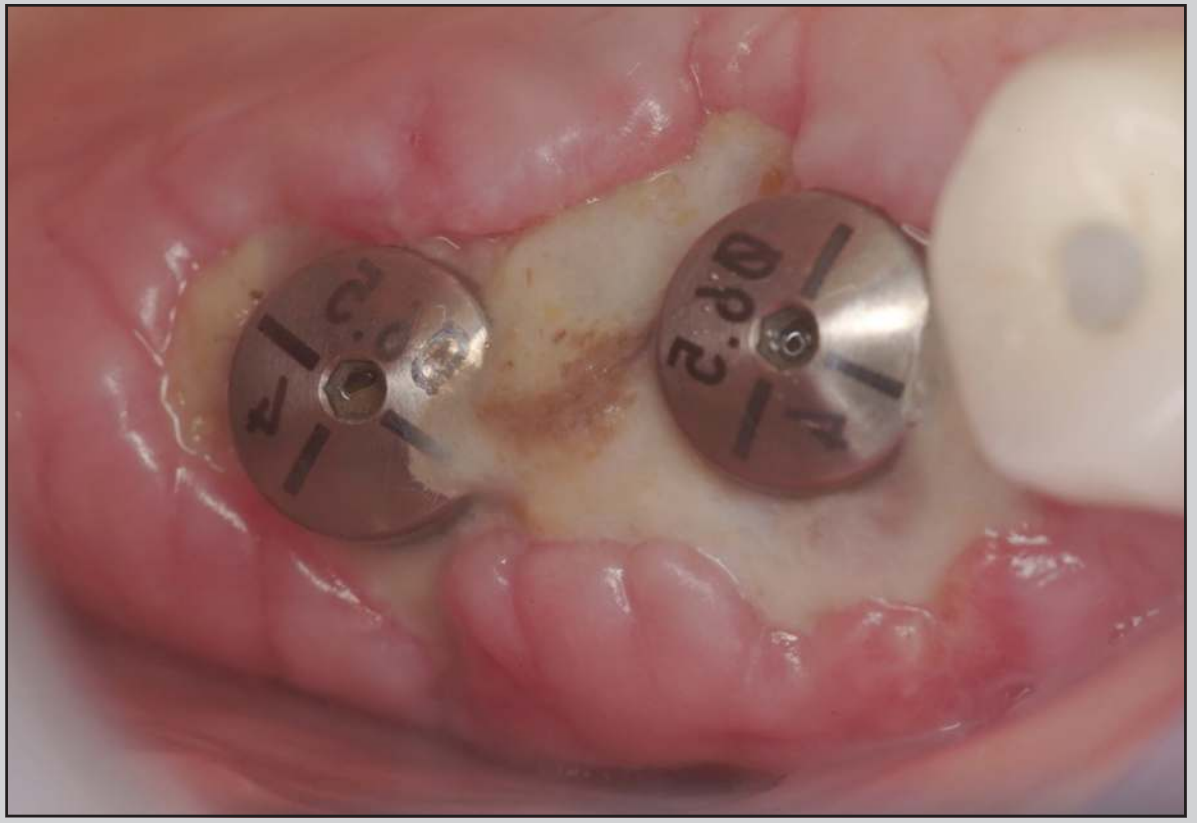
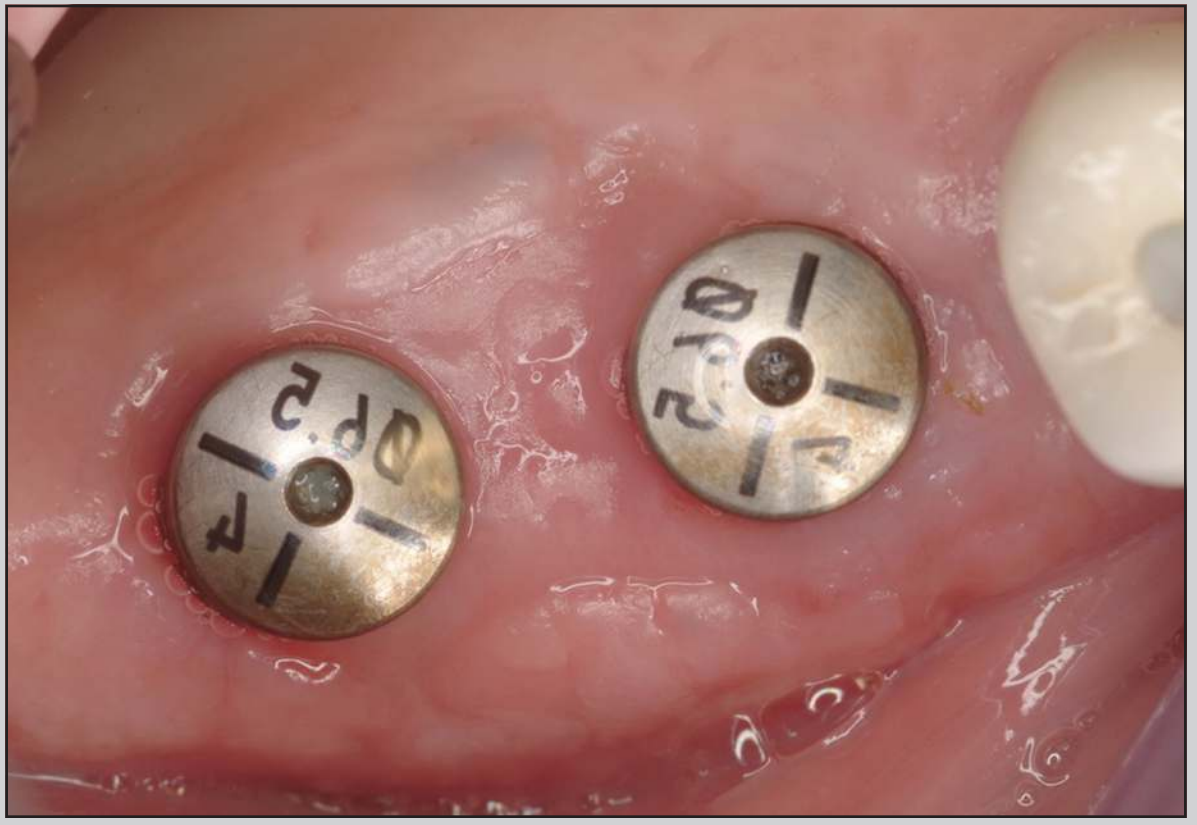
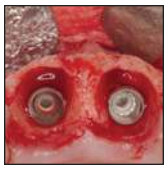




