



SOFT TISSUE AUGMENTATION-AN OVERVIEW

Oral & Maxillofacial Surgery

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ABSTRACT

The increasing acceptance of dental implant therapy has largely been the result of the ability to predictably obtain a rigid bone-implant interface. The overlying soft tissue architecture and consistency are now being scrutinized in an attempt to achieve improved implant longevity and/or aesthetics. This article will overview the indications for soft tissue procedures around implants and describe techniques to improve these soft tissue parameters.

KEYWORDS

Augmentation, soft tissue augmentation, Dental implant, Soft tissue procedures

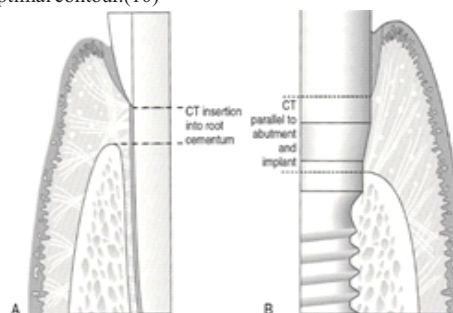
INTRODUCTION

The composition of the epithelial and connective soft tissues surrounding dental implants has been established to be similar to that of natural teeth.(1-3) A junctional epithelium forms a hemidesmosomal attachment to the implants and natural teeth, approximating 2 mm in length. The connective tissue interface, however, is different based on the attachment orientation geometry and type of attachment. The connective tissue zone is approximately 1 mm around teeth and 2 mm around implants. Collectively, the junctional and connective tissue attachment is referred to as the soft tissue "seal." Differences in the soft tissue connections involve the fact that connective tissue directly attaches to the acellular root cementum of a tooth, whereas the connective tissue around implants runs parallel to the implant surface and inserts into the bone.(7,8) In addition, the periimplant connective tissue has significantly higher collagen content and less fibroblasts.(4,6) The significantly reduced vascularity of the periimplant connective tissue(7) is thought to place this attachment mechanism at higher risk for bacteria-induced inflammatory breakdown.(8,12) It is therefore preferable to provide dimensions and quality of soft tissue that are more resistant to bacterial induced bone loss and thus reduce the chance of subsequent implant failure or aesthetically compromising recession. Historically, adequate dimensions of bound keratinized tissue have been the gold standard for mucogingival health around teeth and implants. Wennstrom(9) challenged this belief, suggesting that a movable mucosa around an implant perimucosal extension or abutment can be a stable end point if adequately maintained. Most authors (6,10) however, agree that long-term stability is more probable with bound tissue, keratinized or not. Unbound tissue of either keratinized or mucosal origin would be least desirable because of the potential for either increased pocket depth or recession.

SOFT TISSUE AESTHETIC CONSIDERATIONS

Lack of aesthetics around implants can be a deficiency of several soft tissue factors, including color, contour, and consistency. Specific problems within these categories include loss or reduction of the interdental papilla, increased crown height, and exposure of implant margin. It is the author's observation that many of these common problems arise during the restorative phase of treatment when surgical solutions are not possible, feasible, or well accepted by the patient. It therefore behooves the surgeon to understand and communicate to the patient any potential or preexisting aesthetic compromises that are present or may occur as a result of anatomic considerations. The patient's expectations should be elucidated, recorded, and harmonious with those of the treating clinician. Methods of communicating expectations of this sort use a nomenclature system, such as established by Misch.(10) The three category classification system of Misch is of particular utility when discussing the anticipated appearance of the final restoration with patients. The system for fixed implant restorations classification divides the desired prosthesis into one of three categories: FP-1, FP-2, and FP-3. These options depend on the amount of hard and soft tissue replaced and serve to convey the appearance of the final prosthesis to all implant team members(10). Ridge deficiencies described by these systems are most frequently the result of a hard tissue deficiency, which should be addressed early in the treatment plan. Advanced diagnostic techniques, such as CT

imaging, are useful to assess and quantify the need for hard and soft tissue support. Preliminary replacement of deficient hard tissues should be addressed before considering soft tissue augmentation. A ridge deficiency at the implant site should be corrected to within 3 mm of its optimal contour.(10)



**Figure 1: A. Soft tissue attachment around natural tooth
B. Soft tissue attachment around implant**

The likelihood of developing aesthetic complications is additionally based on tissue biotype. Tissue types have been categorized into two forms: thin and scalloped, or thick and flat.(61) The stability of the osseous crest and position of the free-gingival margin are directly proportional to the thickness of the bone and gingival tissue. Kan et al.(13) found that with implants, the level of the interproximal papilla of the implant is independent of the proximal bone level next to the implant, but is related to the interproximal bone level next to the adjacent teeth. He also found that even with ideal execution, facial and/or interproximal gingival recession may occur, especially with a thin, scalloped periodontium.(14) The most predictable and expedient method of addressing an interproximal papilla deficit is to increase the gingival emergence of the adjacent restorations and/or moving the cervical contact point apically.(14)

