Treatment Planning 2000: An Esthetically Oriented Revision of the Original Implant Protocol

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The significant contributions of Bränemark et al have utterly and permanently altered the perspective of restorative dentistry. Currently, utilizing the original protocol specific to the fully edentulous patient, the success of osseointegrated endosseous implants has provided for predictable restoration of function in compromised cases. However, although the primary goal of any dental intervention continues to be the reestablishment of health and comfort, health is no longer defined solely by the absence of disease, and comfort is not represented only by the elimination of pain. The psychosocial needs of the patient must also be considered.

For the demanding partially edentulous patient, the objective of therapy is inherently more sweeping and requires a restoration of "natural" esthetics as well as the overall restoration of function. Therefore, a thorough understanding of the patient's desires and expectations is a compulsory starting point if an appropriate treatment plan is to be formulated for an acceptable overall outcome.

The task of restoring anterior esthetics for the partially edentulous patient is demanding and requires a more rigorous treatment protocol. The intrinsic requisites of esthetic therapy are especially challenged when the edentulous span is deficient in the quantity and quality of bone and out of harmony with the occlusal scheme, the adjacent dentition, or the adjacent gingival contour. Identifying relevant deficiencies and developing appropriate regenerative solutions has become even more critical.

From an esthetic standpoint, an important key to success resides in creating harmony, balance, and continuity of form in the region where the implant restoration exits through the gingiva—the emergence profile. When the restorative gingival interface also lies within the lip perimeter, restoring dimensional deficiencies in the surrounding tissues through purely prosthetic means frequently proves impossible or, at best, esthetically inadequate. Instead, a multidisciplinary treatment approach that reconstructs the insufficiencies in the osseous and gingival as well as the restorative dimensions is usually the only means to achieving the stated goals of implant therapy.

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The reconstructive zone
Prior to the commencement of therapy, a comprehensive analysis of the potential treatment site must be conducted in three dimensions: mesiodistal, buccolinguval, and apicocoronal. The authors define the reconstructive zone as the entire span that will receive the implants as well as the final restoration. The osseous profile of selected sites must be capable of supporting an implant that is adequate in length, angulation, and relative position to the adjacent teeth and opposing arch. In addition to the underlying osseous dimensions and anatomic structures, the other components needing consideration include the overlying gingival profile, including papillae, as well as the anticipated emergence profile of the final restoration.

Identification of problems in any of the elements that make up the reconstructive zone directly affects the decision-making process, and the team members then need to be recruited (Figure 1). If deformities exist that preclude the optimal placement of the implants as dictated by the desired restoration, then the treatment design should include whatever therapeutic modalities are necessary to correct the deficiencies and develop the site to a degree that would enable the achievement of an esthetic profile in the final restoration.

The purpose of this article is to outline the blueprint for a comprehensive multidisciplinary treatment philosophy, designed for developing the foundation for optimal esthetics in implant therapy. In addition, the important synergistic relation of the osseous, gingival, and restorative triad in creating the esthetic profile is described. The need to enhance the individual components of this triad is emphasized as the basis for a revised implant protocol actualized for treating the complex partially edentulous patient.

Figure 1. The reconstructive zone: the components that make up this area are outlined along with the various disciplines that may be used to correct the existing deficiencies.
OPTIMIZING THE ESTHETIC TRIAD

The components of the esthetic profile are the osseous, gingival, and restorative triad and its relation to the adjacent dentition. The premise of this synergistic relationship maintains that the most successful and predictable outcomes can be accomplished if the optimal osseous dimensions are first reconstructed to support the regeneration of the optimal gingival contours that, in turn, can sustain the development of an esthetic restorative profile. The critical interdependence of these components and the need for a systematic reconstruction of significant deficiencies within this triad cannot be underestimated if consistency is to be achieved in esthetic results.

DEVELOPING THE OSSEOUS PROFILE

The osseous topography of the anterior sextants, and their relation in space relative to the cranium, are key factors in shaping dento-facial esthetics. The alveolus in these regions serves as the foundation for the natural dentition or dental implants and their associated gingival tissues; it also supports the lips and directly affects the facial profile and, therefore, overall esthetics.

In diagnosing ridge deficiencies, it is important to ascertain both the magnitude of the dimensional osseous inadequacy and whether it is a localized dilemma or an overlying skeletal issue. This diagnosis is critical to determining an effective treatment approach. Skeletal dysplasia of the maxilla, the mandible, or both can significantly disrupt facial harmony.

Figure 2. A 62-year-old female presents following the fabrication of an upper removable partial denture to replace the anterior abutments of a fixed restoration that spanned the upper right quadrant.