The Dual Function of a Dermal Allograft in Immediate Implant Therapy



Barry P. Levin, DMD[1]

Immediate implant placement often requires tissue augmentation simultaneously. Both hard and soft tissue grafting can improve long-term physiologic and esthetic outcomes. Bone replacement grafts are frequently combined with barrier membranes (guided bone regeneration [GBR]). When these materials are resorbable, they are often composed of collagen or synthetic polymers. These techniques do not address the need for soft tissue augmentation, and harvesting of autogenous soft tissue grafts is required. The use of a dermal allograft composed of natural, non–cross-linked collagen eliminates the need for the second surgical site to harvest autogenous soft tissue. This article demonstrates the dual functionality of a dermal allograft serving as both a GBR membrane and a biologically incorporated soft tissue biomaterial in immediate implant therapy.
(Int J Periodontics Restorative Dent 2015;35:XX–XX. doi: 10.11607/prd.2095)

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The long-term stability of peri-implant tissues is critical to success. This not only applies to esthetically sensitive areas, but posterior sites are also susceptible to bone loss, mucosal recession, and inflammatory disease. This may ultimately lead to loss of peri-implant bone and prosthesis. Much attention has been paid to preservation of peri-implant bone levels. Other than esthetically critical areas, very little has been discussed regarding the health and stability of the soft tissues in sites more remote from the esthetic zone. This article will present the use of a dermal allograft as a guided bone regeneration (GBR) barrier and demonstrate the biologically acceptable structure of the dermal allograft, which allows normal epithelial migration in wound healing sites around dental implants.

