

Current Methods for Soft Tissue Enhancement of the Esthetic Zone

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The recent demand for esthetic dental procedures has brought about a new challenge for surgical specialists placing implants in the esthetic zone. Surgical attempts at restoration of soft tissue architecture, including marginal tissue and papilla levels, have been met with varying degrees of success and failure depending on the complexity of each clinical condition. Among the factors that limit restoration of an ideal soft tissue framework around implant restorations are the absence of a connective tissue attachment to titanium implants and their abutments and the loss of supporting alveolar bone after tooth extraction with subsequent loss of soft tissue volume and bone remodeling adjacent to dental implants.

In the case of inadequate available bone, several approaches have been developed to minimize such tissue deficits via bone grafting before or at the time of implant placement. When intact socket walls are present, immediate anterior implant placement and nonloaded provisionalization have been advocated on the basis of the clinical finding that the final definitive crown supports the gingival marginal tissues that have lost periodontal fiber attachment to the cervical root area after extraction. However, when patients present with a history of factors contributing to loss of the socket wall, such as external root resorption or root fractures, immediate provisionalization is not recommended, and other measures may become necessary. Although hard tissue augmentation procedures have been well researched and documented, soft tissue surgical techniques designed for enhancement of implant restorations in the esthetic zone have fallen short of providing a reproducible and predictable outcome that would simulate natural marginal tissue topography.

The connective tissue graft, initially advocated for soft tissue augmentation and root coverage, offers an attractive option for the improvement of the soft tissue framework around implant restorations. This article presents detailed techniques for enhancement of the soft tissue framework around implants placed in the esthetic zone using the connective tissue graft under different clinical scenarios.

Harvest of the connective tissue

Introduction of the double scalpel handle has facilitated harvest of the graft from palatal donor sites. This technique was used by the author for harvest of the connective tissue grafts shown in this article. It is briefly presented herein as an alternative approach to the original technique.

Two #15 or #15C scalpel blades are placed on the handle (Fig. 1A), which is available with interscalpel distances ranging from 1 to 3 mm, depending on the desired graft thickness. A stab incision is initiated approximately 2 to 3 mm from the palatal gingival margin opposite to the maxillary first molar (Fig. 1B). The handle is angled midway between the palatal soft tissue curvature and the underlying bone surface. A cadaver dissection study has shown that the anatomic

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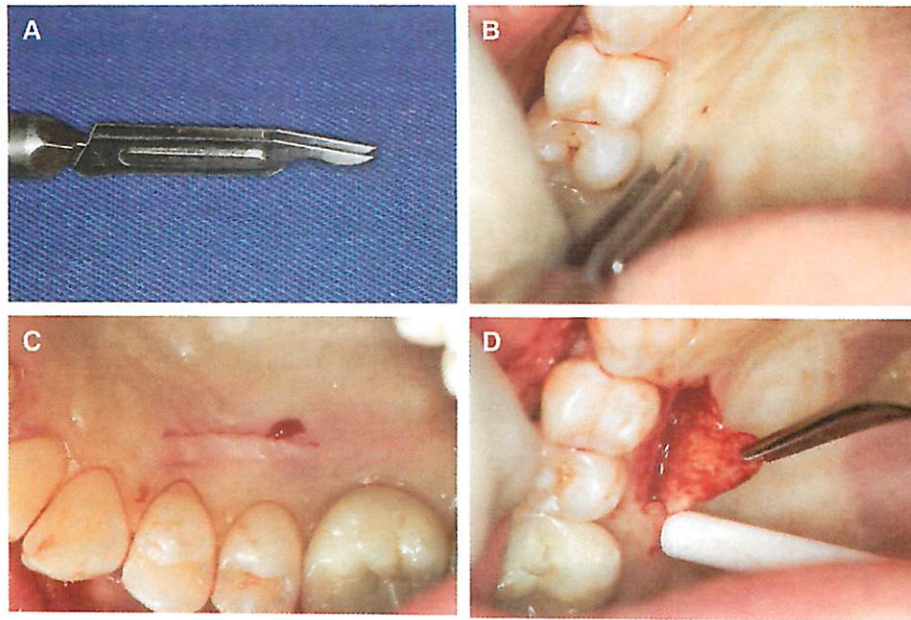


Fig. 1. (A) The double-scalpel handle with two 15C blades. (B) Initial stab incision at the palatal donor site. (C) Horizontal parallel incisions created by the double-blade scalpel. (D) Release of the connective tissue graft from the donor site.

location of the greater palatine neurovascular bundle ranges from 7 to 17 mm from the cemento–enamel junction, depending on the shape and height of the palate. The incision is carried opposite to the maxillary cuspid (Fig. 1C); then, a single #15C scalpel is used to make two vertical incisions within the created pouch, one on either end of the graft. These are connected by another horizontal incision at the apical extent of the graft, thereby releasing the connective tissue graft from the donor site (Fig. 1D).