Another common problem with implant aesthetics, especially when replacing a single anterior tooth with an implant, is a discrepancy in crown heights, especially in the presence of a high lip line. A useful resource to determine the appropriate aesthetic surgical procedure, if any, is the algorithm described by Kokich in a series of three articles(15,16) on aesthetics and anterior tooth position. He notes that the most common crown length discrepancy with natural teeth occurs when one maxillary central incisor is shorter than the other, but the incisal edges are even. The problem can and should be anticipated before implant placement with proper diagnostic planning and establishment of patient expectations. If faced with the problem during the restorative phase the following options exist: (1) gingival surgery to correct soft tissue form or (2) intrusion and restoration of the shorter (natural) tooth. Determination of the appropriate surgical technique is determined by periodontal probing of the labial sulci and measurement of the existing band of attached and keratinized tissue. If the incisal edges are even and cemento-enamel junctions (CEJs) are level, a gingivectomy would be performed to remove the excess tissue. If a narrow band of attached tissue is present or there are differing bone heights, a flap procedure would be needed to allow for osseous

recontouring. Kokich also describes preoperative planning and techniques to address problems with anterior tooth vertical positioning and mediolateral relationships.(17) It should be noted that corrections usually involve orthodontics and restorative dentistry, not soft tissue surgical techniques.

SURGICAL TECHNIQUES FOR SOFT TISSUE HEALTH AND AESTHETICS

The techniques described following may be used to achieve objectives in improving tissue health, aesthetics, or both in varying degrees and may involve either augmentation and/or resection.



Figure 2 A, Pretreatment photo, right central incisor has advanced periodontal disease. B, Lip line. C, Implant crown/natural tooth crown height discrepancy. D, Crown lengthening of hard and soft tissues performed on adjacent teeth. E, and F, Final crowns and adjacent veneers in place.

GINGIVAL AUGMENTATION PROCEDURES TO IMPROVE SOFT TISSUE HEALTH

Techniques to provide more attached gingiva are best performed before abutment connection and are commonly free gingival, connective tissue, or variants thereof. These mucogingival procedures are also used to correct soft tissue problems that can arise during the preimplant bone augmentation, stage I integration, and postrestoration time periods. For bone augmentation procedures, incision line opening is a common complication. Soft tissue grafting will not be able to address the primary problem (bone exposure), and this compounded failure or complication will cause the patient to lose confidence in the treating surgeon. This combination of soft and hard tissue complication is best addressed by serial removal or recontouring of the exposed bone and deepithelialization of the wound edges (for non-bisphosphonate-induced cases). This creeping attachment phenomenon has also been observed following first-stage implant surgery. It is thought that platelet-rich plasma may be useful in accelerating soft tissue healing and thereby reduce the incidence of incision line opening, but this has not been established by controlled clinical trials.

Gingivectomy Removal or recontouring of gingival tissue may be necessary to improve implant health during the integration phase, for treatment of an ailing implant, and for restorative access. During the integration phase, Tal et al.(16) established that partially exposed implants have inflamed tissue over the cover screw that is inflamed and may contain bone debris that potentially could affect the healing implant. For an ailing implant, gingival recontouring may be needed as part of a treatment protocol, with the objective to minimize implant pocket depths.

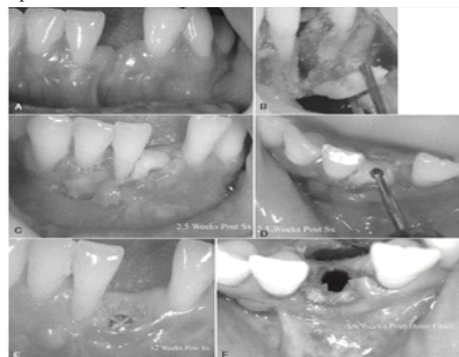


Figure 3 A, Pretreatment photo, note horizontal ridge defect. B,

Autogenous block bone graft from symphysis. C, Incision line opening 2.5 weeks after surgery. D, Serial recontouring of graft every 2 weeks. E, Almost complete soft tissue coverage 61 weeks after bone graft surgery. F, Osteotomy preparation at 16 weeks. For staged procedures, gingivectomy may be performed with a tissue punch assuming adequate surrounding tissue quality. In the context of aesthetic implant treatment, gingivectomies may be necessary around the implant abutment or the adjacent natural teeth to allow for the most harmonious gingival contours.