The biologic width established around natural teeth serves as a physical and chemical barrier for bacterial infiltration and inflammatory processes approaching alveolar bone. The dimensions of this soft tissue attachment were established long ago.[1] Studies have demonstrated in animal and human histologic sections, that a biologic width of similar dimensions also exists around transmucosal dental implants.[2–5] The concept of biologic width becomes applicable in many situations, in particular when the

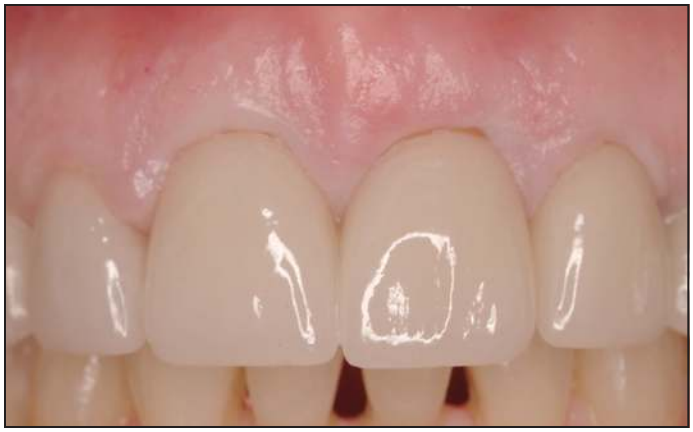
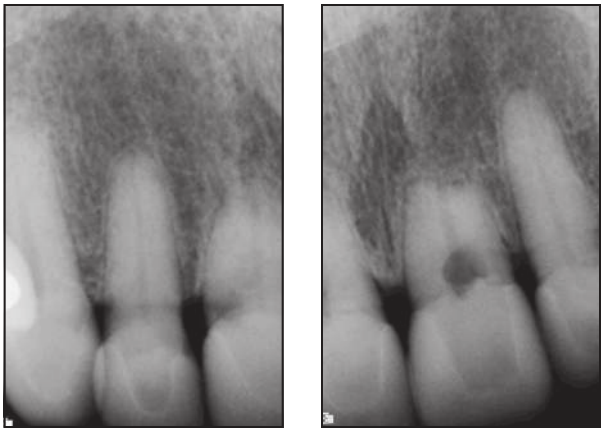


Fig 1 *Pretreatment condition of the maxillary anterior dentition. Periodontal hard and soft tissues are seen to be healthy. Mild gingival recession is noted around the maxillary left central incisor.*



Figs 2a and 2b *Periapical radiographs demonstrate blunted roots secondary to orthodontic therapy, as well as external root resorption occurring on the maxillary left and right central incisors.*

overlying mucosa is relatively thin. Often the a peri-implant biologic width forms at the expense of marginal bone, which must migrate apically to provide physical space for the soft tissue attachment.[6] Recently, Linkevicius[7] demonstrated greater peri-implant bone preservation in sites with naturally thin (< 2.0 mm) mucosa, via augmentation with a dermal allograft at the time of implant placement. The augmented sites maintained bone comparable with those sites naturally demonstrating thicker (> 2.0 mm) tissues.

Method and materials

This article demonstrates the dual function of a dermal allograft (PerioDerm; Dentsply/Musculoskeletal Transplant Foundation [MTF]) in immediate implant placement. The allograft was used to serve as a barrier and augment the thickness of peri-implant soft tissues.

The dermal allograft used in the cases presented herein was obtained through the MTF tissue bank. Its processing maintains the architectural elements of human, unprocessed skin. Hyaluronic acid, which provides structure, is present in the material,[9] as is vitronectin, which is capable of collagen binding and cell attachment.[10] The epidermis and dermis are removed from subcutaneous skin layers. Viable cells are removed with sodium chloride to minimize inflammatory and immunologic reactions. The material is stored at room temperature and rehydrated in sterile saline within about 3 minutes.