Soft tissue enhancement for immediate implants with nonintact socket walls

When a diagnosis of root fracture or external root resorption has been made, it is prudent to anticipate an associated loss of adjacent alveolar bone. Although immediate implants may be considered in sockets with intact osseous walls, loss of bone in the form of large dehiscences or fenestrations may present a risk to successful osseointegration. Additionally, esthetic failure results if the osseous architecture is not reconstructed for support of desirable soft tissue morphology. Fig. 2A shows a patient in whom external and internal root resorption at the maxillary left central incisor resulted in alveolar bone loss due to a history of recurrent infection that has been controlled by systemic antibiotics. Tomographic evaluation indicated the presence of adequate bone volume at the apical and palatal areas for primary stabilization of an immediate implant. A flapless technique is followed, starting with an intrasulcular circumferential incision for release of the attached cervical periodontal ligament fibers. Careful atraumatic tooth extraction is a key factor in minimizing further bone loss or widening of the socket dimensions. Use of a periosteal elevator is the preferred technique. The periosteal elevator is placed at the disto-palatal or mesio-palatal line angle within the periodontal ligament space, and controlled pressure is applied in a back-and-forth motion until tooth luxation occurs. The periosteal elevator may be placed into the facial socket space for final removal of the intact tooth (Fig. 2B). In the case of more complex extractions, an alternative technique includes the use of high-speed diamond rotary instruments under copious irrigation to hollow out the root structure until a thin shell remains. This is collapsed internally with the periosteal elevator or thin elevators. A common sequela after extraction of a tooth with labial bone dehiscence is a more apical location of the gingival margin due to loss of cortical bone support (Fig. 2C). This soft tissue deficit must be corrected to avoid esthetic problems resulting from a final crown length that is not in harmony with the adjacent natural teeth.

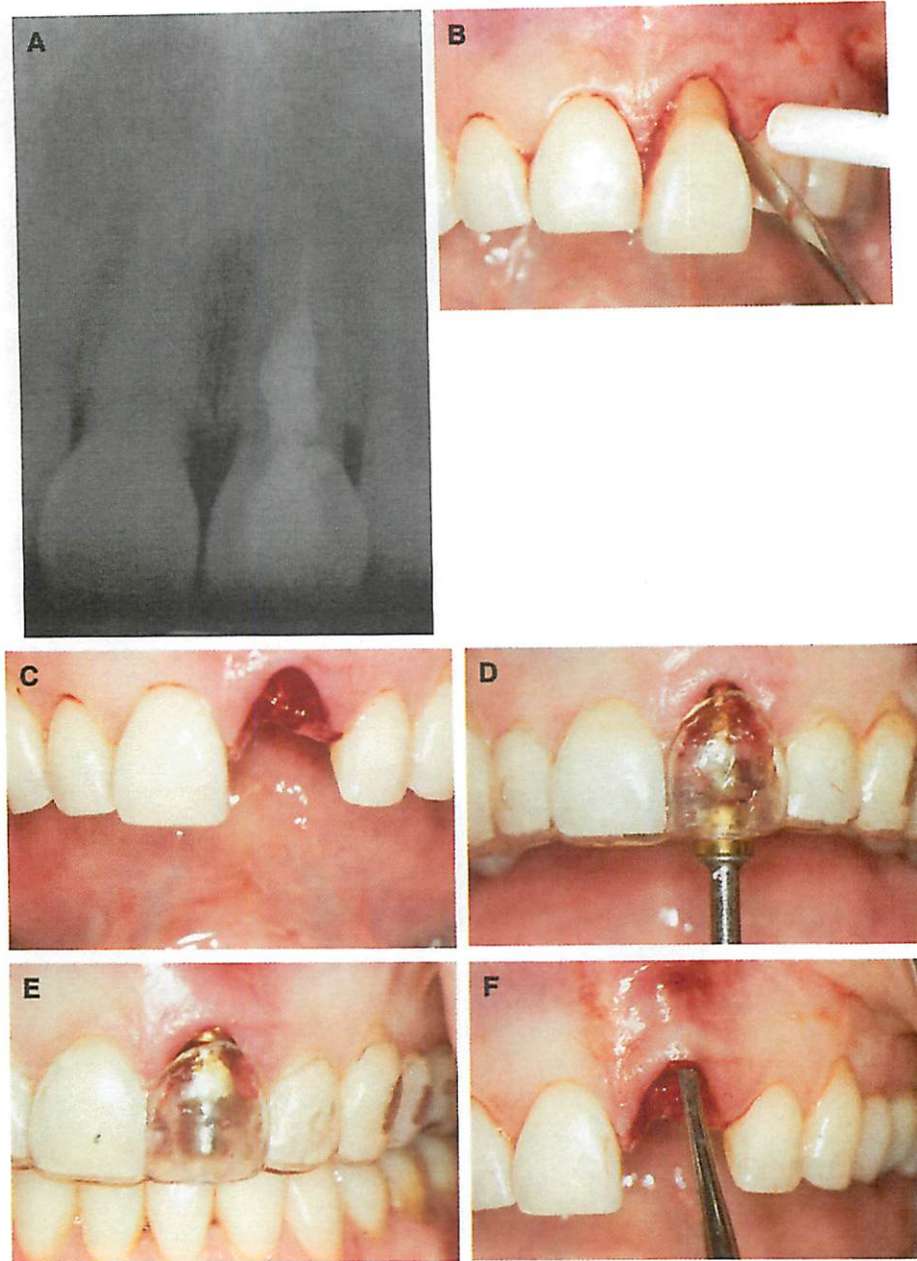


Fig. 2. (A) External and internal root resorption at maxillary left central incisor. (B) Periosteal-assisted atraumatic surgical extraction. (C) Note the more apical location of the facial gingival margin after extraction. (D) Implant site preparation using surgical template guidance. (E) The implant emergence profile is within the confines of the future restoration as verified by the template. (F) Use of a small elevator to create a minimally reflected mucoperiosteal flap.

