Surgical Veneer Grafting

Compensation for Natural Labial Plate Remodeling After Immediate Implant Placement

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Abstract
Contemporary implant therapy aims to provide highly esthetic and predictable treatment outcomes while decreasing treatment duration and complexity. The clinician must therefore be cognizant of circumstances with a predisposition toward esthetic outcomes and treatment plan accordingly. Preservation of the surrounding hard and soft tissues associated with an immediate postextraction socket implant to replace a nonrestorable tooth in the esthetic zone is one of the greatest challenges facing the dental team. Several studies have documented the biologic and esthetic benefits of bone graft containment with either a custom healing abutment or provisional restoration. Because esthetic complications increase in patients with a thin periodontal phenotype, additional surgical intervention may be necessary to enhance the surrounding soft tissue architecture before, during, or after implant placement. A combination of bone graft and connective tissue graft can help in overbuilding the socket site and achieve a sustainable and predictable esthetic outcome, especially in patients with a thin gingival phenotype. A case report of a hopeless maxillary left central incisor in a patient with a thin periodontal phenotype illustrates this new surgical and prosthetic approach. Clinical, radiological, and esthetic parameters were recorded to evaluate primary treatment outcomes.

Key Words: extraction socket, implant surgery, single-tooth implants, overbuilding of the socket site, bone socket graft, soft tissue graft

Learning Objectives
After reading this article, the participant should be able to:

1. Discuss current recommendations associated with placing an immediate postextraction socket implant in the esthetic zone.

2. Appreciate the surgical veneer grafting technique, including dual-zone bone grafting with an epithelial connective tissue graft, and its potential advantages.

3. Understand current surgical techniques to assist in predictable treatment outcomes with immediate implants.

Disclosures: The authors did not report any disclosures.
Introduction
The concept of immediate single-tooth implant replacement in a fresh extraction socket in the esthetic zone with placement of an immediate provisional restoration was introduced in 1998. Since that time, it has become accepted as one of the treatments of choice in esthetic situations. Treatment procedures are condensed into fewer patient appointments, reducing overall treatment time and increasing patient comfort. In the past decade, many studies have described this approach as a predictable procedure, with survival rates similar to that of delayed implant placement with or without provisional restoration and bone grafting.

Esthetic Ramifications of Immediate Implants
The esthetic ramifications of immediate implants, especially for single anterior teeth in the esthetic zone, are of increasing significance. The actual challenge for clinicians utilizing immediate anterior implant placement protocols is no longer only to achieve osseointegration, the rates of which are extremely high, but also to improve protocols that allow for less traumatic, more time-efficient, and highly predictable esthetic treatment outcomes in the more demanding anterior region.

Morphological Changes
In fact, while tooth replacement with immediate implant placement and provisionalization (IIPP) has been shown to be a successful procedure, slight facial gingival recession and buccolingual contour shrinkage has been reported following the first year of prosthetic function. Studies show that changes in the morphology of the hard (bone) and soft tissue surrounding an implant are normal phenomena after dental extraction and implant placement. Several studies have documented the biologic and esthetic benefits of bone graft containment with either a custom healing abutment or provisional restoration. The resorption of a postextraction socket is the direct result of trauma to the bone-periodontal ligament (PDL)-tooth complex. Bundle bone born from a functionally loaded PDL is lost following extraction and leads to an almost certain remodeling of residual buccofacial tissues. In any case, the complete maintenance of ridge volume after tooth extraction with preservation techniques utilizing currently available materials as a primary prevention is not yet predictable. Moreover, a study with 92 cases found that 87% had a buccal plate thinner than 1 mm. The question, therefore, is whether by thickening the soft tissue with a soft tissue graft, the loss of bone volume in the labial area can be compensated for and maintained over time. Accordingly, it has been stated that one can expect there to be at least 1 mm shrinkage of the buccal facial gingiva following immediate implant placement, which possibly can worsen in thin gingival biotypes. It is clear that the thickness of peri-implant mucosal tissues affects abutment material selection in relation to the gingival color, all of which must be in balance to achieve a predictable and sustainable esthetic outcome.

Requisites for Esthetic Success
Today, for an anterior implant restoration to succeed esthetically, it must be supported by natural-looking gingival tissue in harmony with the adjacent dentition. This means that the natural appearance of a restoration and the stability of the surrounding gingival architecture are pivotal for a successful treatment outcome. Moreover, for a particular procedure, such as immediate implant placement and loading, the peri-implant gingival tissue condition is highly influenced by the position, quality, and thickness of the bone and gingival tissue, which must be assessed before treatment.