All patients were treated in the author's private periodontal practice. They all signed informed consent forms in accordance with the Helsinki convention. The following cases demonstrate the use of a dermal allograft, of uniform thickness of 0.4 to 0.8 mm, as an adjunctive material in immediate implant placement. All sites underwent extraction of hopeless teeth, implant placement (Astra Tech, Dentsply), and bone allograft application (MTF or Life Net) in the voids between the implants and osseous walls of the extraction sockets. The dermal allograft was either sutured around provisional restorations with a resorbable suture (Monocryl, Ethicon) or adapted over healing abutments via a tissue punch. Primary coverage of the dermal material was attempted but not always accomplished.

Case 1

The patient was a 71-year-old woman with external root resorption on the palatal aspects of the maxillary left and right central incisors (Figs 1 and 2). Because of the blunted roots and poor restorability of these teeth, extraction and implant replacement were chosen. Following

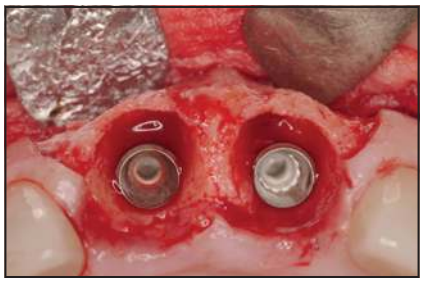


Fig 3 (left) *Immediate palatal placement of implants in the extraction sockets of the two central incisors. The fixtures obtain primary stabilization through engagement of the apical and palatal bone, avoiding proximity to the thin labial cortex.*

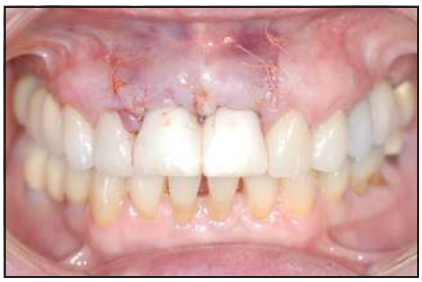


Fig 4 (right) *Splinted, screw-retained provisional crowns tightened to 20 Ncm at the time of implant placement.*

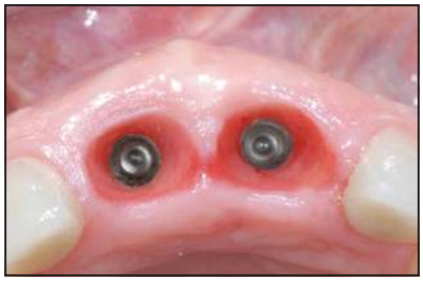


Fig 5 (left) *Soft tissue contours 14 weeks after surgery and immediate temporization. Facial contours are maintained and marginal mucosa is developed via temporization.*

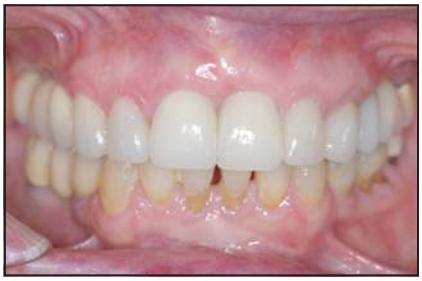


Fig 6 (right) *Computer-aided design/computer-assisted manufacture process is used to tighten zirconia abutments (Atlantis, Dentsply). Individual cement-retained restorations are delivered. (Restorative dentistry by Dr B. Wilk.)*