GINGIVAL GRAFTING TECHNIQUES

Several techniques may be used to improve tissue thickness and attachment. Augmentation techniques include epithelial free-gingival and connective tissue grafting.

1) Epithelialized Free-Gingival Grafting

This technique has a long history dating to the 1960s. The Sullivan and Akins description and overview of the procedure prompted adoption of free, autogenous gingival grafting into common clinical practice.

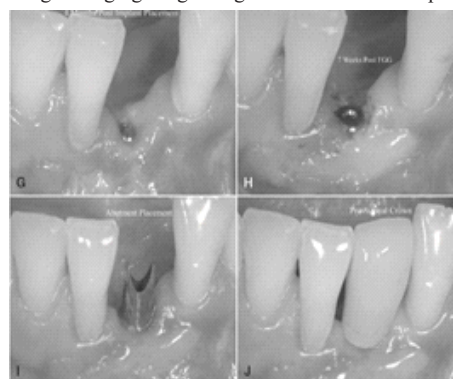


Figure 3 cont'd. G, Four months after implant placement, note minimal amount of attached and keratinized tissue surrounding implant. H, Seven weeks following epithelialized graft placement. I, Abutment in place. J, Provisional crown with improved surrounding tissue quality.

Its predictable and versatile nature has allowed for clinicians to provide increased zones of attached gingiva around teeth and implants with minimal difficulty. The recipient site is prepared first to allow minimal time to elapse between harvesting and graft placement. The autograft can be placed directly on bone (perforated or not), but is most commonly placed on periosteum. The recipient "bed" should be overextended to allow for some degree of tissue shrinkage of up to 25% to 45%, depending on tissue thickness. It is important to remove any residual alveolar mucosa, muscle fibers, and connective tissue fibers from the periosteal bed. These fibers may either cause inadvertent movement of the graft or directly block revascularization. Donor site selection and graft tissue thickness will depend on the defect being treated. Thick grafts of 1.5 to 2 mm have been generally recommended for ridge augmentation, root coverage, and around implant abutments. In contrast to thinner grafts of 0.75 mm or less, the thick grafts are more dimensionally stable and therefore are better able to withstand functional stresses, such as from mastication and plaque control procedures. These grafts, however, tend to have an unaesthetic, patch like appearance. Non-rugae-containing palatal tissue is the most common donor site, with alternative sites including the tuberosity area and edentulous ridge(s). The graft should be free of fat or glandular tissue to allow for plasmatic circulation.

2) Connective Tissue Grafting

Subepithelial connective tissue grafting may be described as a combination of a partial-thickness flap and a nonepithelialized free connective tissue graft technique, first used to correct ridge defects. Introduced by Langer, its success is based on use of a bilaminar flap with the graft having a double blood supply from both the gingival flap and the recipient bed. It is frequently used in conjunction with a coronally positioned pedicle graft to achieve coverage of crown and abutment margins and tooth roots. In addition, the connective tissue graft is useful for edentulous ridge augmentation or repair, soft tissue root eminence formation, and masking gingival discolorations or abutment "show through." Improved periimplant soft tissue health can be accomplished by providing bound tissue around implant abutments. These indications, combined with the technique's high predictability for root coverage,

color matching, and minimal donor site invasiveness.

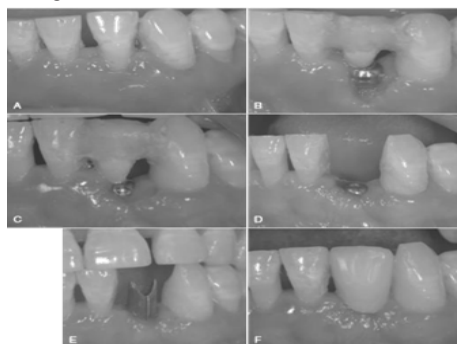


Figure 4: A, Pretreatment photo of mandibular left lateral incisor with advanced periodontal disease. B, Exposure of crest module and implant body during integration period. C, Creeping attachment of soft tissue over implant. D, Complete coverage of implant up to cover screw at 4 months. E, Abutment in place. F, Provisional crown.

