

# IMPLANT PLASTIC SURGERY: A REVIEW AND RATIONALE

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## KEY WORDS

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Implant dentistry has been established as a predictable treatment modality with high clinical success rates. Esthetic considerations of implant restorations have been gaining increased interest over the years. The role of periodontal plastic surgical procedures in the creation and maintenance of peri-implant soft tissue heights to facilitate better esthetics has become more popular. The available plastic surgery procedures and their clinical applications are reviewed in this article. Emphasis is placed on factors to consider for proper case selection and ideal treatment planning.

## INTRODUCTION

Implantology has evolved into an accepted, predictable treatment for restoring lost teeth. Consequently, as the practice of implant rehabilitation has developed and matured, both patients and the reconstructive team have reframed their treatment expectations. No longer is implant rehabilitation simply a vehicle to restore lost masticatory and phonetic function; achieving ideal treatment outcomes in the structural and esthetic “regeneration” of edentulous spaces has become an integral part of modern implant dentistry. Many of these esthetic requirements have arisen from significant advancements in esthetic restorative dentistry in recent years. Patients have come to expect esthetically pleasing restorative treatments and now consider a visible crown margin or a poor porcelain/composite color match an unsatisfying treatment outcome. In turn, implantology

has had to meet these new challenges, which are, in many instances, difficult if not impossible to attain. Although implant success, as measured through fixture osseointegration and restoration of function, is high, the procedures available to create esthetic implant “success” are not always so predictable. Fortunately, esthetic plastic surgical techniques have existed for many years and are considered routine treatment for the correction of various soft tissue defects, from recession and mucogingival defects to improper gingival contours. Implantology can, in turn, benefit from adaptations and modifications to these time-tested periodontal plastic surgery techniques, but, in contrast to natural teeth, the timing of these procedures becomes more critical.

In this article, procedures and techniques used in the development of implant recipient sites will be presented and discussed. These techniques influence both

hard and soft tissues, ideally resulting in healthy peri-implant tissues that are resistant to mechanical forces and masticatory trauma while providing a satisfying esthetic appearance. This becomes especially important in areas of esthetic concern and less so in posterior areas where appearance is of little consequence. Unfortunately, there is little if any scientific support in the literature as to the overall success and longevity of these techniques in well-controlled, long-term studies. Indeed, scant evidence, mainly case reports, exists in the literature to guide our decisions in managing implant soft tissue considerations. Most procedures presented here have been described by leading experts in the field and are generally accepted treatments for soft tissue augmentation and modification around dental implants. In organizing this discussion, the classification of tissue and ridge defects will first be reviewed, followed by the presentation of management techniques organized into these categories of implant soft tissue modification: pre-implant placement, stage 1 and 2 surgery, and postimplant placement.

### CLASSIFICATION

In order to achieve optimal esthetic implant rehabilitation, the following prerequisites are considered essential<sup>1</sup>: adequate bone volume (horizontal, vertical, and, contour), optimal implant position (mesiodistal, apicocoronal, buccolingual, and angulation), stable and healthy peri-implant soft tissues, esthetic soft tissue contours, and ideal emergence profile. The restoration of these conditions necessitates effective communication between all members of the restorative

team. The expectations and limitations of restoring lost supporting structures must be understood by both the dentist and patient before treatment begins. These limitations are best understood through proper classification of the existing structural defects.

#### *Classification of tissue volume*

The first classification of ridge deficiency was proposed by Seibert in 1983<sup>2</sup> and later modified by Allen in 1985.<sup>3</sup> Seibert divided ridge deficiencies into three classes, with a class I defect describing the apicocoronal loss of ridge contour, class II, buccolingual, and class III, a combined loss of both apicocoronal and buccolingual dimensions. Allen further quantified the loss of ridge dimension into mild (<3 mm), moderate (3–6 mm) and severe (>6 mm). Although Seibert's classification was originally intended for edentulous soft tissue defects receiving a pontic, both are based on the amount of available ridge volume in horizontal and vertical aspects. Recently, a classification was proposed that attempts to recommend specific treatment options based on the classification and the severity of the presenting ridge defect, and both soft- and hard-tissue augmentation procedures are addressed.<sup>4</sup>

#### *Classification of bone volume*

Two bone volume classifications were proposed simultaneously in the literature and are frequently used in describing edentulous ridge architecture in terms of remaining bone volume. Lekholm and Zarb described the shape of the residual edentulous ridge in terms of remaining bone volume, with a 5-point classification system from A (intact ridge form) to E (severely deficient ridge form). This classification lacks specific

categorical ridge dimensions and has less detail within categories addressing vertical or horizontal ridge deficiency.<sup>5</sup> Misch and Judy classified available bone into 4 divisions: abundant, barely sufficient, compromised, and deficient (A–D). Adequate bone requires no augmentation and is greater than 5 mm in width, 10 to 13 mm in height, and 7 mm in length. Barely sufficient bone is 2.5 to 5 mm in width, greater than 10 to 13 mm in height, and greater than 12 mm in length and can be modified with osteoplasty or augmentation of hard or soft tissues, depending on the nature of the defect (B–w). Compromised bone necessitates osteoplasty and some form of hard or soft tissue augmentation depending on the extent of the defect in height (less than 10 mm, C–h) or width (less than 2.5 mm, C–w). Deficient bone requires substantial hard tissue augmentation from extraoral sites and is generally not amenable to implant rehabilitation.<sup>6,7</sup> Salama and Salama described a classification system relating the quality and quantity of bone surrounding a condemned tooth to implant placement and the need for ridge augmentation.<sup>8</sup> A class I extraction site is described as having less than 5 mm of potential buccal bone loss, good regenerative potential, and a good esthetic prognosis. Class II extraction sites have the potential of a postimplant placement dehiscence greater than 5 mm and require regenerative procedures prior to implant placement if apical bone socket structure is insufficient for initial stability. Finally, a Class III extraction site finds that a majority of the root resides in a defective environment, necessitating ridge augmentation before implant placement. In a recent attempt to combine hard and soft tissue deficiencies, Wang and Al-Sham-

mari recommend specific treatment options based on the classification and the severity of the presenting ridge defect.<sup>4</sup>

### *Optimal implant position*

A prerequisite to successful implant rehabilitation, both functionally and esthetically, is the proper location of the implant fixture and restoration in the edentulous space. This "restoration-driven implant placement" necessitates implant insertion in an optimal 3-dimensional position (mesiodistal, buccolingual, and apicocoronal) that relates to the final restorative phase of treatment rather than bone availability.<sup>9</sup> To do this, we must have criteria to evaluate space and distances between natural teeth, implants, and anatomic structures as well as guidelines on how to manage soft tissue dimensions to achieve optimal functional, esthetic, and healthy implant restorations.

