Soft Tissue Considerations for Optimizing Implant Esthetics

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ABSTRACT: *This article presents three clinical case studies to demonstrate how an interdisciplinary team approach to care is highly recommended when considering implant therapy in the esthetic zone. Soft and hard tissue maintenance, as well as the ability to diagnose and predictably reconstruct these tissues when they are lacking, are key to esthetic success. Understanding diagnostic keys for replacing a single anterior tooth helps ensure a long-term esthetic result. Proper implant selection and placement in three dimensions are also important. The dental team's ability to diagnose and treat soft and hard tissue deficiencies aids in preventing esthetic implant failures. The interdisciplinary management of these cases enables each clinician to focus on his or her area of expertise in order to produce optimal results—from preoperative case analysis to restorative completion—for the patient.*

Our interrelationships with patients and colleagues are greatly tested when treatment planning in the esthetic zone. Patients today seek quicker approaches for achieving tooth replacement and esthetic results.[1] Achievement of osseointegration, however, does not always correlate to a successful esthetic outcome. Frequently there is a balancing act between the oral plastic reconstructive implant surgeon and the restorative dentist in their attempts to deliver the patient's expected tooth replacement and the realities of predictable treatment results. Comprehensive treatment planning from the outset and understanding the specific values, needs, and expectations of the patient are essential for an overall successful result.[2] To avoid unexpected disappointments, prior to any surgery, clinicians need to share with the patient the case-specific limitations upon treatment based on the patient's clinical presentation and esthetic concerns.

INITIAL CONSULTATION

When interviewing a prospective patient for implant therapy, establishing a rapport with the patient to uncover his or her specific treatment goals is of foremost importance. The patient's medical and dental histories help the clinician in risk factor analysis. Medication-related problems (eg, dry mouth with resulting caries), diabetes, smoking, compliance history, and past and present history of periodontal disease should all be noted. Risk factors should be discussed with the patient so he or she can gain an understanding of the clinical goals and concerns for postsurgical healing and the case's long-term prognosis.[2,3] A comprehensive analysis (ie, periodontal, caries, radiographic, and occlusal) is needed to establish a correct diagnosis and prognosis for each tooth when developing the treatment plan. Necessary caries control, endodontic, periodontal, and orthodontic therapies are properly sequenced based on the patient's treatment goals.

Clinical anatomic site analysis for the placement of a dental implant should include:[1,4]

1. Lip line esthetics (ie, location of smile line: high, medium/average, low)
2. Gingival morphotype (ie, thin with high scallop vs. thick with shallow scallop)
3. Interocclusal relationship (ie, horizontal and vertical overlap)
4. Status of tooth or teeth to be replaced and adjacent dentition (eg, crown integrity, endodontic and periodontal status)
5. Status of the site and adjacent soft tissues (eg, excessive gingival display/gummy smile or inadequate soft tissue because of gingival attachment loss resulting in gingival recession, gingival asymmetry, or a mucogingival problem)
6. Status of the site's hard tissues or bony deficiencies in a horizontal or vertical dimension that may require soft and/or hard tissue augmentation prior to placing an implant in its ideal prosthetically driven position
7. Radiographic status (eg, position and axis of adjacent roots, radiolucencies in the alveolar bone, vertical bone height); root length of the evaluated tooth, if deemed hopeless; and assessment of the level of a root fracture or resorptive lesion of a hopeless tooth

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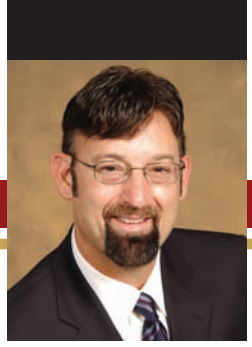

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THE TEAM APPROACH

The complexities and difficulties of esthetic implant dentistry are made seamless with a team approach that involves the oral plastic and reconstructive implant surgeon, restorative dentist, laboratory technician, and other dental specialists as needed for optimal patient care.[5-7] As all are "specialists" in their respective fields, the patient ultimately benefits from this shared approach, which has been the accepted medical model for decades.

