

Connective Tissue and Bone Grafting for Anterior Immediate Implant Placement: Crescent Graft

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Abstract

Immediate implant placement in a one-stage approach, with or without provisionalization, has proven to be advantageous in preserving gingival anatomy around dental implants. But placing implants immediately in the changing alveolar bone of an extraction socket can result in progressive recession of the gingival labial margin over the implant restoration. Thicker biotypes and bone of the labial periimplant tissue have been shown to promote long-term stable gingival margins.

A surgically simple technique is presented here, utilizing crescent-shaped connective tissue and grafting to promote thicker labial bone and biotype. Surgical procedures as well as their biologic and clinical rationale are described. One-year post-restoration results showed stable labial gingival margins over the implant placed in one-stage approach.

Introduction

Alveolar ridge resorption following the loss of anterior teeth often creates challenging esthetic problems in implant dentistry. Horizontal and vertical bone changes surrounding the extraction socket create papilla loss, labial tissue recession and poor, unstable gingival foundations necessary for an esthetic final restoration.

If a harmonious gingival form exists around the tooth to be extracted, immediate implant placement and provisionalization after the extraction more effectively preserves the vertical height of the interdental papilla.¹ However, with this approach, the propensity for labial gingival recession over time can alter the appearance of the final restoration.^{2,3} While proper implant placement and correct fabrication of the restoration are important for esthetics in implant dentistry,^{4,5} there also must be favorable periimplant soft and hard tissues if implant restorations are to provide stable, lasting esthetics.⁶

Studies support that grafting the extraction socket decreases the amount of horizontal resorption⁶ and can enhance the bone thickness. A modified ridge preservation technique called "socket seal surgery," which combines bone- and soft-tissue grafting to preserve the bone graft and enhance the biotype of the ridge, was also used with immediate implant placement for an excellent esthetic outcome.⁷ This technique provides a thick biotype, stable labial gingiva, negligible loss of inter-dental papillary height, and protects the bone graft materials by sealing the socket with gingival graft at the time of surgery. However, it requires a second-stage surgery, and immediate provisionalization is not possible.

A bilaminar subepithelial connective tissue graft was used in conjunction with immediate implant placement, bone grafting and provisionalization in the esthetic zone for gingival biotype enhancement.⁸ Two cases were presented without long-term follow-up, but these showed enhanced labial biotype over the implants. This technique requires a large piece of connective tissue (9mm long and 1.5mm thick), which usually increase the surgical morbidity of the donor site, and it is not convenient for multiple implant placement. In addition, this technique does not compensate adequately in situations where there is unfavorable initial gingival margin and/or underlying bony architecture.

This article describes a relatively simple, less traumatic gingival tissue augmentation technique used with immediate implant placement in a one-stage approach, either with or without provisionalization. It converts unfavorable initial labial gingival level and thin biotype to a more stable biotype with a favorable gingival margin for better long-term final esthetics. One year post-implant restoration shows the stability of the peri-implant gingival tissue with enhanced biotype.

CLINICAL PROCEDURE

Soft and hard tissue assessment of the implant site:

The advantage of one stage immediate implant placement is more predictable preservation of the periimplant gingival tissue with less patient discomfort and less treatment time. Nonetheless, if mere preservation of the existing tissue is insufficient to

provide adequate periimplant gingival foundation for esthetic restoration, other surgical approaches better suited to augmenting the deficient tissue should be utilized.

The criteria and techniques for proper immediate implant placement have previously been established and reported with successful long-term outcomes.^{5,7,9} One of the more difficult aspects of immediate implant placement is positioning the implant with sufficient primary stability in an extraction socket, often without elevating a flap. The alveolar architecture in relation to the angle of the implant to be inserted, the presence or absence of bone concavity apical to the extracted tooth, the amount of existing bone apical and palatal to the extraction socket, which can provide primary stability for the immediate implant, as well as the quality of the bone and soft tissues of the ridge should all be thoroughly evaluated clinically and radiographically prior to the surgery. Many clinicians perform successful immediate implant placement without the aid of a computerized tomographic scan. However, if the tooth involved is long and large in dimension, and/or if an alveolar concavity is present apical to the socket, the use of a CT scan is advised.