#### *Mesiodistal Position*

It has been suggested that a minimum of 1.25 to 1.5 mm of clearance be maintained between the implant fixture and adjacent teeth for proper osseointegration and decreased risk of damage to adjacent natural teeth.<sup>10,11</sup> This is based primarily on the periodontal ligament width of adjacent teeth, although it fails to consider other important aspects such as the coronal and cervical width of the replaced tooth, the proximity of adjacent roots, the presence or absence of a diastema, and the necessity of maintaining the integrity of the interdental papillae.<sup>12</sup> In natural teeth, a direct relationship has been demonstrated between the distance of the interproximal tooth contact point to the alveolar crest and the presence of an interproximal

papilla.<sup>13</sup> This has, in turn, led to recommendations of a 2-mm distance between the cervical implant face and the natural tooth and greater than a 3-mm cervical distance between two implants. Maintaining these space requirements has been shown to minimize the amount of crestal bone loss and increase the probability of proper papilla bone support and soft tissue fill.<sup>14</sup>

#### *Buccolingual Position*

Correctly orienting the implant in a buccolingual position is important in obtaining a natural buccal and proximal restorative contour and in preventing restorative phase correction of implant fixtures that are oriented too far buccally or palatally. Two and 4 mm of space should be maintained between the external implant collar surface and the longitudinal implant axis to the buccal and cervical contours of the adjacent teeth, respectively.<sup>15,16</sup> Spray and colleagues have proposed a critical facial bone thickness of 1.8 mm to maintain the implant soft tissue profile and increase the likelihood of an esthetic outcome. Implants placed in areas with less than this critical bone thickness are more prone to future bone loss and soft tissue recession (Figure 1).<sup>17</sup> A facially oriented implant creates an excessively long crown and a misalignment of the collar with respect to the adjacent contralateral tooth.<sup>18</sup> Additionally, subgingival emergence profile development cannot be achieved. In this instance, it is recommended to orient the implant 5° palatally and closer to the palatal cortical aspect to minimize buccal angulation, an improper implant-to-crown ratio, and resorption of the buccocortical plate, especially in cases where it is already thin.<sup>11,12</sup> If an implant must be placed palatally,

for each millimeter of palatal inclination, the implant should be placed an additional millimeter apically.<sup>19</sup>

#### *Apicocoronal Position*

According to Saadoun and colleagues, the apicocoronal location of the implant shoulder is dependent on a number of factors: the cervical bone resorption morphology, the diameter of the implant, the size discrepancy between the root and the diameter of the implant, the thickness of the marginal gingiva, and the proximal tissues. They suggest that the implant collar be located 2 mm apical to the CEJ of the adjacent tooth if no gingival recession is present and 3 mm from the free gingival margin when it is. Implants positioned too far apically typically result in infra-bony defects, peri-implant pocketing, second stage complications, difficulties in abutment connection, and excess cement during restoration seating.<sup>12</sup> Implant sulcus depths should be limited to 3 or 4 mm, because deeper pockets are associated with increasing counts of anaerobic bacteria and long-term soft tissue complications.<sup>20–22</sup> Excessive occlusal implant orientation can induce soft tissue recession, prevent a proper emergence profile, and result in compromised esthetics.<sup>12</sup>

#### *Emergence profile*

Esthetic soft tissue contours are described by a harmoniously scalloped gingival line, the avoidance of abrupt vertical changes or differences in clinical crown length between adjacent teeth, a convex buccal mucosa of sufficient thickness, and distinct papillae.<sup>23,24</sup> The existing status of the gingival tissues must be evaluated for quantity, quality, color, texture, and biotype (scalloped vs flat)