The following three case reports involve the careful management of the gingival tissues for optimal esthetic results. Too often the surgeon/restorative dentist team ignores the soft tissues, and compromised results are attained at the expense of an unhappy patient.[8] These cases' unique soft tissue considerations are as follow.

- Case #1: treatment of excessive gingival display in conjunction with osseous management of edentulous sites for replacement of congenitally missing maxillary lateral incisors[8-11]
- Case #2: immediate extraction and provisonalization of a maxillary central incisor with an apical fistula and buccal osseous fenestration[12-16]
- Case #3: immediate extractions with immediate implant placements in teeth Nos. 8 and 9, and loading Nos. 7 through 10 with soft and hard tissue augmentation for the development of cantilever ovate pontics in the final restoration[17-30]

FIGURE 1 A patient with a "gummy smile" presented upon completion of two-year orthodontic therapy desiring single permanent tooth replacement for teeth Nos. 7 and 10, which were congenitally missing (orthodontic therapy by Dr. Peter Greco, Philadelphia, PA).

CASE #1: Treatment of Excessive Gingival Display with Implant Placement to Replace Congenitally Missing Maxillary Lateral Incisors

A. Presentation

A 26-year-old healthy, non-smoking female presented desiring tooth replacement for congenitally missing teeth Nos. 7 and 10. The patient had recently completed two-year orthodontic therapy to prepare for implant placement both in a coronal and an apical position, with ideal root position of adjacent teeth. Symmetry was created with ideal 7.0-mm spaces for both sites to place a narrow-diameter (ie, 3.5 mm) implant (Figure 1). Clinically, congenitally missing teeth are frequently associated with a narrow alveolar crest and facial undercuts. *Note: this is especially seen in patients presenting with a prominent premaxillae.* This was confirmed clinically in this patient, who exhibited prominent premaxillae with buccal undercuts in the anterior sextant (Figure 2). In such cases, the surgeon needs to proactively anticipate possible osseous limitations regarding additional costs for guided bone regeneration (GBR) for either fenestration or dehiscence correction at the time of implant placement surgery. Concerns should also be conveyed to the restorative dentist in order to take into account additional costs for custom-angled abutments; these anticipated limitations, as well as the possibility of delay of implant placement for up to six month, should be discussed preoperatively with the patient.

B. Lip Line Esthetics

In this case, the osseous crest levels over the central incisors were measured 2.0 mm from the cementoenamel junctions (CEJs), with 3.0 mm to 4.0 mm of excessive gingiva from the CEJs to the gingival margins. The altered passive eruption (ie, "gummy" smile) was classified as a Type 1, Subgroup A (ie, excessive gingiva with a normal CEJ to osseous crest relationship)[7] (Figure 3). After initial discussions, it became apparent that the patient's gummy smile was her chief complaint, and it became a treatment goal to correct it. Ignoring her excessive gingival display would result in short clinical crowns for both implant sites. Thus, soft tissue crown lengthening of teeth Nos. 6, 8, 9, and 11, as well as osseous reduction of the edentulous sites, were determined to be necessary to achieve the patient's desired esthetic result of normal tooth length.

FIGURE 2 The patient exhibited prominent premaxillae with buccal undercuts in the anterior sextant.

FIGURE 3 Ideal 7-mm symmetrical spaces were created orthodontically. Based on soft and hard tissue locations, a diagnosis of altered passive eruption of Type 1, Subgroup A classification was given.

C. Evaluation of Edentulous Sites in Relation to Hard Tissue Position

The future gingival margin of the lateral incisor crown will determine the vertical position of the shoulder of the implant. The general rule is to provide 2.0 mm to 3.0 mm to this shoulder from the anticipated gingival margin, as dictated by the buccal cervical aspect of the surgical guide template.[1] Site preparation through osseous reduction is frequently needed in periodontally healthy patients prior to implant placement to provide the additional room. This would necessitate bone scalloping of the central portion of the edentulous ridge, without involving the interproximal heights of bone, to avoid attachment loss to the adjacent natural teeth. This procedure will provide for a proper-sized tooth replacement. Otherwise a short, unesthetic tooth will result. The use of an anatomically correct surgical guide template in the anterior maxilla is extremely valuable in properly positioning the implant shoulder to allow ideal emergence profile and proper placement in three dimensions. Thus, bone scalloping allows the subsequent placement of the implant shoulder in its proper subgingival position.