The trend in this area of research is moving toward the idea that increasing peri-implant soft tissue thickness increases the substrate’s color-masking ability and bone stability. Areas of low esthetic value (molars and premolars) might be of less concern; however, a recession and a ridge collapse can result in an esthetic issue in areas such as the anterior maxilla. Compromised esthetics may be compensated by a low smile line and thick gingival biotype when treating single-tooth cases, but when implant therapy is provided to patients with high esthetic risk profiles, high esthetic demands, and thin gingival biotype, the risk for an esthetic failure is exponentially increased. According to these considerations and to the fact that in certain patients, such as those with a thin biotype, the esthetic outcome of an implant-supported restoration is mainly dependent on the soft tissue, both in terms of volume and having a natural appearance that is in harmony with the adjacent dentition. The case report presented in this article illustrates an approach that combines dual-zone bone grafting together with a connective tissue graft. The authors have named this protocol the surgical veneer grafting (SVG) technique.
**Surgical- and Restorative-Specific SVG Protocol**

The goal is to limit the buccal contour change after the extraction and potentially augment the thickness of the peri-implant soft tissues coronal to the implant-abutment interface. Evaluation of the biological width of the tooth to be extracted and of the adjacent teeth is also recommended. This approach involves atraumatic tooth removal without flap elevation, maintaining the periosteal blood supply to the labial bone plate.

The extraction socket has to be debrided thoroughly and the implant should be placed just slightly palatally, according to the cone beam computed tomography (CBCT) evaluation. It should be 3 to 4 mm apical to the free gingival margin (FGM) and at least 1.5 mm from the adjacent teeth to avoid dehiscence of the labial plate and loss of attachment in the adjacent teeth, and to allow sufficient vertical distance for the development of the proper emergence profile of the prosthetic components. Primary stability is obtained due to the implant’s geometry and confirmed with hand torque (at least 35 Ncm) to facilitate immediate full-contour provisional restoration. Palatal implant placement in anterior extraction sockets also commonly results in a lack of facial bone/implant contact, referred to as the gap.

Depending on the thickness and the quality of the palatal tissue, the connective tissue graft is harvested using a first intention or second intention healing technique. For this protocol, it is necessary to have 1 mm thickness of dense connective tissue graft.

Quality and thickness of the palatal tissue is determined by needle penetration during anesthesia. The best donor site area is distal to the second bicuspid and the first molar. A dual-zone bone graft (homologous) is placed in the gap and serves as a scaffold to maintain hard and soft tissue volume as well as blood clotting for initial healing. Finally, a screw-retained provisional restoration is positioned, acting as a prosthetic socket-sealing device, to protect, contain, and maintain the blood clot and bone graft material during the healing phase of the treatment and to mechanically support the adjacent peri-implant soft tissues.
CE—CLINICAL APPLICATION

Case Report

Patient Complaint and Evaluation

A 43-year-old female presented with pain and evidence of a palatal fracture to the maxillary left central incisor, revealed in the periapical radiograph and CBCT evaluation (Figs 1a-2b).

Preoperative antibiotics (amoxicillin, 2 g) were given orally one hour prior to surgery. After the administration of local anesthesia, sharp dissection of the supracrestal fibers was performed with a 15c blade and the root was removed atraumatically with a periotome and extraction forceps with rotational movements, without elevating any flaps.

After an accurate socket debridement with a surgical excavator (Figs 3a-3c), a 3.7-mm diameter tapered design and textured surface implant (Tapered Screw-Vent, Zimmer; Warsaw, IN) was placed (Fig 4), following the indications given by the CBCT evaluation and the adjacent teeth, toward the palatal aspect of the extraction socket to a depth of 4 mm from the FGM. Flap elevation was not necessary and the buccal bone plate was intact after tooth removal. A torque value of 40 Ncm was achieved upon implant placement to permit immediate provisional restoration, and the screw-hole axis was at the level of the cingulum of the adjacent teeth (Fig 5).

Figures 1a-1c: Patient with crowned maxillary left central incisors, which had a root palatal fracture evidenced by the periapical radiograph and the CBCT scan.

Figures 2a & 2b: Tissue biotype, whether it is evaluated visually or with a periodontal probe, is indicative of the thickness of the marginal tissues. This case presented with a scalloped gingival architecture with a thin tissue biotype.