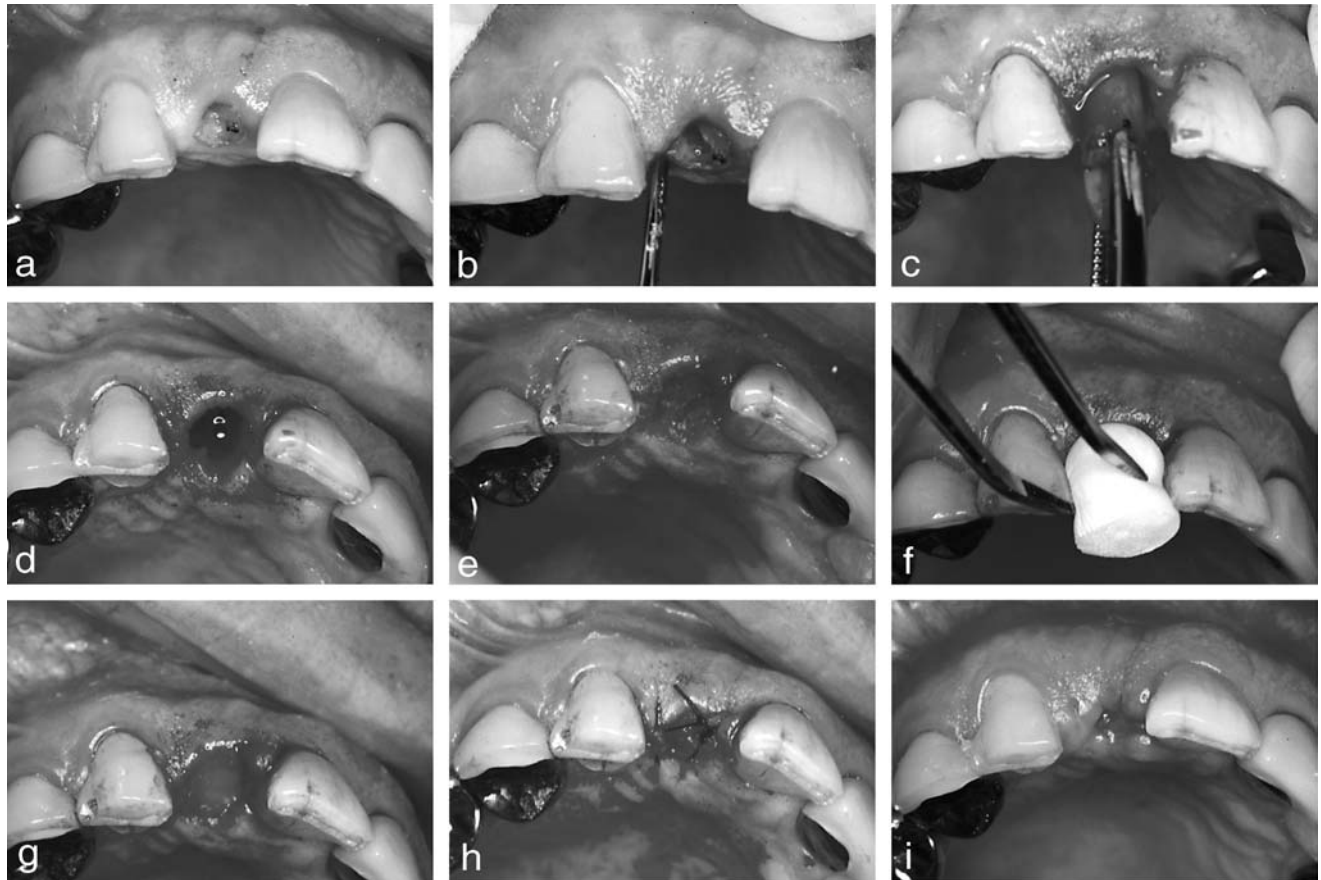


FIGURE 1. Ridge (socket) preservation. (a) Root tip was left on tooth #8. (b) Perioste (Hu-Friedy, Chicago, Ill) was used to loosen (via periodontal ligament space) the remaining root in the socket. (c) The tooth was atraumatically extracted, preserving the labial bony plate. (d) Socket occlusal view showed signs of angiogenesis. (e) Demineralized freeze-dried human bone allograft (Puros, Centerpulse, Carlsbad, Calif) was placed on the bottom two thirds of the socket. (f) Colla-plug (Centerpulse, Carlsbad, Calif) was cut and placed on the top one third of the socket. (g) Socket was compressed with all the materials underneath. (h) Cross mattress suture with 4-0 Vicryl suture (Ethicon, Inc, Somerville, NJ). (i) Two weeks postoperative showed uneventful healing.

before implant surgery is initiated in order to establish expectations regarding esthetic outcome.

The importance of developing a proper emergence profile is critical to achieving a final restoration whose appearance on exiting the soft tissues closely mimics that of adjacent natural teeth. A more ideal emergence profile can be obtained when using an implant of similar diameter to the tooth being replaced.<sup>25</sup> Saadoun et al<sup>12</sup> provide guidelines for implant fixture diameters when replacing specific natural tooth types.<sup>12</sup> For example, for a central incisor, a mesiodistal dimension of 8.6 mm is needed at the crown

level, 6.4 mm at the CEJ level, and 5.5 mm at 2 mm apical to the CEJ, in contrast to the available implant dimensions commonly used of 4.1 to 5 mm. Therefore, development of the proper emergence profile begins after stage 2 surgery, with the placement of a properly contoured provisional restoration that places expansion pressure on the surrounding peri-implant tissues. This “double-guidance concept” facilitates ideal gingival scalloping and papillae reformation while creating a natural emergence profile that will be supported by the final restoration.<sup>14,26–30</sup> Before considering soft tissue augmentation proce-

dures, the ridge deficiency of the implant site should be within 3 mm of its optimal contour, with a buccal bone wall of at least 1 to 2 mm in thickness (critical facial bone thickness), which may necessitate hard tissue augmentation.<sup>1,11,31</sup> In sites with adjacent implants in the esthetic zone, the midcrest of the ridge should approximate the papillary tips of adjacent teeth.<sup>13,32</sup> When augmenting soft tissues, it is important to overcontour by a minimum of 2 to 3 mm (corresponding to a tissue volume of 20%) because subsequent surgical and restorative procedures tend to cause at least 1 mm of tissue recession,

especially if the tissue augmentation is performed before stage 1 implant surgery. An additional 0.75 mm and 0.90 mm of tissue recession has been documented at 6 months and 1 year, respectively, following abutment connection.<sup>14,33</sup> Anterior implants significantly benefit from gingival augmentation procedures, which can resolve discrepant gingival and mucosal contours, enhance existing thin facial tissues, and mask metal fixture and crown components, ultimately creating an inconspicuous final treatment outcome.<sup>34,35</sup> All esthetic tissue management should be completed before seating of the definitive restoration because postplacement esthetic management is severely limited.<sup>36</sup>

#### *Biologic Width*

In understanding the soft tissue-implant relationship, it is necessary to discuss the concept of biologic width, which, in natural teeth, defines the distance between the most apical extension of the gingival sulcus and the crest of the alveolar bone. In the natural tooth, this space is occupied by about 1 mm each of connective tissue attachment and epithelium.<sup>9</sup> Similarly, around implants, the junctional epithelial dimension is about 1.88 mm, and the connective tissue attachment is about 1.05 mm.<sup>37</sup> This overall dimension appears stable over time, with slight variations in each component measure.<sup>38</sup> It is important to note that there is no direct attachment between the implant surface and the connective tissue components as there is in natural teeth, so that a periodontal probe, even with the correct pressure, can probe close to the alveolar crest.<sup>39,40</sup> This becomes important when considering implant soft tissue resistance to bacterial invasion,

inflammation, recession, and trauma from oral hygiene measures; it will be discussed subsequently.