Before implant placement, meticulous degranulation and debridement of the socket must be performed to ensure absence of attached fibrous or granulomatous tissues that may interfere with successful osseointegration. If inadequate bleeding is present, intra-marrow penetration at the palatal socket wall may be performed using a small round bur for enhancement of the blood supply and potential introduction of natural bone growth factors into the socket space.

Surgical stent guidance is necessary for ideal three-dimensional implant positioning (Fig. 2D, E) to facilitate the final restorative phase. The implant drill should be directed just palatal to the apex of the socket for a slightly more palatal bodily positioning of the implant. This achieves optimal primary stability by engaging dense palatal bone and avoids erroneous emergence of the implant in a more labial position, which is one of the most common causes of esthetic failure. The requirements for vertical placement of the implant platform vary among implant

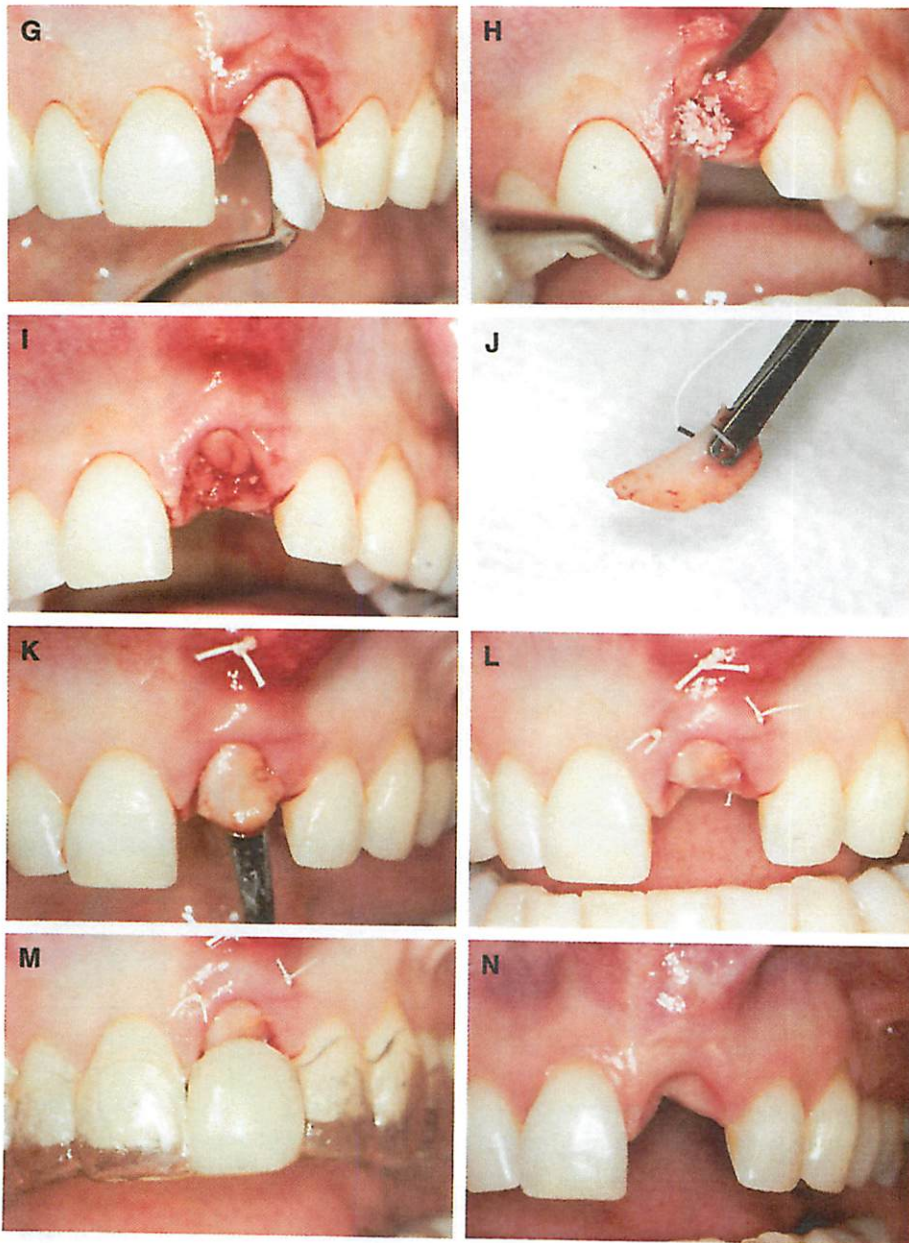


Fig. 2 (continued) (G) The resorbable collagen membrane is introduced into the labial pouch. (H) Particulate bone graft is placed into the residual socket defect. (I) The membrane is folded over the implant/bone graft area and is stabilized under the palatal soft tissues. (J) Corn suture pliers guide the needle through the connective tissue graft. (K) The graft is stabilized between the membrane and the labial soft tissues. (L) The socket is sealed with the connective tissue graft. (M) The natural crown is used as a temporary tooth. (N) Ideal soft tissue topography is reproduced at facial gingival margin and papillae in harmony with adjacent soft tissue levels.