Figures 3a-3c: Minimally invasive extraction of the maxillary left central incisor root, avoiding raising a flap and preserving as much of the surrounding hard and soft tissues as possible. The socket was then carefully debrided before implant placement.
Figure 4: An internal connection implant was placed with the implant shoulder 4 mm apical to the FGM.

Figure 5: Once the implant was positioned, the marginal residual gap measured 3 to 4 mm.

Provisional Restoration

A customized provisional sandblasted and silaned titanium cylinder was tightened by hand and sealed with blue wax at the mouth of the screw (Fig 6a). The prefabricated provisional was filled with acrylic resin (Palavit and Paladur, Heraeus Kulzer GmbH; Hanau, Germany), seated into the abutment after protecting the socket with rubber dam in the proper facial and vertical positions, and allowed to set prior to removal.

It is crucial to place enough acrylic resin material to secure the abutment mechanically and chemically to the temporary cylinder. However, this must be done without engaging the undercut regions of the proximal contact areas, because doing so would make removal of the provisional restoration extremely difficult and could potentially damage the implant’s stability.

The relined provisional restoration was then disinfected and screwed into a laboratory analog, the proximal contact areas were marked with a dark pencil, and the subgingival contours were recreated with flowable composite resin. The contour of the provisional restoration was shaped with burs in a low-speed straight handpiece. The marked proximal contact areas must be respected. Enough resin must be left palatally to keep the provisional restoration intact and stable to the titanium abutment, avoiding any possibility of poor fit.

Finally, the provisional restoration must be smoothed and polished, first using rubber-polishing instruments mounted on a straight handpiece and then using pumice stone. The surface colorants should be applied only to the supragingival area of the provisional restoration to avoid interference with healing of soft tissues (Figs 6b-6d). Smoothing the provisional restoration is one of the most important steps in the entire treatment, to promote adhesion of the epithelium in the early stages of wound healing.

The provisional restoration should be fabricated first, prior to placement of the bone and connective tissue graft material, since the graft material must remain intact and uncontaminated during the procedure.25

Studies show that changes in the morphology of the hard (bone) and soft tissue surrounding an implant are normal phenomena after dental extraction and implant placement.
Figures 6a-6d: A prefabricated provisional cylinder is adapted to the edentulous and interocclusal space. The occlusal surface is open in order to check for passive fit with the temporary titanium abutment and to allow unscrewing following hardening of the acrylic resin. The subgingival contour of the provisional crown is concave to provide more space for the connective tissue, while the area in contact with the gingival margin is made flat to avoid putting pressure on the facial gingival support. The subgingival contours of the provisional crown were reestablished using a flowable composite resin.
Figures 7a-7g: Prior to harvesting the graft, it is suggested to assess the thickness of the palatal donor site and also the thickness of the gingiva around the tooth to be extracted with the use of an endodontic wire. Finally, the amount of tissue to be harvested, which is related to the root profile of the site to be augmented, must be evaluated. The tissue is harvested with a 15c scalpel. After being deepithelialized chairside, the connective tissue is allocated inside the partial thickness envelope flap and fixed intramurally with three single suture points using a 6.0 resorbable suture.
The final phase was to pack the bone graft material into the remaining gap. To accomplish this, a narrow, flat-contoured healing abutment was screwed into the implant after removing the provisional restoration. A homologous cancellous bone graft material (Puros, Zimmer) was used to pack the bone particles up to the gingival margin, giving the blood time to incorporate within the particles. The abutment should be tall and narrow enough to allow the bone graft to be placed and packed against it with a dedicated instrument, to the most coronal aspect of the gingival margin, maximizing the amount of graft material that can be placed into the labial gap (Fig 8a). The flat profile-healing abutment was then removed, leaving the bone graft material undisturbed (Fig 8b) and the provisional restoration was repositioned and tightened with 20 Ncm torque. The provisional restoration had subgingival contours that enabled it to support the soft tissue profile and help protect the blood clot as well as the bone and the connective tissue graft. While screwing in the provisional restoration, cleared from dynamic occlusion, excess bone graft material was removed with a periodontal probe to the level of the gingival margin and a postoperative x-ray was taken (Figs 9a & 9b).

**Figures 8a & 8b:** The marginal gap is filled with small-particle bone graft. The dual-zone bone grafting (placement of the bone graft not only in the gap between the implant and the labial bony plate but also in the zone above the implant-abutment junction) provides support and volume to the hard and soft tissues.