#### *Keratinized vs Nonkeratinized Tissues*

Discussion of the necessity of keratinized tissue around implants is central to procedures in implant plastic surgery. This topic has been debated in the literature and evidence has been presented stating that keratinized tissue around implant fixtures with rough surfaces is desirable, if not necessary<sup>41-51</sup> and conversely, that smooth-surface implant fixture survival is unaffected by the absence of keratinized tissue.<sup>41,52-54</sup> Indeed, it has been reported that the complete lack of masticatory mucosa around an implant fixture results in a mucosal seal that is not as resistant to movement and subsequent disruption of the implant-epithelial junction, plaque accumulation, and inflammatory changes.<sup>46,55,56</sup> Ensuring that a keratinized tissue border exists at the implant-soft tissue interface helps develop tight tissue adaptation and a marginal seal at the implant surface and provides a connective tissue circumferential fiber system that resists mechanical stress and facilitates oral hygiene procedures.<sup>42,44,45,51,55-58</sup>

#### *Tissue preservation and modification*

A large number of soft and hard tissue procedures have been described to facilitate edentulous ridge augmentation prior to implant placement. Many of these procedures have been used successfully in periodontal and oral surgery for several decades to cover recession and for alveolar ridge reconstruction, and they will be briefly outlined here.<sup>59-65</sup> Other procedures—not well known in

the periodontal literature—will be discussed in more detail. Soft tissue modification before implant placement is advantageous in that proper tissue contours and support exist before stage 1 surgery, increasing the predictability of a satisfying treatment outcome. These procedures are indispensable in critical esthetic regions, but they unfortunately necessitate additional surgical procedures and increased cost to the patient.

#### *Ridge (Socket) Preservation (Figure 1)*

Ridge-retention procedures, using bone grafts, membrane placement, or grafting, along with 6 months of healing prior to implant placement, have been demonstrated to be predictable, and they are preferred by many clinicians.<sup>66-68</sup> Although these procedures increase overall treatment time, they are preferable to simple extraction when considering that 3 to 4 mm of resorption can occur during the first 6 months after extraction in the absence of intervention.<sup>69,70</sup> The ideal solution to successful ridge preservation is the flapless, atraumatic removal of the hopeless tooth, leaving much of the bony architecture, including the often-thin buccal cortical plate, intact. Schulte developed the Periotome (Friadent North America, Lakewood, Colo) for the purpose of removing teeth without damage to the surrounding bone.<sup>71</sup> These instruments have been designed for both anterior and posterior teeth. They are used by inserting the small, thin blade around the tooth socket and severing the periodontal ligament connection to the socket wall as far apically as possible to loosen the tooth, which is then easily removed with minimal surrounding bony trauma. After extraction, the

socket is curetted and a decision is made as to what material to use in grafting. Many materials have been suggested in the literature, from an absorbable collagen matrix (Collaplug, Centerpulse Dental, Inc, Carlsbad, Calif), autogenous bone, demineralized freeze-dried bone allograft, combinations of growth factors, to a variety of synthetic grafting materials. Examples of frequently used materials include osteoconductive human hydroxyapatite (HA) (Puros, Centerpulse Dental, Inc, Carlsbad, Calif) and bovine xenograft (OsteoGraf N-300, Dentsply, Lakewood, Colo).<sup>72-78</sup> Another option to consider is the use of a barrier membrane, which necessitates complete tissue coverage without subsequent membrane exposure and infection for crestal bone regeneration to occur.<sup>79-81</sup> Several difficulties in using a barrier membrane during ridge preservation include reduction of keratinized gingiva, alterations of gingival contours, and migration of the mucogingival junction, which may occur during coronal displacement of the flap during tissue closure of the membrane. Even with these drawbacks, some studies have demonstrated success in the use of a variety of membranes for ridge preservation, including absorbable, nonabsorbable, and acellular dermal allografts.<sup>81-84</sup>

*Bio-Col technique.* Sclar has developed a socket (ridge) preservation technique that is unique and has met with some success.<sup>85,86</sup> The technique involves: 1) atraumatic tooth extraction followed by socket curettage and cortical socket perforation, 2) socket grafting with deproteinized bovine bone HA, 3) placement of an absorbable collagen dressing (CollaPlug, Sulzer Calci-tek, Inc, Carsbad, Calif), and 4) socket sealing with an impervi-

ous tissue cement (Isodent, Ellman International, Hewlett, NY). An interim ovate, pontic-form, provisional restoration is delivered after the procedure to replicate the contours of the extracted tooth and to support the surrounding soft tissues.

*Modified graft preservation.* This technique involves 1) atraumatic tooth extraction without a periodontal flap followed by socket curettage, 2) socket grafting with demineralized freeze-dried bone allograft (DFDBA), and 3) placement of a free gingival palatal graft over the extraction socket. The dimensions of the socket are measured after tooth extraction using a periodontal probe and transferred to a harvest site in the palatal tissue at least 3 mm apical to the free gingival margin of the premolars or molars. An additional 1 mm is added to the diameter of the free gingival graft to increase keratinized tissue at the extraction site and expand the existing tissues to minimize shrinkage during the healing phase. The graft is harvested and the thickness adjusted to match the thickness of the existing tissues at the extraction site. The graft is immobilized with interrupted sutures and left to heal for 6 months before implant surgery. This technique results in preservation of existing papillary, crestal, and buccal bony support while maintaining ideal tissue contours during healing.<sup>87</sup>

#### *Forced Orthodontic Eruption*

The use of orthodontics in erupting hopeless teeth before extraction has been used successfully to augment bone and soft tissue support at future implant sites.<sup>8,88,89</sup> In order to advance the periodontal attachment apparatus and the alveolar bone coronally for the correction of bony defects and augmentation of hard

and soft tissue contours, the extrusion must be done using a slow eruption technique.<sup>90-92</sup> One drawback to this technique is the potential loss of proximal alveolar bone support, because orthodontic extrusion tends to level the crestal alveolar bone; it might even create reverse mid-crestal architecture, depending on the degree of extrusion. This may reduce or eliminate the fill of interproximal papillae, which is not favorable in anterior esthetic regions. Therefore, when a tooth is buccally oriented, it is often advisable to remove the tooth and perform osseous augmentation (eg, monocortical onlay grafting). Other drawbacks in using this technique include longer treatment time and increased cost to the patient.