systems; however, platform placement approximately 2.5 to 3 mm apical to the anticipated future facial gingival margin is considered optimal for two-stage implant systems. Although the remaining residual socket defect dimensions may not pose a risk to successful osseointegration, esthetic failure occurs if inadequate hard tissue is present for support of the labial soft tissues at the dehiscence defect. Guided bone regeneration with a resorbable collagen barrier membrane may be necessary.

A conservative mucoperiosteal reflection is performed by introducing a small periosteal elevator through the socket opening. A minimal dissection is carried just beyond the labial dehiscence bone margins (Fig. 2F) to provide a rest for the barrier membrane. Larger dissection

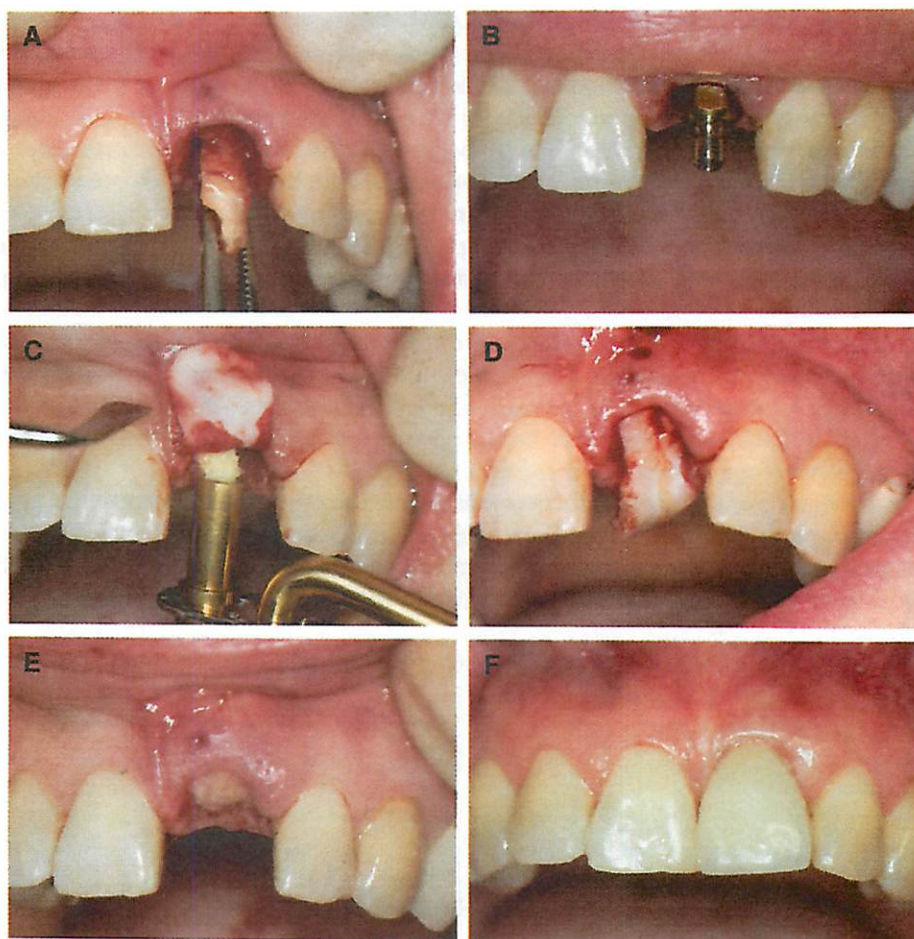


Fig. 3. (A) Extraction of the vertically fractured root at left central incisor. (B) Immediate implant placement with an optimal three dimensional angulation. (C) The resorbable collagen membrane is folded back to allow placement of the bone graft. (D) The connective tissue graft is introduced between the membrane and the labial soft tissues. (E) Complete coverage of the area of guided bone regeneration by the connective tissue graft. (F) The final restoration with an ideal soft tissue profile.

should be avoided to maintain periosteal blood supply to the delicate remaining intact portions of the labial cortical plate. A minimum of half the labial plate must be intact for application of this technique. A similar reflection is performed as necessary for membrane stabilization at the palatal aspect. The collagen membrane is trimmed to follow the labial, occlusal, and palatal bone anatomy and is introduced between the labial cortex and the labial soft tissues to rest passively on the intact bone margins of the dehiscence defect (Fig. 2G). The occlusal and palatal extension of the membrane is gently turned labially while particulate bone graft material is placed to fill the residual socket defect and rebuild the lost portion of the labial socket wall (Fig. 2H). The membrane extension is passed over the socket opening so the edges rest under the palatal soft tissues on the intact palatal bone, thereby containing the grafted material circumferentially around the implant (Fig. 2I). Although this approach offers the potential for improvement of bone volume around the implant, soft tissue augmentation is necessary for socket seal and for repair of the earlier recession associated with extraction and for circumferential support of the marginal tissues. The connective tissue graft is harvested from the palate as earlier described and used for the aforementioned purposes using vertical mattress sutures at the labial and palatal apical extents of the created tissue envelopes. A small elevator is placed between the labial soft tissues and the barrier membrane to guide the suture needle into the intervening space without disturbing the membrane position.