FIGURE 4 *Bone scalloping was completed with the aid of a surgical guide template, a replica of the soft tissue position of the final crowns.*

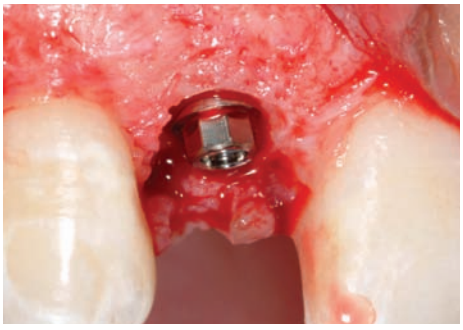

FIGURE 5 *A 12.0-mm narrow-diameter implant was placed according to esthetic guidelines.*

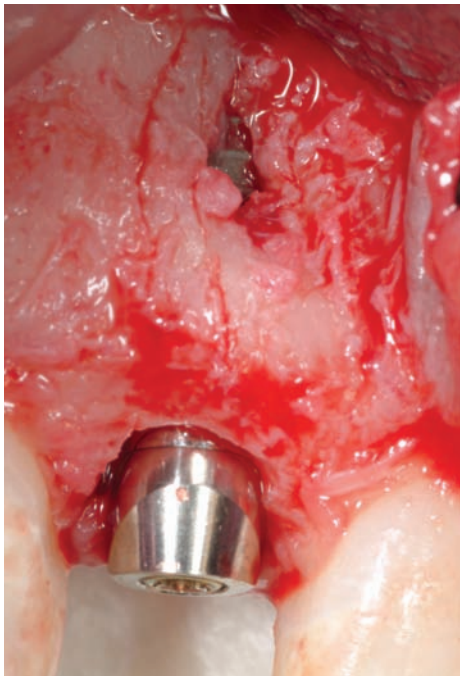

FIGURE 6 *A buccal undercut with fenestration created upon oseotomy preparation was treated bilaterally with autogenous bone harvested locally, veneered with bovine bone mixed with calcium phosphate and tetracycline, and covered with a collagen membrane for GBR.*

D. Space is an Issue: Coronally and Apically

The edentulous width space mesiodistally was measured symmetrically at 7.0 mm bilaterally. Apical root position was noted as parallel for the cuspid and central incisors adjacent to each edentulous site. Ideally, 1.5 mm of space is desired on either side of the implant—with a 3.5-mm narrow neck (NN) shoulder width—to retain adequate papillary space and osseous maintenance. The orthodontically corrected spaces were very favorable, since 3.5 mm + 1.5 mm + 1.5 mm totaled less than 7.0 mm. *Note: the ideal space needed for a NN implant replacement[a] is 6.0 mm to 7.0 mm.* Distances of less than 1.0 mm to adjacent roots from the implant shoulder can create papillae attachment loss with corresponding bone loss over time, thus jeopardizing the esthetic result. The occlusal examination revealed an Angle Class 1 with a 3.0-mm overbite and 2.0-mm overjet relationship, confirming adequate interarch space present for tooth replacement.

E. Surgical Therapy

With anticipation of midapical surgical fenestrations occurring due to significant buccal undercuts requiring GBR, crestal incisions were extended distally to vertical releasing incisions and into the vestibule on the distobuccal aspects of the cuspids for adequate surgical access. Bone scalloping was completed for both sites using high-speed instrumentation with a round surgical length carbide bur and copious water irrigation. The amount of osteoplasty (ie, approximately 2.0 mm to 3.0 mm) was dictated by the future gingival margin replicated on the facial aspect of the surgical guide template (Figure 4). Bone was removed centrally—leaving the osseous untouched in the interproximal areas to support the future papilla—until a 3.0-mm vertical space was created from the guide template's marginal tissue location to the osseous crest. This will allow room for submarginal shoulder placement with adequate emergence profile for a narrow-diameter implant (ie, 3.5-mm shoulder diameter). A minimal distance of 1.5 mm is needed between the shoulder of the implant and the adjacent tooth for papillae formation.