#### *Osseous Augmentation Techniques (Figure 2)*

To facilitate ideal implant placement, several osseous augmentation procedures have been developed and implemented with promising results. These procedures include guided bone augmentation, monocortical onlay grafting (symphysis, ramus, iliac crest, tibia), distraction osteogenesis, ridge splitting techniques, and combination procedures. Because of the nature and scope of this review, we have decided not to discuss these augmentation techniques in detail.

#### *Gingival Augmentation Techniques*

Creative methods of gaining excess autogenous gingival tissues have been described in the literature with some success.

*Controlled tissue expansion.* This technique was proposed by Bahat in 1989 as a unique way to expand soft tissues in ridge deficiencies.<sup>68,93</sup> By exploiting the elastic properties of the gingival epithelium, the tissue is expand-

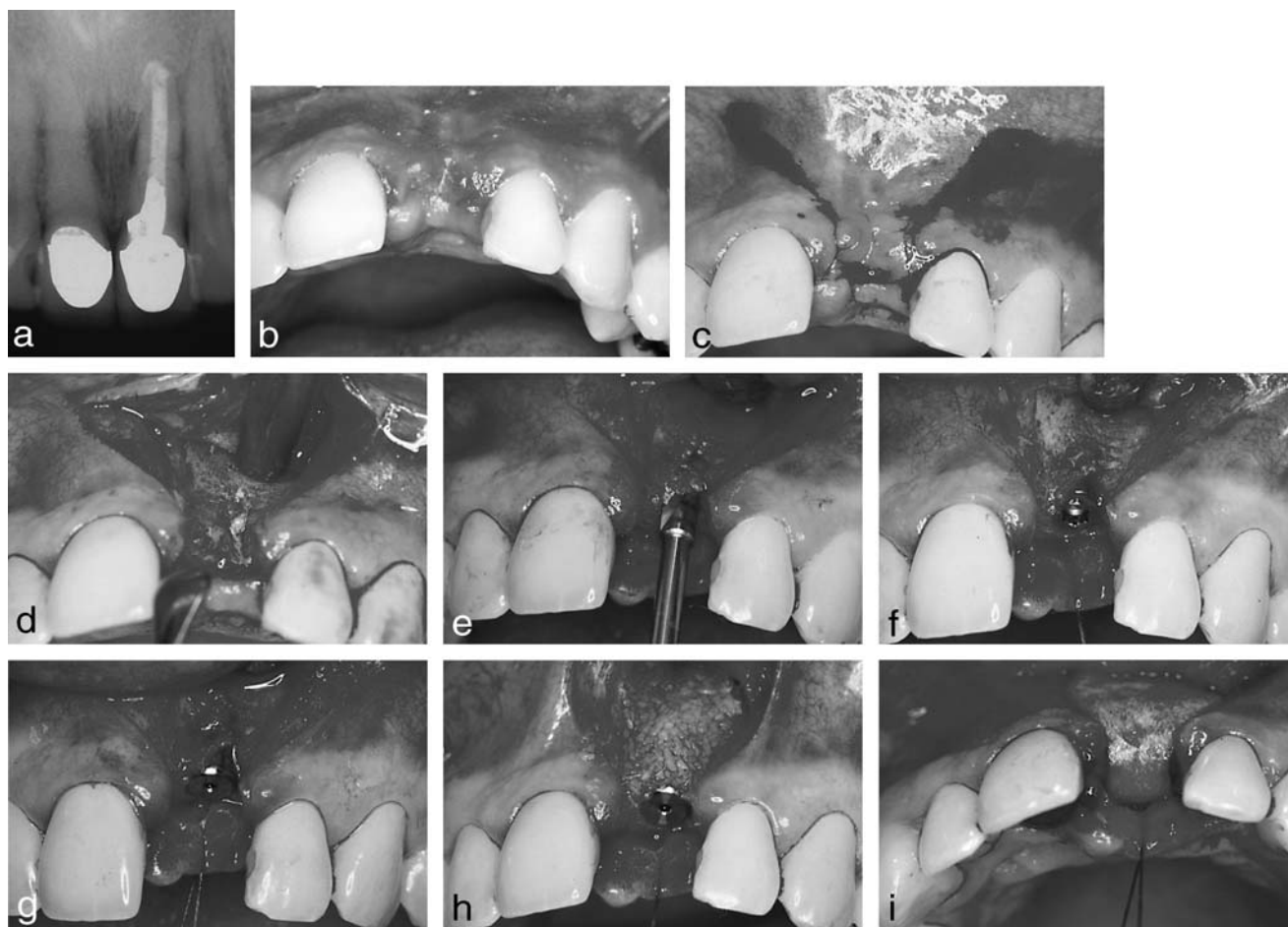


FIGURE 2. Bone augmentation to enhance soft tissue profile. (a) Tooth #9 has root fracture. (b) Occlusal view of the healing socket. (c) Initial incision. Two vertical, diverging, releasing incisions were done. (d) Full thickness periosteal reflection indicated inadequate bone width for proper implant placement. (e) Implant drill sequence (2 mm twist drill). (f) Implant (3.75 × 13 mm) placement (Nobel BioCare, Yorba Linda, Calif). (g) Decortication was performed using one-half round bur on the side of the implant to promote regional acceleratory phenomenon (RAP). (h) Demineralized freeze-dried bone allograft was placed. (i) Collagen membrane (BioMend Regular, Centerpulse, Carlsbad, Calif) was placed to cover the bone graft area and extended to the lingual. (j) Sutured with passive tension. A modified vertical mattress suture was placed on the center of defect to ensure proper wound coverage. (k) Two weeks postoperatively showed uneventful healing. (l) Four months healing after ovate pontic site development by temporary crown. (m) New bone formation was noted on the buccal side. (n) Healing abutment was placed. (o) Sutured around healing to allow soft tissue maturation. (p) Two weeks after healing. (q) Final radiography. (r) Final restoration.