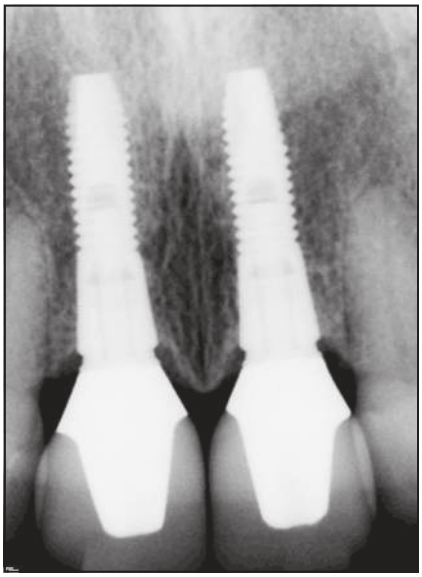


Fig 7 (right) *Periapical radiograph at 19 months after implant placement and approximately 16 months after delivery of final crowns. The interproximal bone between the two implants as well as the mesial bone associated with the lateral incisors has undergone virtually no remodeling. Both implants demonstrate proximal bone levels at the platform of the fixtures.*

reflection of a facial trapezoidal flap, the mesial papillae of the adjacent teeth were preserved and extractions performed, taking care to preserve the facial bone. Two 4.5 × 13.0-mm implants (Astra Tech) were placed in the palatal aspect of the extraction sockets (Fig 3). The void between the implants and the facial cortex was obturated with freeze-dried bone allograft (Life Net), and a dermal allograft was adapted over the healing abutments via a tissue punch, creating an opening smaller than the diameter of the implant platforms. The tissue generously covered the facial bone, and the flap was secured with resorbable sutures.

The patient presented to her restorative dentist immediately after surgery. Using an impression taken before surgical closure and a vacuum-formed template of the pre-existing situation cast, splinted, nonloaded provisional crowns were placed using screw retention (Fig 4). These provisional crowns were not removed for about 10 weeks. At about 14 weeks, custom, computer-aided design/computer-assisted manufacture (Atlantis, Dentsply) (Fig 5) abutments and single-unit, all-ceramic crowns were placed and cemented. Excellent soft tissue development via temporization and stable esthetics have been maintained for 2 years since the final restorations were delivered (Fig 6). The radiographic bone levels 19 months after implant placement have also been maintained (Fig 7).

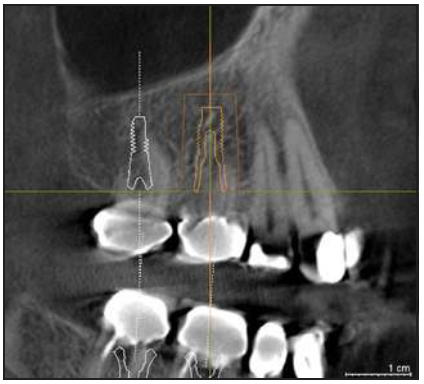
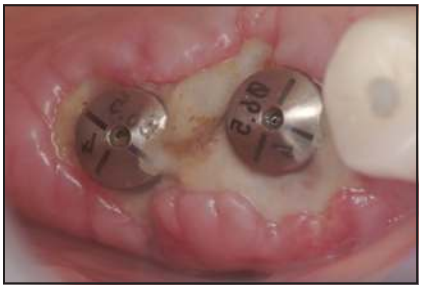


Fig 8 (left) *Tangential view of the maxillary right posterior teeth along with proposed implant positions via planning software (SiCat, Sirona).*

Fig 9 (right) *Secondary closure with significant exposure of the dermal allograft.*



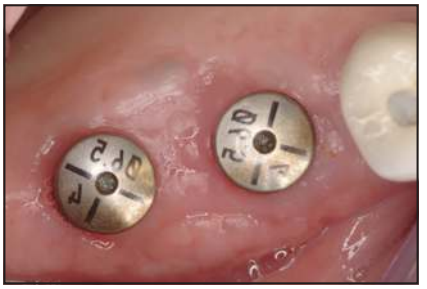


Fig 10 (left) *Ten days after surgery, the firmly bound dermis is visible, covered by a yellow fibrin layer. Inflammation is minimal.*