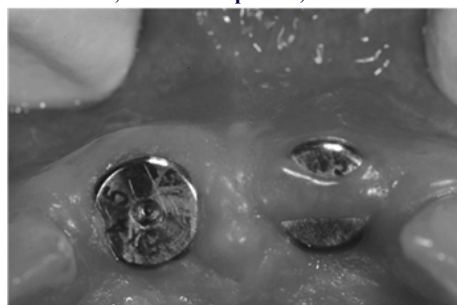


Figure 5: Partial exposure of healing abutment necessitating gingivectomy to establish hygienic gingival contour.

support the contention that connective tissue grafting is the single most versatile soft tissue procedure for both natural teeth and implants.(13,66).Its major limitation is the inability to harvest adequate thickness of donor material.

AlloDerm

The major limitation of the subepithelial connective tissue graft may be mitigated by use of AlloDerm, an allograft. It can therefore be used to bulk out ridge defects that may have previously required hard tissue grafting beyond that necessary for ideal implant positioning and support. This tissue is composed of an acellular dermal matrix derived from donated human skin tissue supplied by accredited tissue banks. As AlloDerm is regarded as minimally processed and not significantly changed in structure from the natural material, it has been classified as banked human tissue.

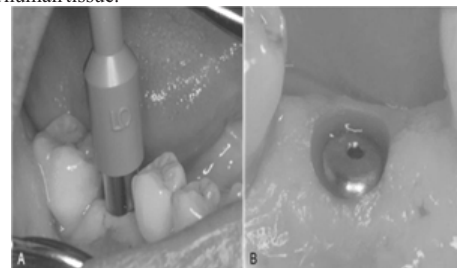


Figure 6 A, Use of tissue punch. B, Implant uncovered with remaining adequate dimensions of attached tissue.

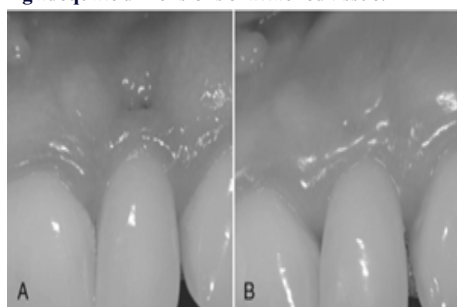


Figure 7 A, Soft tissue ridge defect around implant. B, Connective tissue repair after 2 years.

Its first applications in 1995 were in the medical field, where it continues to be used in varied disciplines, such as urology and orthopedic surgery. It has been used in soft tissue dental applications since 1997. Commercially available dermis is processed by conventional freeze-drying. The uniqueness of AlloDerm tissue centers on the proprietary processing, including a cryogenic aspect that involves removal of the antigenic cellular components, leading to increased preservation of the tissue's essential biochemical and structural composition.

3)Pediculated Connective Tissue Graft (PCTG)

The pediculated connective tissue graft is a vascularized subepithelial connective tissue graft that involves the rotation of a periosteal-connective tissue flap from the palatal soft tissues onto the recipient edentulous site. Because of the maintenance of a vascular supply, this graft has the potential to gain large volumes of soft tissue for vertical and buccal ridge augmentation. Postoperative aesthetic results are excellent, with minimal shrinkage. It is limited by the size and shape of the donor palate, and care must be taken not to overthin the donor tissue, which can result in sloughing. The PCTG has been found to be particularly useful in the treatment of aesthetic dilemmas around implants that have been caused by improper implant placement and inadequate soft tissue management.(66)

4)Modified Roll Tissue Graft

As described by Abrams, this technique involves rotating a deepithelialized connective tissue pedicle from the palate to a labial pouch. Originally designed for buccal and vertical augmentation around fixed prosthetics, it has been adapted for use around implants. It is not in common use because of the utility of alternative procedures and the potential for donor site morbidity despite technique modification by Scharf and Tarnow to prevent total bone denudation.

FLAPDESIGNS TO IMPROVE AESTHETICS

It is always desirable to have a zone of attached tissue around an implant. Appropriate incision design either at the time of implant placement or (for a staged procedure) at uncovering can allow for this desirable result without the need for subsequent mucogingival surgery.

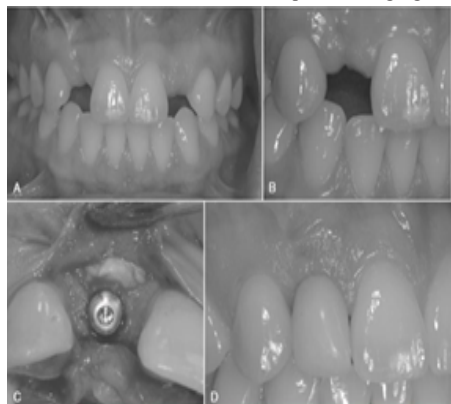


Figure 8 A, Pretreatment. B, Facial ridge defect. C, Connective tissue graft used to fill out defect. D, Provisional with soft tissue contour reestablished.