In this case, the patient was a 54-year-old male with a left central lateral fractured at the dentogingival junction. There were no medical contraindications for dental implant treatment. Biotype labial to the lateral was on the thin side, with the labial margin at the tangent line joining the labial margins of the adjacent canine and central. Interproximal papilla height was within normal range, and the underlying bone levels were within 3mm from the margin based on probing (figs. 1, 1a). The periapical radiograph confirmed this bone level (fig. 2).



Fig. 1. Gingival l fracture of maxillary right lateral incisor.

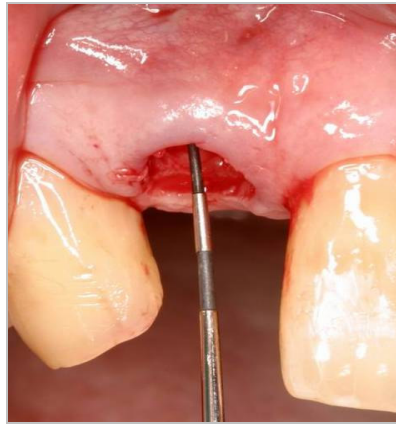


Fig. 1a. Probing of extraction socket..



Fig. 2. Preoperative periapical radiograph.

Surgical Procedure

Socket preparation:

The tooth should be extracted with minimal damage to the surrounding alveolar bone and gingiva. If the root needs to be elevated, the elevator should be placed at mesio-palatal or disto-palatal line angles to minimize damage to labial, mesial and distal interproximal bone. Use of a periotome to initiate the separation of the tooth-alveolar PDL junction can decrease the chance of thin labial bone breaking off during the extraction. The fresh extraction socket is thoroughly degranulated with a surgical spoon, a Prichard curette, or both. It is important that all soft tissue is removed and hard socket bone is felt with hand instruments. This minimizes the chance of post-operative infection and ensures optimal osseointegration without soft tissue impingement. The gingival walls of the socket orifice are de-epithelialized with the use of a 15C blade, or gently with a high-speed diamond bur. The exposed, bleeding lamina propria will

enhance the revascularization of the connective tissue graft which will be placed after the implant placement.

Implant Placement:

Implant placement starts with determining the final desired labial gingival margin for the implant restoration. This may be different from the existing gingival margin. Once this is decided, the proper apical position for the implant placement can then be determined. The implant platform should be 2-4mm from it. An implant with sufficient length should be used to engage the bone 3-5mm beyond the apex of the extraction socket to provide initial primary stability. This is the single most important factor for its success.

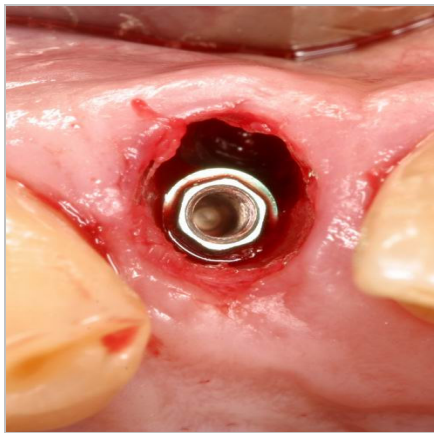


Fig.3. Extraction Socket with implant immediately placed in a palatal position.