Figure 3. A diagnosis of the reconstructive zone of this patient reveals three-dimensional deficiencies of the soft tissue and underlying bone in the upper right quadrant as well as a 100% deep overbite.
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When the dysplasia is severe, ridge augmentation of localized defects or dental compensation through orthodontic or prosthetic intervention can often prove inadequate. Under such extreme circumstances, only orthognathic surgical intervention can reestablish the optimal facial harmony and esthetics. However, most patients encountered in everyday practice are those with a normal skeletal pattern who have lost a substantial degree of their original osseous dimensions through tooth loss or trauma (Figures 2 and 3). This article addresses only patients within this category.

Figure 4. Reflection of the flap at stage I implant surgery displays a significant vertical discrepancy between the labial crest at the extraction defect of the right central incisor when compared with that of the existing adjacent incisor. Placement of an implant without osseous augmentation would result in compromised soft tissue esthetics and/or increased peri-implant probing depth.

Esthetic reconstruction of deformed edentulous spans requires a three-dimensional perspective of the osseous topography. Optimal reconstruction would require inclusion of buccal and vertical enhancement of the osseous dimensions to allow for functionally and esthetically oriented placement of the implant(s) (Figures 4–8). Approaches that are limited only to the buccolingual dimension often result in not only inadequate support for the soft tissue but also poorly positioned implants that must then support excessively long clinical crowns.

Figure 5. One of two autogenous osseous blocks is harvested from the mandibular symphysis region.
Buser et al highlighted the following factors as additional contributors to predictable osseous augmentation procedures:\(^3\text{,}^4\):

- Decortication of the bone to establish a bleeding surface that may act to enhance the availability of undifferentiated cells and blood vessels from the marrow spaces.
- Stabilization and close adaptation of the membrane to the surrounding edges of the defect.
- Autogenous grafts to help maintain the space and stabilize the clot.

Currently, extraction site defects and ridge resorption patterns that occur following tooth loss or trauma are routinely augmented by osseous grafting techniques alone or in conjunction with a barrier membrane.\(^3\) Guided bone regeneration (GBR) is an osteopromotive technique whereby soft tissue is excluded from the defect site by the utilization of a membrane, to encourage bone healing and bone neogenesis.

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**Figure 6.** A graphic representation of the placement and fixation of the graft using fixation screws. The graft aims at augmenting both the buccolingual and the vertical dimension of the resorbed ridge, thereby allowing for more ideal implant placement.

**Figure 7.** Placement of seven implants including the placement of two implants simultaneously with the autogenous grafts in the areas of the upper right central and left lateral incisors.
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Autogenous grafts for GBR can be acquired from extraoral sources, such as iliac crest, calvaria, and fibula, or much more frequently from intraoral sources, such as the mandibular symphysis (see Figure 5), retromolar region, or tuberosity. The selection of the donor site depends on the quantity of bone required as well as specific patient considerations. Of course, bone substitutes can also be used successfully; however, the authors traditionally avoid them whenever autogenous donor sites are available.

Osseous grafting techniques can be utilized in conjunction with implant placement or in a staged approach (see Figures 7 and 8). When a staged approach is used, preliminary ridge augmentation is followed by a 6- to 9-month healing period prior to implant placement (Figures 9–11). This approach is recommended in the

Figure 8. Cancellous bone chips are packed in around the block grafts prior to suturing.

Figure 9. A fixed provisional restoration is used to protect the grafted sites from transmucosal loading during the healing phase of osseointegration. A fixation screw is evident through the thin mucosal tissues.

Figure 10. Exposure of the graft at 6 months.
treatment of larger defects and to allow for more control in an esthetically driven implant placement protocol. In addition, once the osseous dimensions have been enhanced, a better foundation is created for recreating an optimal gingival profile.

DEVELOPING THE GINGIVAL PROFILE

Soft tissue profiles play a critical role in establishing optimal esthetics as well as facilitating long-term maintenance of implant-supported restorations. When deficiencies in gingival dimension compromise the desired restorative outcome, soft tissue enhancement procedures become an integral component in the comprehensive approach of implant site development aimed at reestablishing esthetic balance. Especially challenging is the recreation of the anterior peri-implant papilla. Depending on the specific periodontal and/or esthetic needs of the patient, sequence of therapy may dictate that soft tissue augmentation be performed before, during, and/or after implant placement.

Figure 11. Coping transfer impression is performed at stage II surgery.

Figure 12. A diagrammatic representation of the submerged healing abutments in guided gingival regeneration along with the resultant dead space. This space allows for clot formation, reorganization, and subsequent replacement by connective tissue.
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The traditional stage II surgical protocol to expose previously submerged implants includes a simple crestal incision to access and remove the cover screw. This is followed by the connection of restorative or healing abutments and the approximating of the flaps to the buccal and lingual contours of the abutments. Under conditions requiring buccolingual enhancement, a palatal incision is performed and the labial flap is rolled from the palate to the buccal to enhance the width of the keratinized gingival collar as well as the horizontal dimensions of the soft tissue profile. In the anterior region, however, where the creation of an optimal gingival profile, including papillae, requires significant vertical augmentation to modify an existing flat profile, a modified surgical protocol that is capable of three-dimensional soft tissue enhancement becomes necessary.