FIGURE 7 *Compare the full smile upon completion with the presenting condition in Figure 1.*

Upon completion of the osteotomy preparation, the implants were installed and torqued to 35 Ncm during final insertion (Figure 5). This allows the surgeon to consider completion of the prosthetics at six to eight weeks due to the surface characteristics of the implant. GBR followed to correct the fenestration defects (Figure 6) using autogenous bone harvested locally

[a] Narrow Neck Standard Plus Implant/SLAactive Surface Technology, Straumann USA, LLC, Andover, MA

FIGURE 8 Custom porcelain staining by the laboratory was performed to provide a more natural result; compare with Figure 2 (dental laboratory: Edward's Dental Studio, Feasterville, PA).

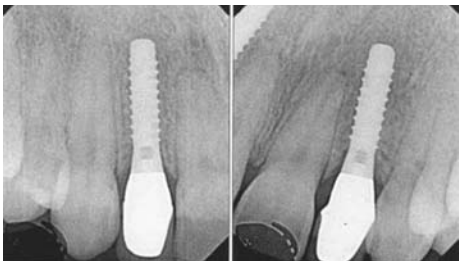

FIGURE 9 These final postoperative radiographs show adequate room coronally and apically for implant restorations (restorative: Dr. Michael Tuman, Philadelphia, PA).

and veneered with a bovine bone mixture of surgical-grade calcium sulphate and tetracycline, which was covered with a collagen membrane wetted with tetracycline liquid and calcium sulphate. The tissues were sutured with 6-0 resorbable material. A gingivectomy was performed on the facial aspects of Nos. 6, 8, 9, and 11 for esthetic crown lengthening. An eight-week healing period was allowed, after which a 35 Ncm reverse torque was applied successfully to confirm bone healing. The laboratory became involved with custom staining of her final crowns (Figures 7 and 8). Final radiographs confirm the postoperative healing seen clinically, along with proper spacing for long-term health between adjacent teeth and implants coronally and apically (Figure 9). A six-month periodontal maintenance program with the restorative dentist is ongoing because the patient is periodontally healthy.

CASE #2: Replacement of a Root-Fractured Central Incisor with Apical Fistula

A. Presentation

A 65-year-old female presented for implant consultation for the replacement of a recently fractured tooth No. 9. Within a six-month period, the patient had completed extensive periodontal, implant, and prosthetic care using the team approach to correct esthetic concerns involving old crown and bridge restorations whose metal margins were clinically exposed. The recent reconstruction included replacing maxillary anterior single crown restorations (Nos. 7 through 10) and posterior single crowns on natural teeth in the maxilla and mandible. Additionally, her lower right was restored with single implant crowns replacing Nos. 29 and 30 (Figures 10 and 11).

A non-smoker for 10 years with no history of parafunctional habits, the patient had a noncontributory medical history. Her chief complaint was an asymptomatic draining fistula in the apical area of No. 9 (Figure 12). Radiographically, the crown-to-root ratio was poor, and the tooth recorded a three-degree mobility. A favorable low lip line was noted. The treatment plan called for an immediate extraction with immediate provisional, if possible. If this could not be accomplished, the patient was informed that she had the short-term option of using a removable appliance through the healing phase. *Note: clinicians should refrain from making clinical promises because unforeseen events may occur during surgery that may alter the proposed restorative treatment plan.* All of these considerations were discussed with the patient and the restorative dentist prior to treatment.

B. Surgical Therapy

The uneventful extraction of tooth No. 9 was followed by thorough socket degranulation, saline irrigation, and immediate implant[b]

FIGURE 10 The patient presented with the chief complaint of a draining fistula apical to No. 9. Past history included conservative root canal therapy and apical surgical therapies for both central incisors.