Corn suture pliers are used to introduce the suture through one end of the tissue graft (Fig. 2J), and the needle is passed back through the socket opening to guide the connective tissue

into the labial pouch and stabilize it on the labial aspect (Fig. 2K). A similar approach is followed to stabilize the graft on the palatal side. Additional sutures may be placed as necessary for socket seal and for complete coverage of the underlying membrane and for support of the marginal soft tissues circumferentially (Fig. 2L). If a removable partial denture is not provided by the restorative dentist, the natural crown portion of the extracted tooth may be used for provisionalization. This can be secured with composite resin bonding inside a vacuum-formed Essix-type clear appliance. This is fabricated from the pre-extraction cast and delivered as a temporary removable prosthesis until initial healing occurs (Fig. 2M). A removable partial denture with an ovate pontic design is later delivered and modified as necessary by the restorative dentist to create and maintain ideal marginal soft tissue anatomy before second-stage surgery (Fig. 2N). The ovate pontic design is critical to the final esthetic outcome, and its use further facilitates implant uncover surgery, where a conservative punch-type incision may be performed within the created soft tissue concavity at the expense of the palatal tissues. A fixed provisional implant restoration is recommended at this stage because it may be modified to further enhance the soft tissue topography before placement of the final restoration.

Figs. 3A to 4E demonstrate clinical cases where soft tissue enhancement around single maxillary anterior implant restorations has been achieved using the described technique. In Fig. 4D, the use of this connective tissue graft technique has helped eliminate the persistent soft tissue sinus tract noted at time of extraction (Fig. 4A, 4B, 4E) and implant placement.

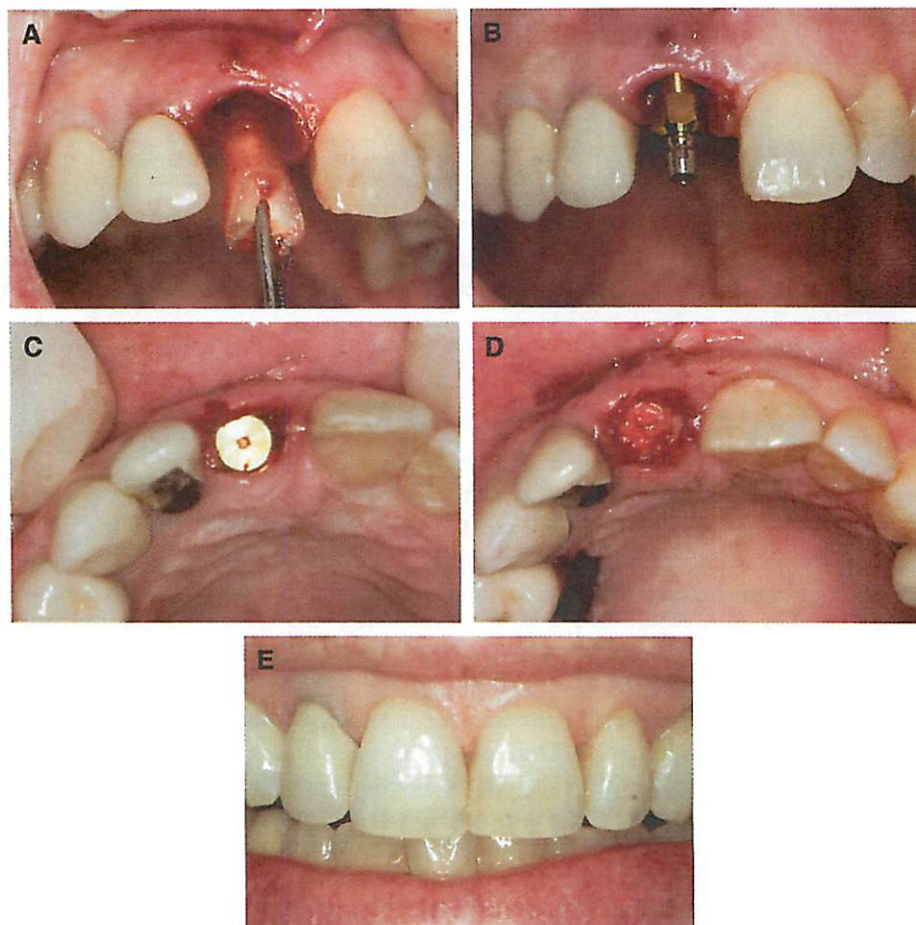


Fig. 4. (A) An obliquely fractured tooth is extracted atraumatically. (B) The immediate implant platform is approximately 3 mm below the facial gingival margin. (C) Labial bone dehiscence results in collapse of the facial soft tissue against the implant surface. (D) The connective tissue graft supports the marginal soft tissues while covering the guided bone regeneration area circumferentially over the implant. (E) The final restoration at the maxillary right central incisor is supported by an esthetically pleasing soft tissue topography that is visible in the patient's smile.