The angulations of the implant should avoid adjacent roots and be no more than 15 degrees off, bucco-lingually, from the long axis of the ideal position. One of the common mistakes made is to angle the implant placement too labial to accommodate the existing bone for primary stabilization. This will not only cause restorative difficulties but increase labial recession problems as well. Furthermore, bucco-lingual positioning of the implant

should be within the outline of the final crown, with 1-2mm of space present between the inner surface of the labial wall and the labial surface of the implant (fig. 3). This also helps to engage the palatal wall for primary stabilization. The mesio-distal position must ensure that there is sufficient room for the interdental papilla. Placing the implant in this manner will ensure both a proper implant restoration emergence profile and hygiene. After placing the implant in a proper position, a bone profiler is used to profile the interproximal bone so that the healing abutment or the provisional fits passively. A healing abutment of 2-4mm in length, an appropriate abutment for a cement-on provisional, or a screw-retained provisional can be placed with an appropriate torque. If a healing abutment is used, then a denture tooth or a crown of the extracted tooth can be attached to the adjacent tooth as a provisional during the healing period. For a cement-on type of abutment, the margin of the provisional should stay supragingival at this stage for minimal disruption of the grafted site. Chemical irritation from the monomer must be avoided during the fabrication and polymerization of the cement-on provisional. There should be at least a 1.5-2mm space labial to the abutment or provisional restoration to accommodate a connective graft without excessive horizontal and vertical pressure. The provisional restoration emergence profile should be under contoured, and it should be out of occlusion.

Bone Grafting:

The space between the inner surface of the labial bony wall and the labial surface of the implant is filled with either mineralized freeze-dried particulate bone allograft (DBA) or particulate xenograft (BioOss, Osteohealth Co, Shirley, N.Y.). There is evidence that the space fills without grafting,¹⁰⁻¹² but filling the socket with graft material minimizes both vertical and horizontal resorption of the labial bone.¹³ Many clinicians prefer the use of xenograft because there seems to be less shrinkage over time, but the choice of grafting material does not appear to influence the survival of the connective tissue graft. The use of autogenous bone is not recommended due to greater horizontal shrinkage of the ridge. The bone graft is lightly packed to 3mm below the height of labial gingival margin. If the graft is packed too shallow or too deep, it will interfere with the final result. At this point there should be a crescent-shaped depression, about 3mm deep, around the mesio-labial-distal aspect of the stable implant abutment or provisional, lined by the inner lining of the labial gingiva with sulcular epithelium removed at the socket preparation stage (fig. 4). This is the space that will receive the crescent-shaped connective tissue.



Fig.4. Bone graft material is lightly packed to 3mm below the labial gingival margin

Crescent Connective Tissue Harvesting:

A crescent-shaped connective tissue graft with epithelium intact is usually harvested from the ipsilateral palate, approximately 5mm below the palatal gingival margin of the canine or premolars. The crescent shape follows the palatal gingival outline of the near by dentition (fig. 5). This will ensure the proper fitting of the graft in the recipient site. A 15C blade is ideal for this procedure. The blade is penetrated perpendicular to the palatal surface of the underlying alveolar bone, following the shape of a crescent as much as possible. The length and width of the graft are determined by the mesio-distal dimension of the socket, with the bucco-lingual dimension approximately 3mm. Due to the flexibility of the gingival wall, this dimension does not need to be exact. The graft is removed by scraping with a 15C blade or Orban knife along the tissue-bone interface. The resulting graft is usually about 3mm in thickness, which will fit snugly into to the recipient site. The graft tissue is either immediately placed into the recipient site or maintained in a moist environment to prevent desiccation. A small piece of collagen dressing material (Collacote or Gelfoam) is

placed into the donor site, and an interrupted suture is placed at the middle part of the donor site. Most of the time this is sufficient for hemostasis, but one or two more interrupted sutures may be necessary if oozing continues (fig. 6).



Fig.5. Crescent shaped connective tissue is harvested from the ipsilateral palate.

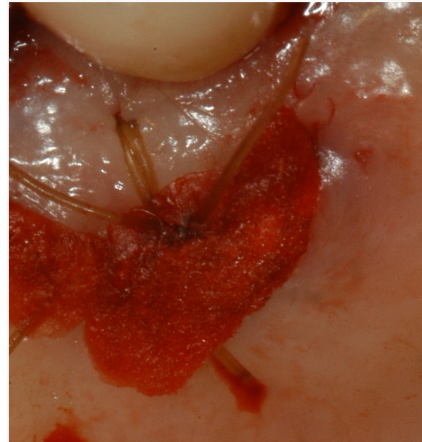


Fig.6. Collacote is placed into the donor site and sutured.