**Figures 9a & 9b:** Occlusal and profile views of the screw-retained provisional restoration in place the day of surgery. Note the overbuilding of the socket site.
Postoperative

The patient was instructed to rinse three times a day for one minute with chlorhexidine digluconate (0.12%) and to avoid removing plaque by mechanical means at the surgical sites for three weeks. Sutures were removed three weeks postoperatively and the patient was asked to commence plaque removal at the provisional with a soft-bristled toothbrush and to rinse twice a day for one minute for an additional month. She also was instructed to follow a semi-liquid diet for the first week and then soft foods for the next two months.

The patient returned for regular follow-up appointments; at the four-month visit a periapical digital film was taken to verify healing (Fig 10a). The provisional restoration was removed at that time and a healthy prosthetic running room was noted (Fig 10b). Subsequently, an optical digital impression was taken, capturing the subgingival soft tissue profile by scanning the provisional restoration contour chairside (Figs 11a-11c). Using CAD/CAM technology, the dental laboratory was able to design, project, and fabricate a screw-retained layered zirconia crown to be constructed with titanium base (Figs 11d-12b). An 18-month intraoral occlusal view (Fig 13) and 24-month CBCT scan (Fig 14) show excellent bone levels around the implant, especially in the facial plate interface. At every follow-up appointment, the periodontal health surrounding the restoration was controlled by the probing depth evaluation.

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Figures 11a-11e: CAD/CAM technology was used to duplicate the prosthetic running room in the design and production of the zirconia substructure on titanium base. CAD software provides total control during the prosthetic design. Opposing dentition, restorative volume, soft tissue contour, and screw-hole axis are all shown in the same image, permitting precise design of the zirconia abutment.
Figures 12a & 12b: Definitive prosthetic restoration in place. The definitive crown is screw-retained.
(Laboratory work by Luca and Matteo Dondi, Bologna, Italy)

Figure 13: Intraoral occlusal view at 18 months shows not only integration of the facial contour of the implant site compared with the adjacent teeth, but also stability of the ridge contour over time.

Figure 14: CBCT scan taken 24 months after surgery. Note how the overbuilding of the socket worked. The amount and stability of the peri-implant marginal bone is optimal.
Discussion

Single-implant treatment has been found to be highly predictable in terms of implant survival rates. Classical parameters seem little affected by the timing of implant placement relative to tooth extraction and variations in the surgical and restorative procedures. To decrease the duration of patients’ surgical phase, postextraction socket implants were used. Postextraction socket implant replacement survival rates are equivalent to those of delayed placement, while decreasing the number of clinical procedures. In addition, bone grafting is not a requirement for immediate implants, even those with large labial gaps, to achieve osseointegration of the implant.

Dual-Zone Concept

In 2012, Chu and colleagues evaluated the buccolingual contour change in immediate implant placement and provisionalization cases and introduced the dual-zone concept. This concept, linked to the achievement of esthetic success, demonstrates why it is critical in the early phases to take not only buccal photographic references but also occlusal views to begin evaluating what must be done to make the definitive restoration blend in with adjacent teeth.

The dual-zone protocol suggests to bone graft the residual gap up to the gingival margin at the time of the placement; this would limit the changes in the buccal contour and potentially enhance the thickness of the peri-implant soft tissue, and, therefore, the overall esthetics of the final restoration. The study’s conclusion was that placing a bone graft into the residual labial gap around an anterior implant in a postextraction socket is helpful in limiting the amount of faciopalatal contour change. The study’s authors postulated that to achieve predictable esthetic success, the critical clinical keys that must be respected are:

- Atraumatic tooth removal without flap elevation
- Placement of a dual-zone (bone and tissue zone) bone graft in the residual gap around an immediate fresh extraction socket implant
- A screw-retained provisional restoration acting as a prosthetic socket seal device.

Other Studies

Araújo and colleagues showed that xenograft particulate material can be incorporated and encapsulated into the peri-implant mucosal tissues with bone grafting and immediate implant placement. These particles may act as benign foreign bodies when a localized inflammatory response is absent. This volume increase can create a masking effect that would overcome gray-colored abutments and enhance the esthetic outcome.

What was still unknown were the effects of connective tissue grafting alone on the peri-implant soft tissue dimensions. Chu and colleagues also state that esthetic complications increase in patients with a thin periodontal phenotype; therefore, an additional surgical intervention may be required to improve the surrounding soft tissue architecture before, during, or after implant placement.