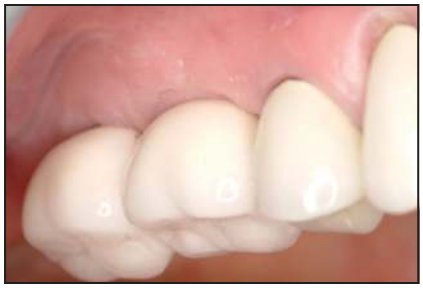
Fig 11 (right) *Five weeks after the first postoperative appointment, the peri-implant mucosa appears pink and free of inflammation. A significant increase in the dimensions of buccal keratinized mucosa is noted.*

Case 2

The patient presented for extraction and implant placement surgery because of secondary caries in the area of the first and second molars. Radiographic evaluation, including cone beam computed tomography scanning demonstrated adequate bone volume intraseptally to anticipate primary implant stability and restoration-driven placement (Fig 8).

Following sectioning of both maxillary right molars, all six roots were carefully removed, preserving the surrounding bony walls and intraseptal bone. The second molar was replaced with a 5.0 × 11.0-mm implant and the first molar was replaced with a 5.0 × 13.0-mm implant (Astra Tech, Dentsply). Both implants were inserted in the septal bone of the alveoli of the teeth they replaced. The residual sockets were obturated with freeze-dried bone allograft and the dermal allograft was stretched over the healing abutments after applying two 5.0-mm-diameter tissue punches. The overlying flaps were adapted without achieving primary membrane coverage (Fig 9). This was intentionally performed to avoid relocating the buccal mucogingival junction coronally, possibly compromising the amount of keratinized mucosa after healing and restorative therapy.

At the suture removal appointment 10 days after surgery, a wide area of exposed dermal allograft coated with a yellowish-white fibrin layer was noted (Fig 10). The patient was asymptomatic, with no pain or swelling. The original flap margins were noted as being firmly affixed to the dermal allograft and nonmobile. The patient returned about 5 weeks after the first postoperative appointment, demonstrating healthy, keratinized mucosa surrounding both healing abutments (Fig 11). The zone of buccal keratinized tissue was qualitatively judged to be wider than the pretreatment levels (Fig 12), and the radiographic bone levels appear stable 1 year after treatment was completed (Fig 13).



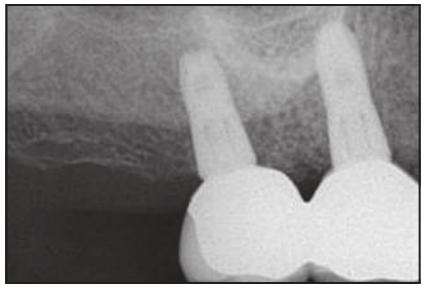


Fig 12 (left) *Two cement-retained crowns are present with healthy soft tissues. (Restorative dentistry by Dr Mona Patel.)*

Fig 13 (right) *Excellent bone preservation approximately 1 year after implant placement.*

Discussion

The question of osseointegration serving as the endpoint of implant therapy is no longer relevant. The long-term health and stability of the implant, prosthesis, and peri-implant tissues are the most desirable outcomes for implant therapy. Often bone preservation, albeit radiographically evaluated, is the focus of clinicians. The presence of keratinized mucosa is not an absolute criterion for success, yet it is still desired by most clinicians. The removal of a tooth and the bone loss that ensues is a dynamic process. Radiographically, it was shown that the crestal bone resorbs in horizontal and vertical dimensions after immediate implant placement and temporization.[10] Kan et al[11] demonstrated that as facial bone continues to remodel far after delivery of the restoration, the mucosa continues to recede as well.