FIGURE 11 Upon flapless surgical removal of the failed tooth, there was immediate implant placement along the palatal wall. The flapless approach was used to avoid marginal recession by exposing crown margins on adjacent restored crowns.

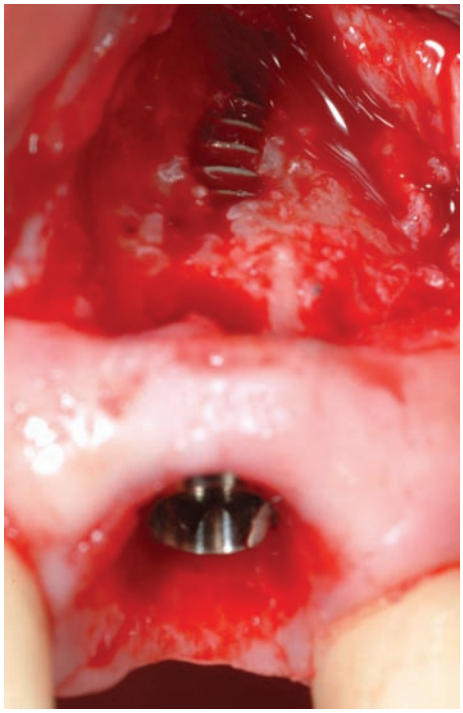

FIGURE 12 Beveled incisions were made along the mucogingival junction to gain access to the midbuccal fenestration. Bone grafting of the fenestration with autogenous bone was overlayed with a mixture of bovine bone and calcium sulphate to increase osseous healing; the mixture was also packed into the socket labial to the implant to heal the horizontal defect dimension (HDD) and support the labial plate of bone.

[b] 12.0-mm RN TE 4.1 x 4.8 mm Straumann SLA®, Straumann USA, LLC, Andover, MA

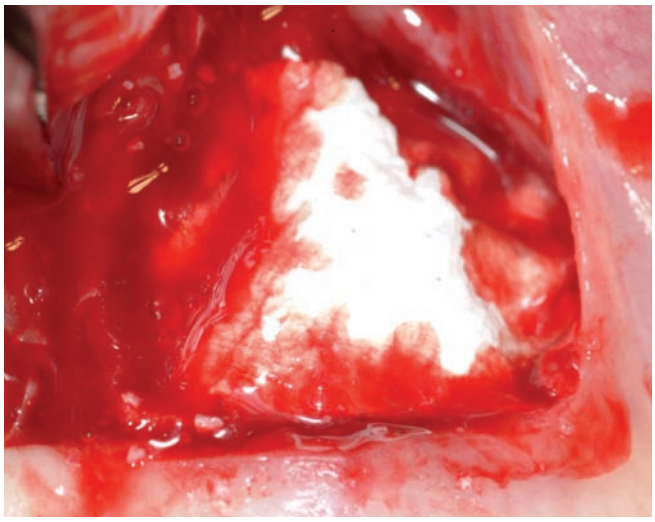

FIGURE 13 A resorbable collagen membrane was used to exclude soft tissue cells from the wound to promote GBR. A hard and soft tissue re-growth promoting material was then applied liberally over the membrane and around all incision lines.

FIGURE 14 A temporary meso abutment was incorporated into a crown former and acrylic. Labial contours are flat and unsupportive of the labial soft tissues to allow marginal soft tissue healing and collapse of the tissues coronally.

FIGURE 15 A screw-retained provisional was placed and torqued to 15 Ncm. The incisal edge was reduced to avoid protrusive and intercuspal contact. To prevent incising on her central incisors, the patient was instructed to follow a soft diet for six weeks.

FIGURE 16 A two-week postoperative visit showed favorable collapse of the soft tissue coronally; the fistula appeared to be clinically closed.

FIGURE 17 The final crown on No. 9 exhibited excellent soft tissue response. No marginal recession of adjacent teeth occurred as a result of using the flapless surgical approach. The marginal soft tissue was supported with resulting gingival symmetry, and the apical fistula was fully healed (dental laboratory: Rob Burns, Benchmark Dental Laboratory, Southampton, PA).

