profile. A regular connection temporary meso abutment becomes the subgingival area attached to an appropriate canine crown former. **(13.)** Seating of the provisional with a labial screw access, which would be filled in with cotton and composite resin. **(14.)** Postoperative check by the periodontist at 4 weeks after the provisional placement by the restorative dentist. The soft tissue health looked excellent. Further interproximal and mid-buccal soft tissue support has been recommended to help in further sculpting of the papillae.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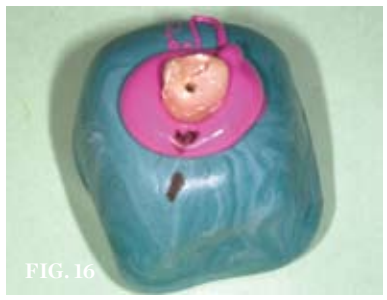
FIG. 16


FIG. 17

IMPRESSIONING (15.) Soft tissues at 3 months after initial provisionalization of tooth No. 11. The subgingival contours had been developed further to better support the soft tissues buccally and interproximally. Compare with figure 14. **(16.)** The provisional crown was seated, attached to a laboratory analog, and embedded into PVS impression putty and wash to the depth of the cervical third of the clinical crown to pick up emergence profiles. Note the pencil line on the mid-buccal of the crown. **(17.)** After the material set, the crown was removed and replaced with an open-tray impression coping attached to the implant analog.


FIG. 18


FIG. 19

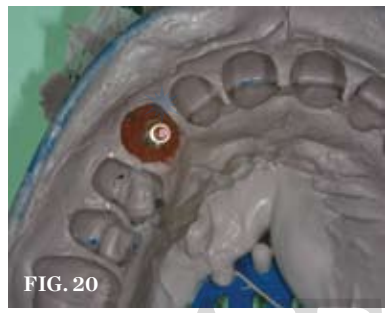
FIG. 20

IMPRESSIONING (18.) Pattern resin was applied to completely fill the void around the impression coping. This re-creates the subgingival and emergence profile of the provisional restoration. **(19.)** Custom impression coping in proper position for final impressions. Note penciled line along mid-facial aspect of the resin. **(20.)** Pick-up of the custom impression coping in the final impression.


FIG. 21

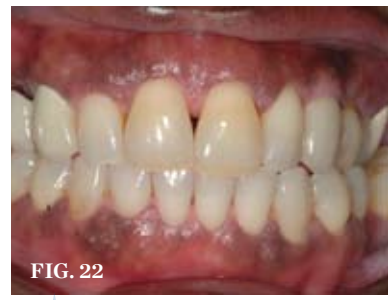
FIG. 22

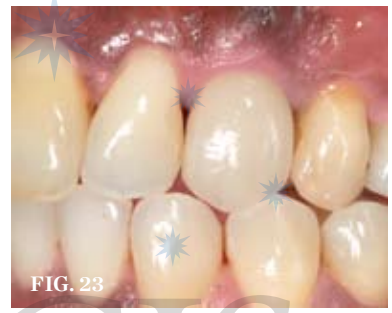
FIG. 23

ABUTMENT PLACEMENT (21.) Seating jig fabricated to properly position the zirconia abutment in place before torquing to the manufacturer's recommended 35 Ncm. **(22.)** Completed crown on No. 11. Compare with Figure 1 as the appearance of a tooth root has been reconstructed with the help of hard tissue grafting and provisionalization with "sculpting" of the soft tissues.**(23.)** Completed crown on tooth No. 11. Note restored soft and hard tissue profiles on the facial aspect. Compare with Figure 3. The final crown was duplicated from the provisional, which acted as the final "blueprint" of the necessary crown contours. (Laboratory: Newtech Dental Laboratories, Landsdale, PA.)

the buccal flap. The bottleneck healing abutment also helps in primary closure of the vertical releasing incisions and easy access to the top of the implant (Figure 9). The patient went home after postoperative instructions were reviewed wearing her last Invisalign tray after adjusting the undersurface acrylic on tooth No. 11 to allow space for the soft tissues and the healing abutment (Figure 10).

At the 3-month postoperative appointment, the bottleneck healing abutment was removed, bone healing was tested without anesthesia with a reverse torque test of 35 Ncm using a RC implant carrier device and the manufacturer's (Straumann) torque driver taking the torque slowly up to the 35 Ncm line and then reversed and removed. If the patient does not feel any discomfort or movement of the implant is not felt or viewed clinically the case is ready for prosthetic completion. Finally at this visit, topical anesthetic is placed into the site for 1 to 2 minutes and a 6X6 mm conical healing abutment is placed slowly to depth to "stretch" the tissues. Blanching of the soft tissues will usually occur and disappear in a couple of minutes (Figure 11). The patient had a previously coordinated appointment with her restorative dentist (Present) for provisionalization of the implant.

Prosthetic Phase

The development and appearance of the transmucosal region as the tooth emerges into the oral cavity can be the difference between treatment failure and success. It is important to use the provisional to sculpt the pericoronal tissue to duplicate to the best of our abilities the contralateral canine. According to the ITI 3rd Consensus Conference: *"to optimize the esthetic outcomes, the use of provisional restorations with adequate emergence profiles is recommended to guide and shape the peri-implant tissue before definitive restoration."*[1,3,4] A primary goal in the development of the soft tissue contours is to have predictability and long- term stability. To achieve this we must give adequate time for maturation of the soft tissue prior to making our final impression.