The remaining question is whether it is necessary to place a bone graft and a connective tissue graft in association with a provisional restoration at the time of implant placement. In some cases (i.e., for patients with a thick biotype) just one type of graft may suffice, with the understanding that not all procedures are 100% successful (risks being loss or infection of the graft).

A study by Grander comparing three-dimensional contour change with connective tissue grafting (12 patients) and without it (12 patients) showed that only 1.1 mm of facial tissue change occurred without the graft and 0.3 mm of facial tissue change occurred with the graft, measured at 3 mm from the FGM, if an implant was placed with only a healing abutment and without flap elevation. Neither a bone graft nor provisional restoration was placed in this group of patients. This is considerably less change than was presented in several classic studies with flap elevation and intact sockets.

Linkevicius and colleagues affirmed that tissue thickness was shown to affect crestal bone stability around implants, indicating that initially thin mucosal tissues can cause crestal bone loss after implant placement at one year in situ. It has also been proposed that a minimum of 3 mm of peri-implant mucosa is required for a stable epithelial connective tissue attachment to form. This soft tissue extension is usually referred to as the biologic width around implants, and it serves as a protective mechanism for the underlying bone.

Kan and Rungcharassaeng implied that bilaminar subepithelial connective tissue graft (SCTG) in conjunction with immediate tooth replacement procedures is a technique-sensitive procedure with inherent risks that must not be overlooked; inadvertent thinning or perforation of the flap or partial exposure of the SCTG can result in partial or complete necrosis of the SCTG. In this study, 2 of 10 patients experienced connective tissue graft necrosis. However, the authors also stated that IIPP in conjunction with a connective tissue graft is more likely to result in sufficient peri-implant tissue thickness to conceal underlying restorative materials than when performed without a connective tissue graft. The key of the surgical veneer grafting protocol presented in this article likely is the partial-thickness approach, which may help the connective tissue graft receive a higher percentage of blood supply guaranteed by the periosteum, avoiding the potential risk of necrosis. A pivotal role is played
by the tissue graft thickness: 1 mm of dense connective tissue is required to achieve less shrinkage over time, compensate the coronal bone crest remodeling, and obtain an optimal esthetic integration linked not only to the thickness, but also to the surface and the color of the adjacent tissues.

In a two-year randomized clinical trial, 47 participants were randomly assigned to the test group (immediate load postextractive implant treated with SCTG placed using the tunnel technique in the labial area) and the control group (immediate load postextractive implant treated without the connective tissue graft) with an allocation ratio of 1:1. Both groups received deproteinized bovine bone mineral in the gap. The bone graft was placed only in the bone zone, not in the tissue zone. Patients were observed at baseline, crown insertion, one-year follow-up, and two-year follow-up. At the two-year visit, the test group showed a statistically significant increase of mean KM thickness of 34.29% (0.5 mm) and a mean recession of 10.01% from the initial KM highness (0.2 mm). A statistically significant difference was also reported when comparing different gingival biotypes: thick biotypes showed minor soft tissue shrinkage and recession with respect to thin biotypes. The correlation analysis showed a direct correlation between gingival thickness and pink esthetic score, highlighting the importance of thickening soft tissues to obtain more predictable esthetic results. In fact, soft tissue changes observed, although small, were within the clinical threshold for detectable change and therefore would have esthetic implications.

In this study, the final outcomes were fairly encouraging. However, the bone graft in both groups was incorporated only on the labial aspect of the bone zone; whereas, the surgical veneer grafting protocol presented in this case report, the bone graft was packed up to the gingival margin, including in the tissue zone area. As described by Tarnow and Chu in fact, the role of the bone graft in the tissue zone plays a key role, helping to maintain the buccal palatal dimension despite the bone remodeling that occurs after tooth extraction.

It is the current authors’ opinion that this last surgical indication could enhance the final esthetic outcome even more, especially in patients with a thin biotype and scalloped architecture in the esthetic area.

Summary

In situations in which a highly esthetic outcome is important, immediate implant placement should be performed with caution, particularly if there is damage to the facial bone wall or if the tissue biotype is thin. For these reasons, this protocol should be considered a technique-sensitive procedure and cases should be selected carefully.

Use of a connective tissue graft combined with socket bony grafting at the time of immediate implant insertion in the esthetic zone is an effective treatment option to compensate for the expected loss of labial soft tissue volume and to maintain good esthetic results over time. However, to safely implement a new treatment into everyday practice, data from long-term clinical studies are required. Such data for this particular treatment are not yet available.

References


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