The nature of periodontal biotype likely plays an important role in the expectation of mucosal stability around implants. One study identified numerous factors relating to the location of the underlying bone as well as biotype serving as factors affecting soft tissue levels around maxillary anterior implants.[12] Patients with thicker periodontal tissues demonstrate thicker and wider amounts of keratinized gingival and thus peri-implant mucosa. Attempts to widen the band of keratinized tissue resulted in more stable dimensions of tissues and improved esthetics.[12] In that study, by Grunder,[13] flapless placements were combined with autogenous, subepithelial, connective tissue grafts. The sites that were not augmented lost horizontal ridge dimension, whereas a slight gain in tissue thickness was noted in the areas receiving soft tissue grafts. Interestingly, Chen et al[14] were unable to demonstrate the benefit of this procedure in a similar study. In an animal model, Caneva et al[15] demonstrated histologically that connective tissue grafts failed to significantly preserve buccal bone after immediate implant placement, yet resulted in significantly thicker soft tissues. Soft tissue thickness has been suggested to play an integral role in bone maintenance. Linkevicius et al[7] were unable to radiographically demonstrate an advantage of platform shifting over horizontally matching systems when the overlying mucosa was less than 2.0 mm. In the canine model, Berglundh and Lindhe[16] showed histologically that surgically thinned mucosa underwent greater crestal bone remodeling to re-establish biologic dimensions compared with naturally occurring thicker tissues. Whether the nature of the mucosa is keratinized or composed of lining mucosa, reviews of the literature have been inconclusive regarding the importance of keratinization.[17,18] It can be inferred from most studies that thick, more abundant facial mucosa will result in better esthetic outcomes. Therefore, these adjunctive procedures have merit.

Regardless of the composition and quantity of the peri-implant soft tissues, the importance of underlying bone cannot be overstated. Preservation of the proximal and buccal bone is critical for long-term maintenance of soft tissues. Spray et al[19] demonstrated that bone thickness of approximately 2.0 mm is necessary to prevent soft tissue recession around implants. Buccal bone thickness capable of

supporting soft tissues is frequently established via bone grafting and GBR. Frequently, this bone is not present at the time of extractions.[20–22] When buccal bone thickness is not adequate at the time of implant placement, the site can often be augmented simultaneously.[23] The cases presented herein received bone grafts between the implant fixture and the walls of the extraction socket. In cases in which the distance from the implant surface to the external surface of the facial cortex was thin (< 2.0 mm), another layer of allograft was applied between the facial bone and the dermal allograft.

Implant position within the extraction socket also plays a role in the maintenance of the buccal plate of bone. In an animal study, Covani et al[24] demonstrated that placing implants along the lingual wall and inserting narrower diameter fixtures resulted in greater buccal bone regeneration compared with wider implants placed in proximity to the facial plate. In a human study, Evans and Chen[25] showed that buccally positioned implants resulted in three times the amount of soft tissue recession.

It is of note that the dermal allograft used in this study is mainly composed of collagen. Its application between the buccal cortex and periosteum of the mucoperiosteal flap may serve a protective role in bone preservation. In a canine model, Caneva et al[26] demonstrated approximately 23% bone preservation of the buccal outline of the alveolar process, whereas untreated immediate placements resulted in greater bone loss at 4 months. The goal of GBR via the dermal allograft was combined with an attempt to increase the thickness of the mucosa surrounding the transmucosal abutment. Vervaeke et al[27] demonstrated that peri-implant bone remodeling was greater around implants with thinner mucosa. They speculated that bone loss was not a pathologic but physiologic phenomenon that occurred to re-establish biologic width. The application of an acellular allograft capable of integrating with the host soft tissues can increase tissue thickness. However, this is a speculation because the case reports described herein lack histologic study. It is apparent, however, that the material was incorporated well within the surrounding host tissues, and hard and soft tissue health was maintained over a long period of functional loading. The present technique uses a single biomaterial to accomplish the desired barrier function and soft tissue augmentation. Avoiding the harvesting of autogenous connective tissue from a remote site reduces morbidity. The allograft is more versatile than autogenous tissues, providing uniform thickness and making trimming/tissue punching for adaptation easier.

Conclusion

The technique presented in this article provides a method of using a dermal allograft for both barrier and soft tissue augmentation. The importance of soft tissue thickness resulting in bone maintenance and long-term mucosal stability is emphasized. Clinical and histologic studies should be performed to further support the clinical conclusions drawn from this brief case series.

Acknowledgments

The author received no financial or material support to perform this case series.

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