Placement and Suturing of the Graft in the Recipient Site:

In order to maintain the blood supply and nutrients to the donor tissue, it is important that the outer surface of the crescent graft fits in good contact with the bleeding lamina propria of the labial gingiva. The graft should push slightly against the gingival wall. The donor tissue harvested as described will fit into the recipient site with the inner side of the graft also in snug contact with the implant abutment or provisional restoration (fig.7). The graft-implant margin will usually be approximately 1mm coronal to the existing gingival

margin. With the epithelium of the graft to the outside, the bone graft and the exposed socket environment are essentially sealed from the oral cavity. Since the bucco-lingual thickness of the graft is slightly thicker than the recipient space, it may have a tendency to squirt out. It is kept in the site using gentle pressure with a blunt instrument such as a tissue plier while starting the suturing. Placing a crescent graft that is too thick can create excessive pressure and hinder the blood and nutrient flow to the graft. In such a case the graft should be trimmed as needed. The suture recommended is P-3, 5-0 chromic gut or Vicryl. The first suture is started at the mid-labial area with the needle entering through the epithelium of the graft at the mid bucco-lingual thickness level. It penetrates through the graft and the labial gingiva approximately 2-3mm apical to the gingival margin and tied (fig. 8). Without cutting, the suture is wrapped around the provisional or slung over the abutment and tied to the palatal tissue. This ensures that the labial side of the graft is in good stable contact with the labial gingival inner bleeding surface, and prevents the graft from being displaced coronally out of the recipient site. The same type of suture is placed in the mesial and distal aspects of the graft. Most of the time three sutures are sufficient, but one or two more may be necessary in larger grafts. Proper suturing is very important in maintaining the blood supply to the donor tissue during healing and paramount to the success of the procedure. At the end point, the site should exhibit a socket completely sealed with the crescent connective tissue graft with epithelium, and a healing abutment or a provisional restoration (fig. 9). The resulting gingival margin at this point is usually 0.5-1mm coronal to the

final desired gingival margin. This often compensates for possible future shrinkage.



Fig. 7. Crescent connective tissue placed should slightly push against gingival wall.

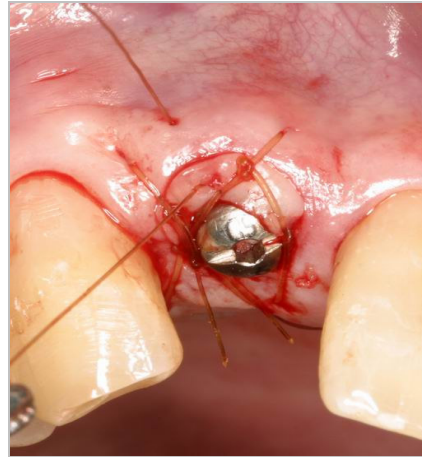


Fig. 8. Suture entering from the graft to labial tissue.



Fig. 9. Connective tissue stabilized with three sutures. The socket is sealed



Fig. 10. 1 week post-op.

Postoperative Instructions:

The patient is instructed not to brush the area of the surgery, apply Chlorhexidine gluconate (0.12%) twice daily and stay on a soft diet. Direct functioning on the implant provisional is not advised for a period of at least 2-3 months. Antibiotics and

analgesics should be prescribed appropriately. The patient should be seen for a 1-2 week post-operative visit. A pinkish graft with some white pseudo-epithelium indicates a successful graft (fig. 10). A yellowish or white tissue appearance indicates an unsuccessful graft. If the latter occurs, remove the necrotic portion of the tissue with a sharp scissors and let it heal. Usually the apical portion of the graft is alive, and it should be preserved. The patient can return to normal light brushing in 2 weeks and is advised to apply chlorhexidine to the area twice a day indefinitely after brushing.