ed using a technique modeled after breast implants to gain adequate soft tissue for primary coverage of subsequent osseous grafts. Full thickness mucoperiosteal flap reflection of the deficient ridge is performed with releasing incisions extending into the buccal vestibule. The inflatable silicon balloon expander is then positioned and sutured in place, the port of the expander exiting the soft tissue at the height of the

vestibule. The expander is inflated through the exposed self-sealing port with sterile saline every 3 or 4 days for 2 to 3 weeks, depending on the size of the ridge defect and the anticipated amount of soft tissue coverage required for bone grafting. One particular drawback of this technique is the potential need for additional soft tissue procedures to gain keratinized tissue, because this technique preferentially expands the

moveable alveolar mucosa over the thicker, more resistant masticatory mucosa.

*Spontaneous in situ gingival augmentation.* This technique is used to augment a future implant site through allowing the body to manufacture gingival tissue around a tooth scheduled for extraction; it has been reported to reduce the need for additional grafting procedures at implant placement.<sup>94,95</sup> This tech-

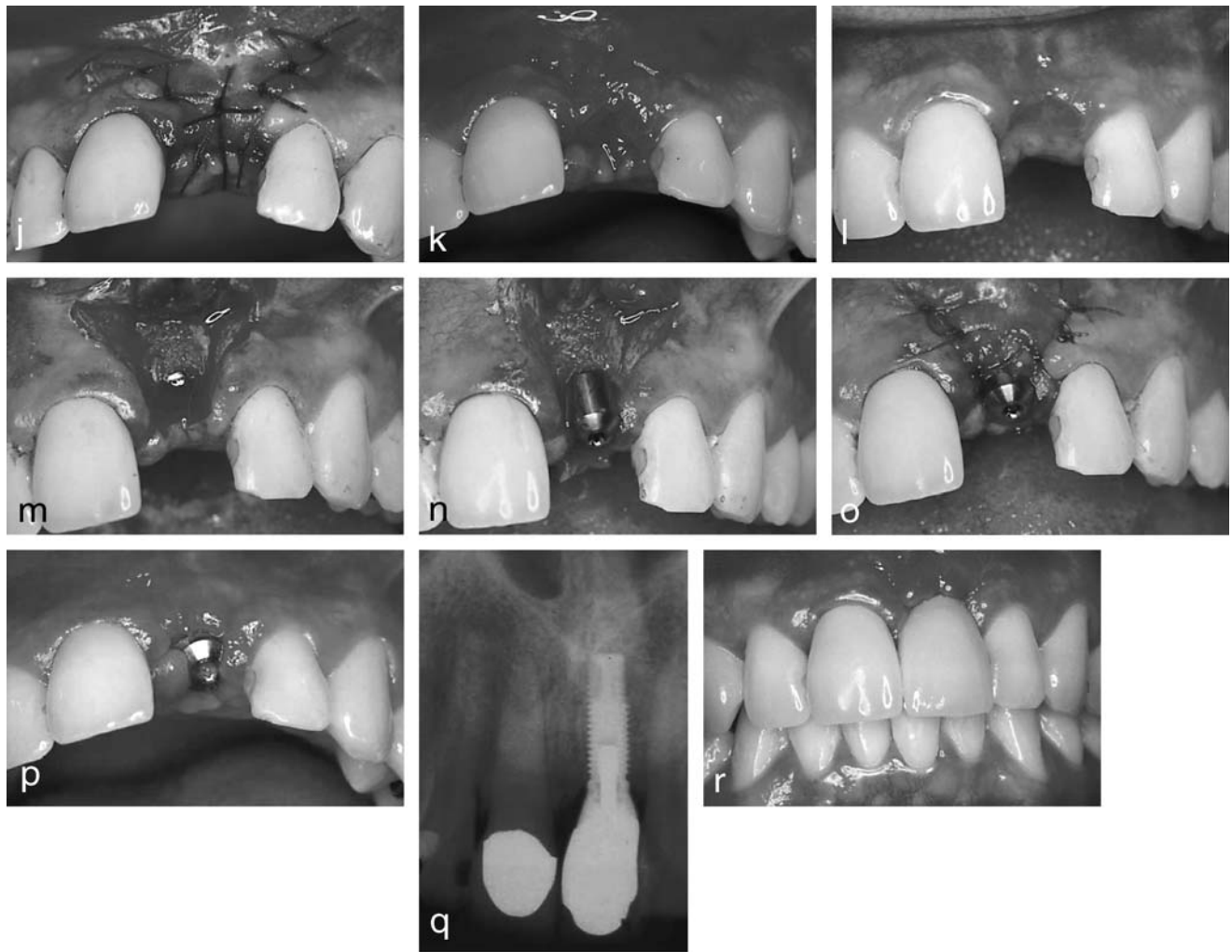


FIGURE 2. Continued.

nique involves reduction of the condemned tooth below the level of the free gingival margin followed by 2 to 3 weeks of soft tissue healing. The gingival tissues proliferate, covering the remaining tooth root with keratinized gingiva, after which a flap can be elevated, the remaining root extracted, and an implant immediately placed. Some distinct advantages of this technique include complete primary coverage of the implant at stage 1 surgery, reduced treatment time, and cost to the patient, when compared with other socket preservation techniques. Drawbacks

include the possibility of damaging the crestal bone during extraction and the presence of fenestration or dehiscence defects, which would necessitate further grafting procedures.