For first-stage procedures, the use of a limited, papilla-sparing, flap design is recommended to minimize interproximal crestal bone loss and possible loss of the papillae. A study by Gomez-Roman¹⁸ attributed decreased interproximal crestal bone levels to periosteal denudation and therefore recommended leaving a minimum papilla width of 1 mm. Incisions can be designed to bisect minimal areas of attached tissue to conserve and/or reposition attached and keratinized tissue for improved aesthetics and health. One specific technique is described following.

Papilla Regeneration Technique Palacci described a technique to address the common aesthetic problem of missing or reduced-height papillae adjacent to dental implants. He proposed making implant uncovering incisions more palatal, thus creating a wider flap from which one or more pedicles could be disengaged. These pedicles could be rotated, creating one or more papillae. Variations of this procedure have been published by Kinsel and Lamb⁽¹⁹⁾ and Nembcovsky.⁽²⁰⁾

with varying success in augmenting papillary form. A technique variation by Misch et al. uses a split-finger approach to create both a cervical and elevated interdental and/or interimplant soft tissue. This approach is based on the manipulation of both palatal and facial soft tissues to provide sufficient additional tissue volume to increase the interimplant papillae height.

The established acceptance and use of dental implants for tooth replacement has led to an associated interest in the surrounding soft tissue. Practitioners need to be able to manage the parameters of health and aesthetics with regard to the soft tissue. It cannot be emphasized enough that soft tissue procedures to improve health and especially aesthetics are best accepted by the patient as part of an initial plan of treatment that has taken into account patient expectations. Practitioners and patients should also be aware of the importance of hard tissue relationships in the overall treatment plan and the less-than-ideal outcomes that can result if neglected. Even under the best of circumstances, aesthetic dilemmas can arise. Soft tissue procedures can help address these problems, but the multifaceted nature of implant aesthetics demands consideration of all options, including prosthetic. This article has given an overview of such concepts. The reader is encouraged to review more detailed references on specific topics that are beyond the scope of this writing.

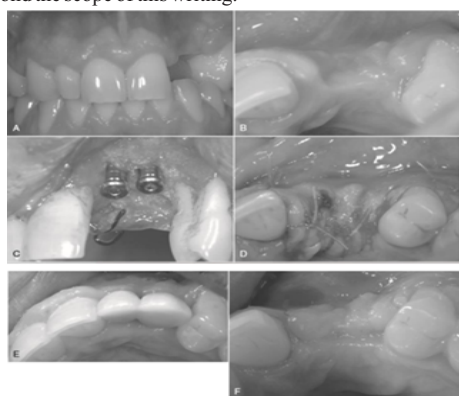


Figure 9 A, Pretreatment photo. B, Horizontal ridge width deficiency. C, Permucosal extensions in place before coverage with dermal matrix graft. D, Reestablishment of buccal ridge contour. E, Ridge after 4 months of healing. F, Provisionals in place.

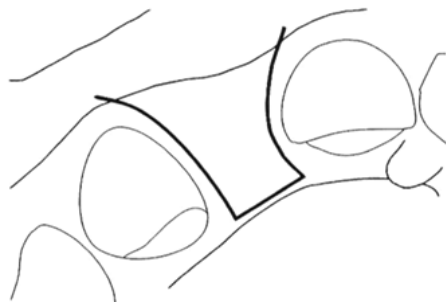


Figure 10 A limited, papilla-sparing, flap design is recommended to minimize interproximal crestal bone loss and possible loss of the papillae. (From Gomez-Roman G: Influence of flap design on periimplant interproximal crestal bone loss around single-tooth implants, *Int J Oral Maxillofac Implants* 65:61–67, 2001.)

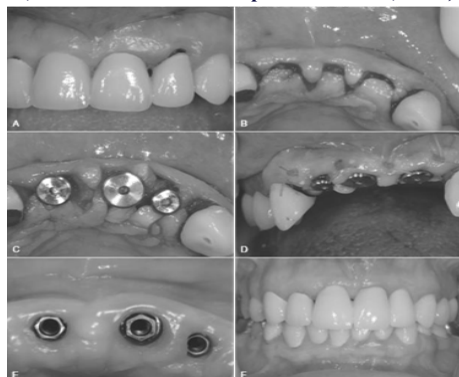


Figure 11 Split-finger technique: A, Pretreatment. B, Initial incisions. C, Secondary incisions. D, Vertical mattress suturing of papillae. E, Postsurgical tissue contours. F, Final restoration

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