Immediately after second-stage surgery, a screw-retained provisional was fabricated using a Straumann RC Temporary Meso Abutment (Figure 12 and Figure 13). A screw-retained provisional was used because it could be easily removed and the contours modified as the emergence profile was developed. In addition, there would be no danger of leaving residual subgingival cement which can significantly compromise wound healing. Finally, the provisional could be used to fabricate a custom impression coping. The provisional would be evaluated every 3 to 4 weeks for the next 3 months to evaluate the tissue contours, modify the provisional as needed, and to allow adequate time for the maturation of the soft tissue. At 4 weeks the provisional was evaluated and the contours modified to improve the pericoronal architecture (Figure 14). The patient returned again at 8 weeks and a small fistula was present near the apex of the implant. The implant was stable with no radiographic bone loss. It was determined that the fistula was likely originating from tooth No. 12, which had a previously treated root canal. The fistula was followed with a gutta-percha point, which approximated the apices of No. 12. She was referred for endodontic evaluation and re-treatment. After re-treatment, the fistula closed and the area healed uneventfully. The endodontist recommended 6 months before a definitive restoration was fabricated for No. 12. At 3 months the peri-coronal tissue was mature, the desired emergence profile had been established, and the patient was ready for the impression for the master cast.

To prevent the collapse of the pericoronal tissue and accurately transfer the developed emergence profile established by our provisional restoration to the working model and communicate the clinical situation to the laboratory

technician, a custom impression coping must be used. The technique to make a custom impression coping includes:

1. The provisional crown with the established emergence profile is removed from the mouth and the appropriate implant analog is attached.
2. The crown-analog structure is imbedded into PVS impression putty and wash to the depth of the cervical third of the clinical crown. The facial surface of the crown is marked on the impression putty (Figure 15).
3. Remove the provisional crown by unscrewing, leaving the analog embedded in the impression putty.
4. Attach an open-tray impression coping to the implant analog (Figure 16).
5. Apply pattern resin to the impression coping, filling the space completely (Figure 17).
6. Mark the facial aspect on the impression coping, remove, trim any flash, position the coping, and make the impression (Figure 18 and Figure 19).

After the impression, bite registration, and color mapping, the impression was sent to the laboratory for fabrication of an Ekton® zirconium custom abutment, coping, and crown. The abutment was delivered torqued to 35 Ncm as per Straumann recommendations, and the screw access was sealed (Figure 24). The crown was cemented with Premier® Implant Cement™ (Premier Dental Products, www.premusa.com) (Figure 20 through Figure 24).

Conclusion

Osseointegration today has progressed to a point where it is taken for granted and the focus has shifted to esthetics. Patients not only expect a functional long-term restoration, but also one that is esthetic, gives the illusion of the missing dental units, and is in harmony with the peri-implant tissues. To better serve our patients and to optimize treatment outcomes, a team approach should be used where the talents and expertise of various specialists are used.[26-28]

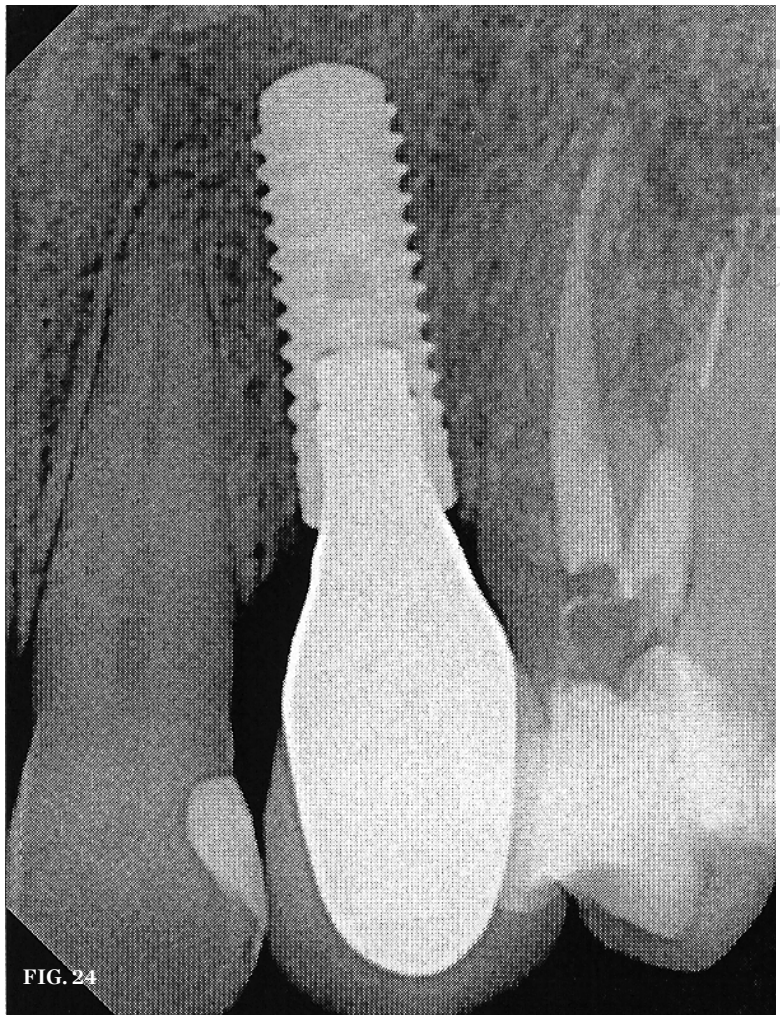

FIG. 24

FINAL RADIOGRAPH (24.) Completed crown on No. 11 with CAD/CAM zirconia abutment. (Endodontic therapy re-treatment of tooth No. 12 completed by Dr. Peter Brothman, Bala Cynwyd, PA.)

Acknowledgment

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Disclosure

Both Dr. Present and Dr. Levine are Fellows of The International Team for Implantology (ITI, Basel, Switzerland); both authors have received honoraria from Straumann and Dr. Levine also has received honoraria from Exactech and PiezoSurgery.

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