Result

The labial gingival margin one year after the final implant restoration is stable at 1mm coronal to the original gingival margin. There is a thick biotype without gingival discoloration (fig. 11). The periapical radiograph indicates stable alveolar bone surrounding the implant at a normal level (fig. 12).



Fig.11. Facial view of final restoration after 1 year of function

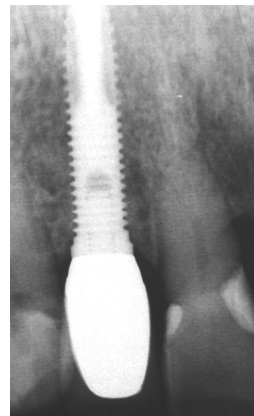


Fig. 12. Periapical radiograph 1 year after restoration.

Discussion

Immediate implant placement with provisionalization after an extraction better preserves the vertical height of the interdental papilla⁵ compared to the delayed approach to implant placement. The problem is, there is a propensity for labial gingival recession over time due to the changing environment of the extraction socket. The difficulty lies in predicting which socket will result in unstable labial gingival margin and which will remain stable over time.

Two anatomical factors which seem to matter most in determining labial marginal stability are the thickness and the position of the underlying bone and the biotype of the labial gingiva. However, determining the adequate thickness of bone and biotype in relation to the patient's physiology and function after implant placement is difficult.

If there exists in the extraction socket a 2-3 mm thickness of labial bone within a 3mm distance from the final desired facial margin, additional bone or gingival grafting may not have much impact on the final outcome.¹³ Thick biotype often accompanies thick underlying bone, and this probably has a synergistic effect on the marginal stability.

In most cases, the anatomical indicators and the stability of the labial margin are not perfectly clear. Therefore, when placing an immediate implant in a one-stage approach, a prudent strategy would be to overcompensate for these two factors, both of which are vital for the stability of the labial gingival margin involving immediate implants.

There is evidence that the space fills without grafting,^{11,12} but grafting minimizes thin ridge shrinkage, as labial bone starts to resorb from the crest and labial surface within days after the extraction.¹⁴ The preservation of the horizontal volume of the ridge over time is essential for the long term stability of the periimplant gingiva.

Histological analysis of the periimplant soft tissue in dogs indicated 3-4mm of soft tissue coverage of the implant supporting bone.¹⁵ Therefore, grafting to 3mm of the gingival margin should provide sufficient gingival support. Since the position and the stability of the gingiva are determined by the underlying bone, creating a surgical healing environment which promotes formation and maintenance of thicker labial bone at this vertical height, in the manner described in this technique, will likely enhance marginal stability.

The same holds true with gingival biotype. It has been reported that an average of 1mm of facial gingival recession occurred on immediate implant placed with provisional restoration.¹⁶⁻¹⁷ Retrospective observation showed that, as with natural dentitions, thin biotype gingiva involving immediate implants generally resulted in greater recession over time than thicker biotypes.^{18,19} Instead of utilizing anatomically correct abutments to idealize the immergence profile of the implant restoration, many clinicians now use smaller-diameter healing abutments to increase biotype during healing.^{20,21,22} This has been reported to give a thicker labial gingiva, and a more stable gingival margin over time. Therefore, as with bone, the logical strategy should be to increase the quality and quantity of the

gingival tissue via gingival grafting, as a part of immediate implant placement in the esthetic zone.