FIGURE 18 The final postoperative radiograph confirmed the marginal fit and osseous healing (restorative by Dr. Zola Makrauer, Huntingdon Valley, PA).

placement. A flapless approach was used to prevent any postsurgical marginal recession of the adjacent, recently restored crowns on teeth Nos. 8 and 10, which most likely would be seen in a flapped approach. In order to maintain her final marginal gingival position, it was important to avoid any soft tissue reflection. In accordance with the principles of maxillary anterior implant placement, the lingual wall of the bony socket was used to guide the osteotomy preparation, thus leaving a 2.0-mm to 3.0-mm horizontal defect dimension (HDD) to the facial aspect of the implant. This avoids any trauma to the thin buccal plate that would result in hard and soft tissue loss and compromised final esthetics (Figure 13).

An endodontic surgical design was anticipated because of an apical fenestration filled with soft tissue from the previously performed apicoectomy. This incision design enabled the surgeon to gain access to the apical area, without the concern of postoperative gingival recession resulting from a full-thickness flap approach. This endodontic surgical approach with beveled incisions at the mucogingival junction allowed complete visualization of the fenestrated area with access for GBR, which was completed with the same materials as in case #1. An immediate screw-retained provisional[c] was placed with buccal undercontouring, creating a flat emergence profile that allows soft tissue collapse coronally, as seen clinically associated with an undercontoured facial restoration or crown. The soft tissue prevented any pressure to the buccal marginal tissue and the marginal tissue recession that could have resulted (Figures 14 through 16). At three months, a reverse torque of 35 Ncm was applied successfully, confirming bone healing. The final crown showed maintenance of soft tissue heights, symmetry, and periodontal health with the adjacent soft tissues (Figure 17). The final radiograph confirmed the prosthetic fit and osseous healing (Figure 18). An alternating periodontal maintenance program is ongoing with the patient's restorative dentist because of her periodontal disease susceptibility and completed implant and restorative restorations.

CASE #3: Extraction with Immediate Implant Placement and Loading with Tissue Augmentation to Develop Cantilever Ovate Pontics

A. Presentation

A 62-year-old retired male—an admitted dental phobic who had not been to a dentist in more than 25 years—presented requesting

[c] Straumann® RN synOcta temporary meso abutment, Straumann USA, LLC, Andover, MA

immediate restoration of his severely decayed maxillary dentition (Figure 19). The patient, who was planning retirement to a warm-weather location, attended the consultation at the urging of his wife. Apart from smoking up to 10 cigarettes per day, his medical history was noncontributory. A comprehensive team approach work-up was completed, including surgical guide template fabrication for anticipated implant placement for site Nos. 3, 5, 8, 9, 12, and 13. Teeth Nos. 6 and 11 were to be retained and restored with porcelain single crowns in the final restoration. Coordinated surgical and prosthetic appointments were made for the day of surgery to take implant-level impressions for fixed immediate provisional restorations. Nonsurgical periodontal therapy was completed for the lower jaw with extraction of tooth No. 18. Future dental implants were discussed for site Nos. 28 and 29 to establish a bilateral bicuspid occlusion. A low lip line was noted clinically (Figure 20).

FIGURE 19 *The patient presented with generalized severe caries in the maxilla, with relative periodontal resistance. Oral sedation was discussed and accepted by the patient.*

B. Surgical Therapy

With the use of oral sedation, surgical extractions of all maxillary teeth were completed, with the exception of Nos. 6 and 11, which helped in surgical guide template stabilization. Esthetic guidelines were followed for placement of implants in teeth Nos. 8[d] and 9[e] along the lingual walls, avoiding engagement of the buccal plate (Figure 21). An HDD of 3.0 mm was measured and packed with bovine bone mixed with calcium sulfate and tetracycline for preservation of the buccal plate and to fill the defects. This mixture was also packed into both lateral incisor extraction sites, along with site No. 3, and covered with collagen membranes for ridge preservation and GBR. A collagen membrane was placed over the buccal plate of No. 7 after bone grafting, where a large and deep fenestration was present from a chronic periapical infection. Palatal connective tissue grafts from the underside of the palatal flaps were used as a socket seal and for primary soft tissue closure to prevent early bone graft and membrane loss for site Nos. 3, 7, and 10 (Figures 22 through 24).