Soft tissue enhancement for delayed implants with minor ridge defects

The connective tissue graft may be used for correction of minor ridge defects in conjunction with delayed implant placement. The patient in Figs. 5A and B presented with a slight ridge deficiency associated with congenitally missing maxillary lateral incisors. The thin mucosal tissues would constitute an esthetic problem at the cervical area of the final restoration due to light reflection from the gray titanium implant collar and transmission through the thin marginal soft tissues resulting in a grayish hue. At the time of implant surgery, a connective tissue graft is placed over the labial cortical plate (Fig. 5C) to provide an adequate thickness of keratinized soft tissues that would reduce the dark color transmission and help with ovate site preparation (Fig. 5D). The result may be further enhanced by using tooth-colored abutments for support of the final all-ceramic restorations (Fig. 5E), which is particularly important when the patient has a high smile line, as noted in this case.

Soft tissue enhancement for delayed implants with large ridge defects

In cases with more advanced tissue loss, bone augmentation is necessary before implant placement. Fig. 6A demonstrates a patient with severe ridge deficiency after trauma to the anterior maxilla. Cortico-cancellous block bone grafts harvested from the mandibular symphysis or ramus areas may be used for reconstruction of lost bone volume. The block grafts are

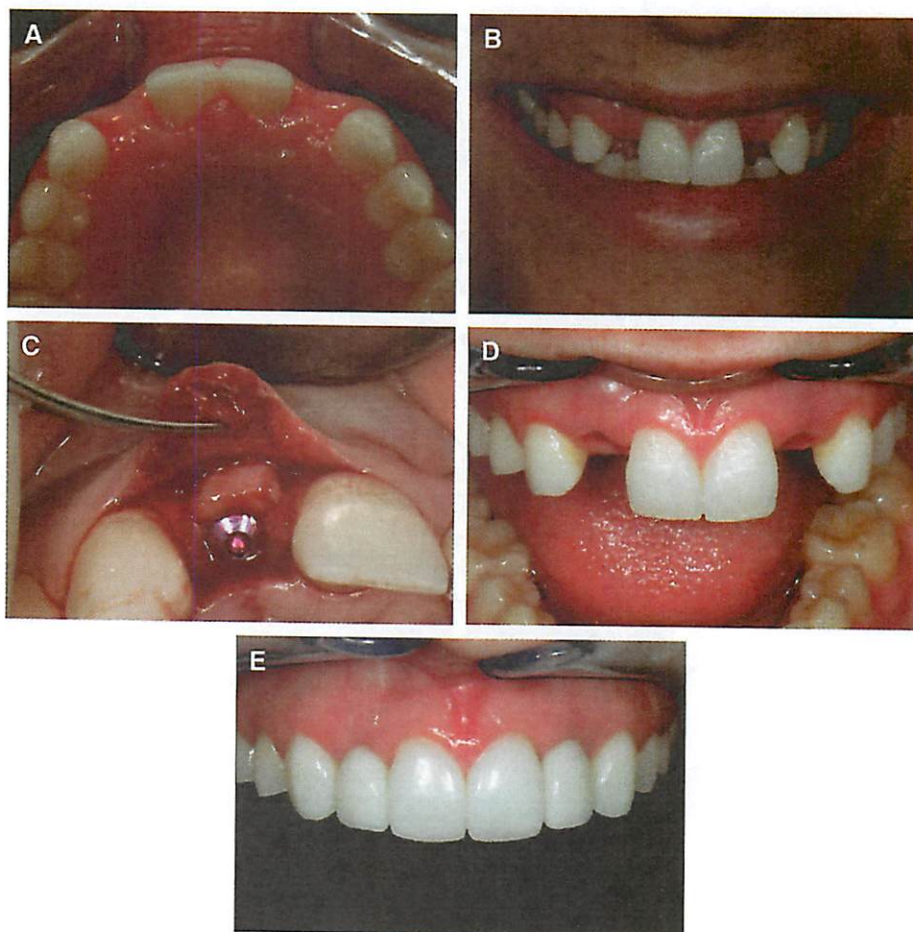


Fig. 5. (A) A patient with slight ridge deficiency due to congenitally missing lateral incisors. (B) The patient's high smile line constitutes an esthetic challenge. (C) Connective tissue grafts are placed on the facial aspect of each implant for soft tissue augmentation. (D) Soft tissue enhancement resulting from ovate designed provisional teeth. (E) Final implant restorations at upper lateral incisors.