#### *Soft Tissue Grafting*

Soft tissue grafting procedures have been used successfully for many years in periodontics and oral surgery in resolving recession defects around natural teeth and augmenting alveolar ridge contours.<sup>59–65</sup> Many of these procedures can be translated directly to peri-implant tissue modification, although scientific evidence

of longitudinal success and stability has yet to be established. The following procedures are designed for use in augmentation of edentulous ridge defects: the roll technique,<sup>96</sup> pouch procedures,<sup>2,3,61,62,68,93,97–104</sup> interpositional grafts,<sup>105–108</sup> onlay grafts,<sup>2,109,110</sup> and combination grafts. These techniques might differ in name and approach; however, when properly utilized in their indicated clinical situations, they can provide significant gains in soft tissue volume and contour that can contribute to the esthetic management of implant sites.



### *Papilla Regeneration Technique*

This technique was developed to correct deficient interproximal papillae contours between multiple implants at stage 2 surgery and is primarily an esthetically driven procedure. The procedure involves elevating a full thickness mucoperiosteal flap at the palatal or lingual extent of the implant cover screws. Vertical releasing incisions are used to aid in flap elevation, and the incisions are made so as to exclude the papillary tissue of adjacent natural teeth. Semilunar, beveled incisions are then created in the buccal flap extending toward each abutment, beginning with the distal aspect of the most mesially located implant. The pedicles are secured between the abutments using tension-free suturing and are allowed to heal for 4 to 6 weeks before final restoration.

### *Tissue Punch (Flapless) Technique*

This technique was developed for minimally invasive stage 1 implant placement and stage 2 implant exposure in the presence of abundant keratinized gingiva or previously augmented sites. It has the benefits of maintaining existing soft tissue and papilla contours, and it can be used to create pressure on the surrounding peri-implant tissues with a healing abutment or provisional crown in developing an ideal emergence profile, which is especially useful in anterior esthetic regions. Limitations include inadequate preoperative keratinized gingiva and the presence of gingival defects that require additional soft tissue grafting at stage 2 surgery.<sup>89</sup>

### *Titanium Papillary Insert*

The titanium papillary insert (TPI) is composed of a pyramidal-

shaped, polished titanium core 2 to 3 mm in height, 1 mm in width, and 3 mm in length. It was designed as foundational support for the development of interimplant papillae; it yields immediate results, and it is thought to allow for a predictable and stable esthetic outcome. The TPI is placed between adjacent implants, and it requires more than 3 mm of interimplant distance to ensure sufficient blood supply. A 1-mm diameter twist drill is used to create a 5-mm deep osteotomy, then the insert is screwed in with cotton pliers until it is flush with the alveolar crest. Primary soft tissue closure is obtained and healing ensues.<sup>111</sup> This unique procedure appears to produce favorable results in limited cases, and it may prove useful in recreating the elusive interimplant papilla; however, it is not readily available, and long-term results have not been substantiated.

### *Treatment sequencing*

At the time of implant placement or abutment connection, the previously discussed soft tissue modification techniques are employed. Gaining keratinized tissue at stage 2 implant surgery is commonly performed in nonesthetic areas using an apically positioned flap and allowing crestal healing to progress via secondary intention.<sup>112,113</sup> Planning soft tissue augmentation at implantation or uncovering has the benefit of eliminating separate surgical procedures and decreasing overall treatment time. Additionally, the underlying bony contours and adequacy of alveolar support can be evaluated for the need of modification or augmentation, which may be concomitantly performed. In addition to those procedures previously discussed, several other techniques merit review.

### *Immediate Implant Placement*

Using techniques of immediate implant placement eliminates the need for preplacement hard and soft tissue augmentation or ridge preservation when there is sufficient alveolar support around the tooth to be replaced (Figure 3). Evidence exists demonstrating immediate implant placement success with the preservation of existing alveolar bone and supporting structures.<sup>85,114–117</sup> Many clinicians prefer to use membranes to cover immediately placed implants, creating difficulties in primary flap adaptation at a site that may already lack adequate keratinized tissues. Most techniques advocate coronal advancement of the buccal flap through periosteal releasing incisions to achieve primary closure, which often decreases the zone of keratinized tissue and displaces the mucogingival junction in the area of the implant. These difficulties often require secondary grafting procedures at stage 2 surgery to correct. It may be obviated by the use of grafting procedures concurrently with stage 1 surgery.<sup>118</sup>

### *Postplacement soft tissue modification*

All esthetic tissue management should be completed before seating of the definitive restoration inasmuch postplacement esthetic management is severely limited.<sup>36</sup> Traditional periodontal soft tissue grafting procedures do not fare well when one attempts to cover a nonvital implant surface, because the tissues do not respond as they do around vital teeth. Postplacement soft tissue modification in this context therefore consists primarily of hard tissue regenerative procedures or hard or soft tissue resective pro-