Connective tissue grafts (ie, palatal, tuberosity, or dermal) are used frequently in the "esthetic zone" by the oral plastic and reconstructive implant surgeon for not only primary closure over GBR

FIGURE 20 *Note the low lip line esthetics in this patient.*

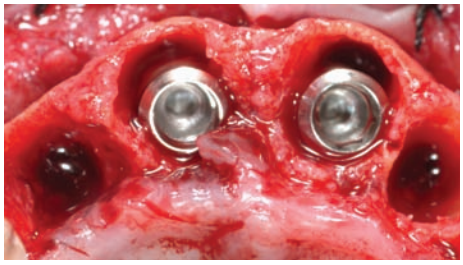

FIGURE 21 *Implant placement for both central incisors followed esthetic implant placement principles along the palatal walls of their respective sockets. HDD of 2.0 mm to 3.0 mm to the facial was noted. A distance of 3 mm to 4 mm between implants is recommended in the esthetic zone.*

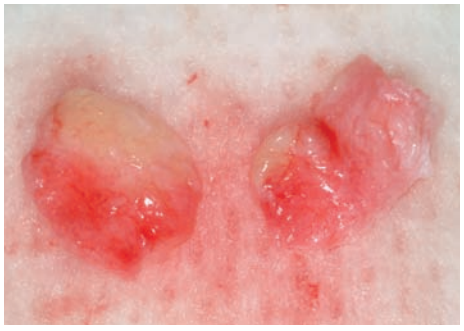

FIGURE 22 *Connective tissue grafts were harvested from under the palatal flaps in the bicuspid areas for use in soft tissue closure over the lateral incisor bone grafts.*

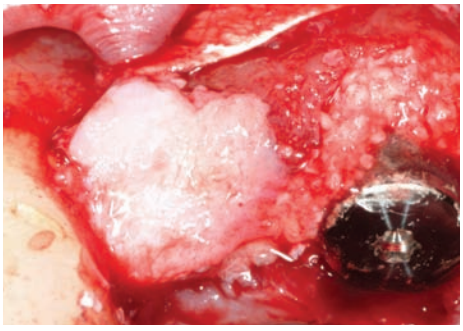

FIGURE 23 *Bovine bone mixed with calcium sulphate was packed into the HDD of both central incisors and the extraction sites of both lateral incisors. A large apical granuloma was removed from the site of No. 7, with the bone mixture packed into this defect after curetting and irrigation. A connective tissue graft was placed passively over the bone graft and collagen membrane for socket seal at site No. 7.*

FIGURE 24 *A second connective tissue graft was laid passively over the bone graft and collagen membrane for socket seal at site No. 10.*

[d] Straumann® RN 4.8 mm x 11.0 mm, Straumann USA, LLC, Andover, MA

[e] RN 4.1 mm x 4.8 mm TE Straumann SLA®, USA, LLC, Andover, MA

sites, but also for facial soft tissue augmentation in cases of thin periodontium. Connective tissue grafts sutured under the buccal flaps aid in preventing post-surgical exposure of the buccal implant margins by locally creating a thicker periodontium. When keratinized tissue is lacking and GBR is anticipated, a dermal graft can serve two functions: as a GBR membrane and a soft tissue augmenter. In this case, suturing with a combination of 4-0 silk and 6-0 resorbable sutures was completed after placement of closed tray impression[f] copings and positioning cylinders (Figure 25). The patient proceeded directly to his restorative dentist for impressions for immediate load laboratory-processed, metal-reinforced provisionals to be inserted in three days. His case was divided into three separate provisional bridges: Nos. 3 through 5, Nos. 7 through 10, and Nos. 12 through 13 (Figure 26). After a healing period of three months, ovate pontics were developed for site Nos. 7 and 10, and a 35 Ncm reverse torque was applied successfully to all implants to confirm bone healing. *Note: many patients with a low lip line will benefit from the ovate pontic design in anterior edentulous sites, since phonetics can become an issue if ovate pontics are not incorporated into the final restoration.*