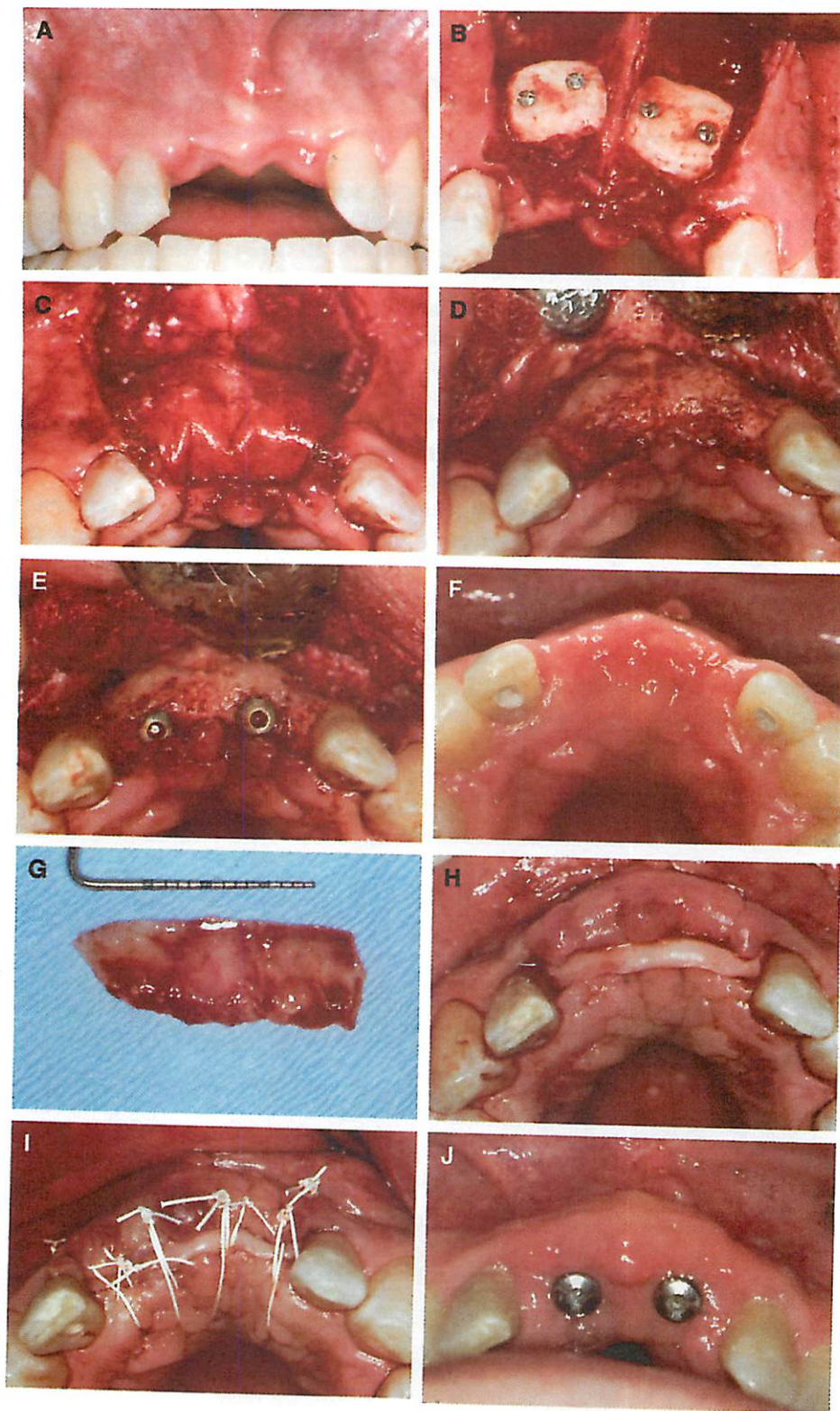


Fig. 6. (A) A severe residual defect is present after trauma to the anterior teeth. (B) Block bone grafts are secured in position for delayed implant placement. (C) A resorbable barrier is used over the bone graft area. (D) The ridge dimension is reconstructed to an ideal thickness. (E) Implants are placed within adequate supporting bone. (F) Bone graft resorption results in reduction of ridge dimension. (G) A large connective tissue graft is harvested from the palate. (H) The graft is placed in a partial thickness pouch labial to the implants. (I) Mattress sutures are used to stabilize the graft apically and occlusally. (J) Restoration of the lost ridge dimension is achieved after soft tissue maturation.