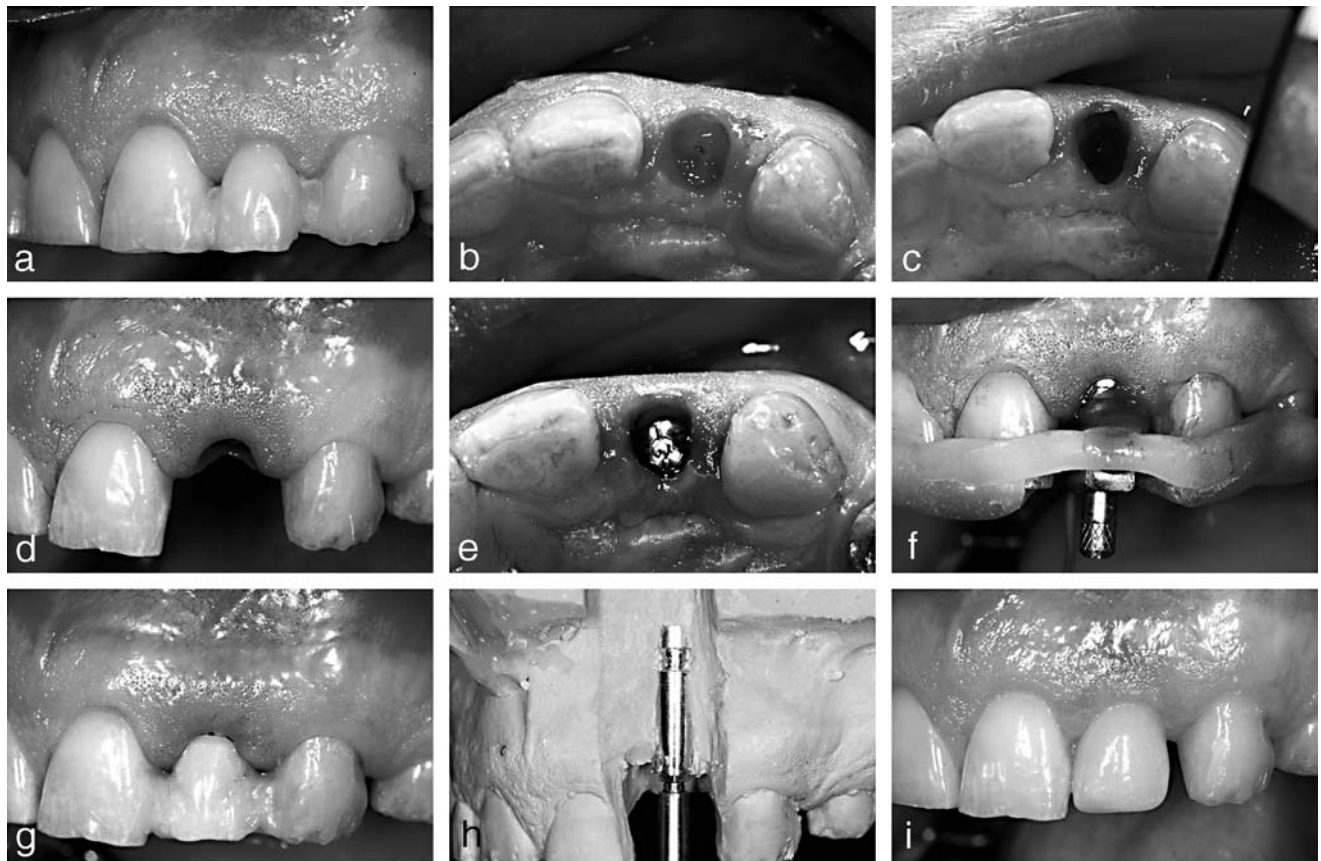


FIGURE 3. Immediate implant placement. (a) Tooth #10 has fractured apical to the CEJ. The crown was bonded to the adjacent teeth by the referring dentist. (b) Occlusal view of the remaining root in the socket. (c) The tooth was atraumatically extracted, preserving the labial bony plate. (d) Endosseous implant placed (occlusal view). (e) Endosseous implant placed (facial view). (f) Indexing of the implant was performed. (g) The crown was rebonded as a temporary restoration. (h) The replicated cast used for crown fabrication. (i) Final view after 6 months. Note the preservation of the interproximal papilla.

cedures in an attempt to restore the health of peri-implant tissues.

#### *Vertical Defects*

To correct vertical bone defects around existing implants, a full thickness mucoperiosteal flap is elevated and the defect is curetted to remove any soft tissue, while ensuring that the implant surface remains untouched. If the extent of bone loss is less than 2 mm, the defect can be grafted with autogenous bone or it can be removed through osteoplasty, converting the defect into a horizontal deficiency. Osteoplasty in this instance is more predictable. Vertical defects larger than 2 mm are generally grafted, unless it

represents one half or more of the total implant height, in which case it is removed. Another option in treating mesial or distal vertical defects involves creating a wedge into the bone several millimeters away from the implant body. This creates bone compression against the implant surface and resolves the vertical defect, while the distant site heals uneventfully. Similarly, buccal or lingual defects can be corrected by using a blunt instrument and mallet to compress the buccal or lingual bone against the implant body. If the defect is greater than 2 mm in depth and extends over 25% of the implant circumference, it is suggested that a barrier

membrane be placed over the grafted area.<sup>119</sup>

#### *Horizontal Defects*

The most predictable method of treating horizontal implant defects is through reduction of the soft tissue thickness via apical repositioning. If threads or a rough surface are present above the bone, a white stone and rubber wheel are employed to smooth the area, thus limiting plaque accumulation. If the horizontal defect extends beyond one half of the implant body, it should be removed. Another option is to attempt regenerative procedures using autogenous bone and a bar-

rier membrane to gain height around the implant fixture. This is indicated only in single- or multiple-implant fixed restorations or when additional bone-to-implant interface is required to withstand the forces exerted on the prosthesis.<sup>119</sup>

## CONCLUSIONS

Many procedures exist to augment soft tissue contours around dental implants, although no effort to date has been made to organize this body of literature into a coherent treatment approach. As such, the term "implant plastic surgery" is appropriate in describing this loosely connected collection of principles and techniques, which facilitate future development of this subspecialty of implantology. The table summarizes the various implant plastic surgery procedures recommended at different stages of implant placement.

It is evident that little scientific literature exists in this area and that there is a strong need for further research in establishing the long-term success and stability of the many techniques discussed here, as they relate to implant soft tissue modification. To date, most of the evidence in this area is based on clinical opinion and isolated case reports rather than well-controlled, longitudinal investigations from which sound treatment recommendations can be formulated. From existent evidence concerning soft tissue modification around natural teeth and the evidence presented here, implant plastic surgery should emerge as a distinct subspecialty of implantology that will continue to develop and expand as dental implants are accepted as a routine treatment for the restoration of function and esthetics.

TABLE Implant plastic surgery procedures at different stages of treatment	
Preplacement procedures	Ridge (socket) preservation – Bio-Col technique – Spontaneous in situ gingival augmentation – Modified graft preservation Forced orthodontic eruption Controlled tissue expansion Soft tissue grafting
Stage 1 and 2 procedures	Immediate implant placement Papilla regeneration techniques Tissue punch technique Titanium papillary insert
Postplacement procedures	Vertical defects: – Osteoplasty – Guided tissue regeneration – Soft tissue graft Horizontal defects: – Osteoplasty – Guided tissue regeneration – Apically repositioned flap

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