The use of crescent connective tissue grafts with epithelium intact provides labial gingival margin stability involving immediate implants, probably by preserving labial bone thickness and increasing gingival thickness. The epithelial barrier provided by the crescent graft in this technique maintains the labial socket space and isolates bone grafts from the insults of the oral environment. This may be conducive to a better preservation or formation of labial bone height and width.⁷ The literature also suggests enhancement of bone healing by excluding the epithelium through gingival grafting.²³

The advantage of this approach to gingival augmentation is simplicity and minimal surgical morbidity. In addition to providing a sealed protection for bone grafts around resorption sensitive labial crestal bone, the recipient site involves no surgical manipulation other than the removal of sulcular epithelium as described. Gingival walls, and periostium are completely intact with a full blood supply. The donor site involves a small wound 3mm deep with intact epithelium 3mm apart at the widest point, which epithelializes within a week and causes minimal discomfort for the patient. Since each donor tissue graft required is small, multiple donor tissue grafts can be harvested from a single palate, so that multiple immediate implants can be augmented at same time. Placement of a larger connective tissue graft will provide more gingival quantity, but that also requires a partial or full thickness flap release of a much larger area over the delicate labial bone to receive it. The long-term consequence of this on the resorption-sensitive labial

bone and gingiva of the socket is not clear. Removing a large connective tissue graft from the palate can have considerable surgical morbidity and certainly precludes augmentation of multiple anterior immediate implantation. One of the added advantages of improvement of labial gingival biotype thickness through a crescent grafting procedure is its effect on the preservation of the interproximal papilla height. Studies have shown that a thicker gingival base better supports the vertical height of tissues.²⁴

Furthermore, with this gingival augmentation technique, a small amount of unfavorable initial gingival margin may be compensated, since it typically results in a new gingival margins coronal to the existing gingival margin. This minimizes a need for proactive orthodontic extrusion or a delayed approach to implant placement. Whether this technique can be used as effectively in situations where the labial bone of the extraction socket which has been partially lost remains to be seen. However, many of the cases treated by the author suggest that an esthetically favorable final gingival margin can be achieved even in this type of situations.

Even in situations where the graft does not survive, the underlying bone grafting often maintains the labial gingival margin well. If more than expected horizontal resorption of the ridge has occurred with labial recession, a traditional subepithelial connective tissue grafting can be performed in the future without refabrication of the implant restoration. This is possible due to the favorable preservation of the vertical height of the interdental papilla. However, if the surgical procedures are carried out as described, such occurrences should be rare.

Summary

Optimal esthetics in implant therapy in an esthetic zone depends on a synergistic relationship between the underlying osseous architecture, gingival anatomy, implant and implant restoration. The crescent-shaped connective tissue gingival augmentation technique described will preserve and enhance the labial soft and hard tissues involved with immediately-placed implants in a one-stage approach. The epithelial barrier provided by the crescent graft of this technique maintains the labial socket space and keeps bone graft isolated from the insults of the oral environment. The connective tissue enhances the labial biotype and improves the labial gingival marginal height. This approach to gingival augmentation is simple, and it has minimal surgical morbidity. The recipient site involves minimal surgical manipulation, and the donor site involves only a small wound which re-epithelializes within a week with minimal discomfort for the patient. Since each donor tissue graft required is small, multiple donor tissue grafts can be harvested from one side of a palate, allowing multiple immediate implant connective tissue augmentations at same time. One-year post-restoration results showed stable labial gingival margins over the implants immediately placed in a one-stage approach.

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Captions (Figures 1-12):

Fig. 1. Gingival fracture of maxillary right lateral incisor.

Fig. 1a. Probing of extraction socket.

Fig. 2. Pre-operative periapical radiograph.

Fig.3. Extraction Socket with implant immediately placed in palatal position.

Fig.4. Bone graft material is lightly packed to 3mm below the labial gingival margin.

Fig. 5. Crescent-shaped connective tissue is harvested from the ipsilateral palate.

Fig. 6. Collacote is placed into the donor site and sutured.

Fig. 7. Crescent connective tissue placed should push slightly against gingival wall.

Fig. 8. Suture entering from the graft to labial tissue.

Fig.9. Connective tissue stabilized with three sutures. The socket is sealed.

Fig.10. one week post-op

Fig.11. Facial view of final restoration after 1 year of function.

Fig. 12. Periapical radiograph 1 year after restoration.