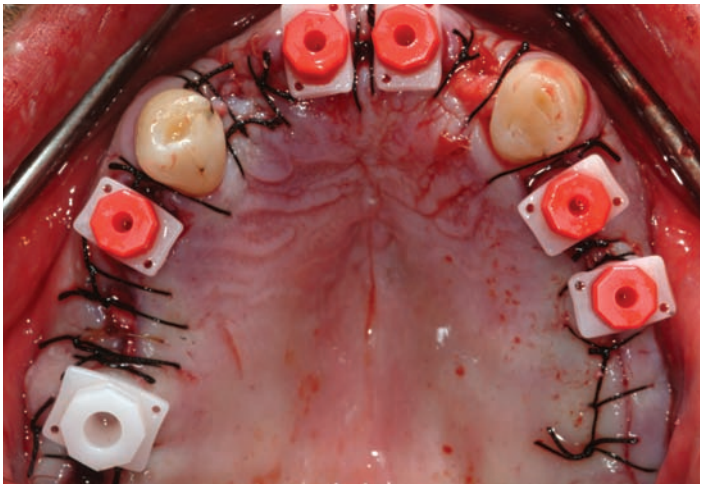

FIGURE 25 *Suturing with a combination of 4-0 silk and 6-0 resorbable sutures was completed after placement of closed tray impression copings and positioning cylinders.*

Final impressions were taken at three months and custom abutments were fabricated (Figures 27 and 28). The final case revealed excellent soft tissue healing and improved esthetics upon smiling (Figures 29 and 30). Radiographic osseous healing of all implant sites, with favorable prosthetic fit, was evident (Figure 31). An alternating three-month periodontal maintenance program was recommended with his new restorative dentist and newly referred periodontist in the area where the patient has relocated.

FIGURE 26 *The provisionals were placed three days postoperatively.*

FIGURE 27 *Ovate pontic sites were developed for the lateral incisors and supported in acrylic by the provisional restoration. Note the good soft tissue healing for all sites that resulted from the ridge preservation techniques.*

FIGURE 28 *Final impressions were taken at three months and custom abutments were fabricated (dental laboratory: Edward's Dental Studio, Feasterville, PA).*

FIGURES 29 AND 30 *The final case revealed excellent soft tissue healing and improved esthetics upon smiling (restorative: Dr. Donald Katz, Philadelphia, PA).*

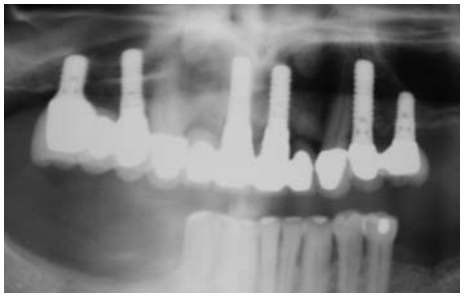

FIGURE 31 *The final postoperative radiograph confirmed marginal fit and osseous healing.*

[c] synOcta Straumann® closed tray abutment, Straumann USA, LLC, Andover, MA

"The dental team's ability to diagnose and treat soft and hard tissue deficiencies aids in preventing esthetic implant failures."

CONCLUSION

Given the complex required procedures for successful and ultimately cosmetic and long-term results, an interdisciplinary "team approach" to care is highly recommended when considering implant therapy in the esthetic zone. Soft and hard tissue maintenance, as well as the ability to diagnose and predictably reconstruct these tissues when they are lacking, are key to esthetic success. Understanding the diagnostic keys when replacing a single anterior tooth helps ensure a long-term esthetic result. Proper implant selection and placement in three dimensions are also important factors. The dental team's ability to diagnose and treat soft and hard tissue deficiencies aids in preventing esthetic implant failures. The interdisciplinary management of these cases enables each clinician to focus on the aspect of care that he or she is most comfortable with and has the most clinical experience performing. From preoperative case analysis to restorative completion, the patient will be the ultimate beneficiary of the team philosophy.[31]

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DISCLOSURE

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