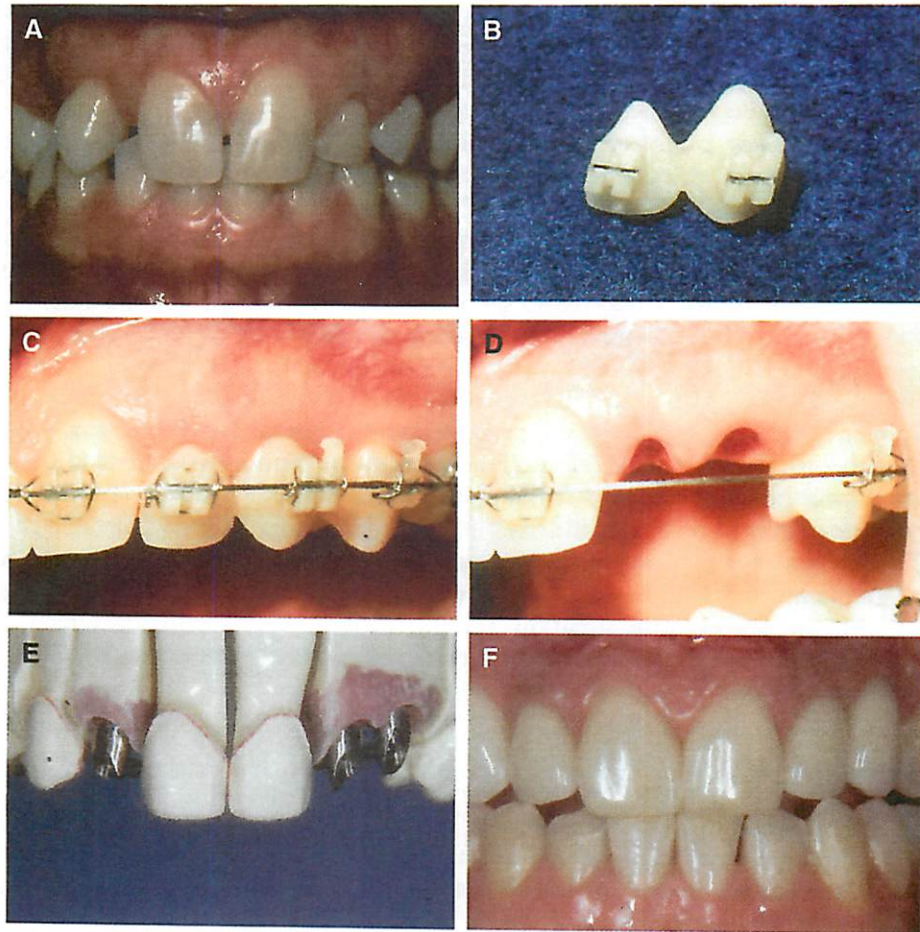


Fig. 7. (A) The patient presents with orthodontic problems, missing permanent teeth, and mobile deciduous teeth. (B) Orthodontic brackets are placed on the provisionalized teeth. (C) The ovate pontic design supports the soft tissue topography and is stabilized with orthodontic wire. (D) Maintenance of the interproximal papilla after implant placement. (E) Reproduction of the soft tissues on the working cast to assist the technician. (F) The final restorations. Note the gingival margin and papilla levels adjacent to each implant.

stabilized at the recipient sites (Fig. 6B), and the results may be enhanced by using a composite of autogenous cancellous bone chips mixed with mineralized particulate bone graft and covered by a resorbable collagen membrane (Fig. 6C). Although significant improvement in bone volume is predictably achieved for implant placement (Fig. 6D, E), a soft tissue problem is encountered in such cases due to the coronal repositioning of the mucogingival junction to achieve primary wound closure after periosteal releasing incisions. This places thin mucosal tissues at the future emergence site of the implant restorations. Additionally, a reduction in bone volume occurs due to remodeling and partial resorption of the block grafts (Fig. 6F). The connective tissue graft is used to compensate for this reduction in tissue thickness and to provide adequate keratinized tissues at the restoration emergence area (Fig. 6G). The graft is secured inside a partial-thickness soft tissue pouch created facial to both implants using apical and occlusal mattress sutures (Fig. 6H, I). This may be performed before or at the time of second-stage implant surgery. Fig. 6J demonstrates the significant improvement in tissue thickness with this technique.

Restorative and orthodontic soft tissue enhancement for delayed implants

The restorative dentist and laboratory technician must be cautioned against over-contouring of the implant restorations, particularly at the delicate labial gingival margin, to avoid iatrogenic labial soft tissue recession. On the other hand, an optimal contour supports the

interproximal papillary tissues and maintains proper form and fullness. The interproximal height of bone at the adjacent natural teeth has been shown to be a determining factor in the presence or absence of papillae adjacent to single tooth implants. Although the papilla height is approximately 5 mm between adjacent natural teeth, the interimplant papilla may be lost or may measure 3.4 mm in height on average. Therefore, placement of adjacent implants is the least desirable option in anterior tooth replacement, and measures must be implemented to reduce this problem.

In some clinical situations, papillae heights may be maintained nonsurgically. The patient in Fig. 7A presented with tooth malposition problems and congenitally missing permanent maxillary lateral incisors and left cuspid teeth. Mobility of the retained deciduous teeth dictated a restorative plan that includes orthodontic space management and implant replacement of the missing permanent teeth. Provisionalization with ovate pontic designs at extraction time would provide the needed support for the interproximal papilla (Fig. 7B, C). The orthodontic wire is used to support the temporary teeth and maintain papilla form during orthodontic therapy and through the osseointegration phase (Fig. 7D). A soft tissue cast is recommended to guide the technician during ceramic build-up for support of the delicate marginal tissues (Fig. 7E). Lingual set screws may also provide the fixed implant restorations with a retrievable advantage. Figure 7F demonstrates a good esthetic result achieved with a combination of implant-supported and laminate veneer restorations. Although the final outcome is esthetically pleasing compared with the preoperative situation, the interimplant papilla remains somewhat more apical to the desirable ideal papilla height noted at the papillae between the implants and the adjacent natural teeth.

Summary

The procedures presented in this article emphasize the role of the surgeon in reconstruction of ideal soft tissue contours around implant restorations. Implants placed in the anterior maxilla present a surgical challenge due to tissue limitations that are unique to dental implants compared with natural teeth. The connective tissue graft offers versatile approaches for enhancement of the soft tissue profile around esthetic zone implants. These procedures must be complimented by a good understanding of the restoration role in the maintenance of an esthetic submergence profile to support the marginal soft tissues.

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Further readings

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