Figure 13. Two weeks following exposure of the fixtures. At stage II an effort to further optimize the vertical dimension of the gingival profile in the extremely challenging right quadrant is undertaken, using the protocol of submerging healing abutments and guided gingival regeneration. Notice that in the area of the left lateral incisor, the profile is adequate and the standard protocol was used.

Figure 14. Fabrication of custom restorative abutments. (Metal: Al Nelson, Amsterdam Laboratory, Philadelphia, Pennsylvania)
As part of an esthetically oriented revision of the standard protocol, the authors have suggested new therapeutic guidelines to optimize the three-dimensional enhancement of the peri-implant gingival profile to develop anterior esthetics. In this approach, enhancing the osseous dimensions whenever necessary remains a primary prerequisite. In demanding esthetic environments, this soft tissue management protocol purposely creates "dead space" below the flap during stage I implant placement, by tenting the repositioned flap over healing abutments of appropriate height rather than the traditional flat cover screws (Figure 12). In especially complex cases, where significant bone grafting is performed concomitantly with implant placement, this technique is reserved for stage II surgery (Figure 13).

Submerging the healing abutments serves to support the flap in the important vertical plane as well as to protect the blood clot during the healing phase (see Figure 13). Since no membrane is utilized, the significant dead space created can only be filled in with connective tissue. This approach is termed guided gingival regeneration and can be summarized as guided tissue regeneration without a membrane.

Figure 15. A new provisional restoration is fabricated to incorporate and test the new abutments and their restorative profiles.

Figure 16. The provisional restoration shortly after insertion. The lower incisors were bonded and a therapeutic vertical dimension reestablished, thereby diminishing the deep overbite.
PROTOCOL FOR GUIDED GINGIVAL REGENERATION

The technique for guided gingival regeneration utilizes a horizontal incision palatal to the crest of the implant site. This incision extends to the palatal transitional line angles of the adjacent teeth and is only 2 mm deep. A palatal partial thickness flap is raised, and the remaining underlying connective tissue is scored on its periphery and elevated as part of the labial full thickness flap. This flap design, in effect, increases the working length of the labial flap, usually by 5 to 7 mm.

The final step involves choosing a healing abutment that is capable of supporting the flap vertically to the level of the adjacent papillae in the natural dentition. The healing abutments are placed and the flap advanced sufficiently to cover it without tension. In many cases, since the flap acquires extra length from the palatal extension, it requires minimal advancement and usually does not alter the relation of the mucogingival junction or the depth of the vestibule. However, when the palate is thin and partial thickness dissection is impractical, significant advancement of the labial flap is required. This often requires a secondary subepithelial connective tissue graft procedure, labially, at a later date, to reestablish vestibular depth. In addition, for augmentation of even larger horizontal defects, an interpositional
subconnective tissue graft can also be placed beneath the flap for added bulk.

DEVELOPING THE RESTORATIVE PROFILE

Once the osseous and gingival dimensions have been brought into balance, the resulting harmony and continuity of form must be extended to include the restorative components. The final esthetic result will depend on the shape and contours of the final restoration and the manner in which it emerges from the gingival tissues. Management of this important restorative gingival interface is the final therapeutic constituent in the development of the esthetic profile.

To achieve the optimal relation in the restorative gingival equation, the authors utilize transfer impressions that relate the position of the head of the implant and the surrounding gingival contours in the mouth to a soft tissue laboratory model (see Figure 11). These mounted models are then used to custom fabricate restorative abutments with the specific necessary contours to support the desired gingival and restorative profiles (Figure 14). During the provisional phase, the design of the restorative components is examined and altered as necessary to achieve and maintain the health of the periodontal tissues at the restorative gingival interface (Figures 15–17). This evaluation must be

Figure 18. A and B, The lateral profile.
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constantly repeated during this phase to ensure the health and adequate stability of the result.

In addition to allowing evaluation of the restorative contours and gingival support, the provisional restoration acts as a template that allows the testing of esthetic and occlusal schemes as well as phonation and comfort (Figure 18). The provisional restoration also allows for the provisional loading of the implants and the regenerated osseous tissues. Only when all the parameters of the envisioned final restoration are fulfilled, including patient satisfaction, should the final restoration be taken to completion (Figure 19).

Figure 19. A, The lateral high smile profile; B, the mandibular restorations; C, the esthetic profile. Compare with Figures 2 and 3.
SUMMARY

Soft and hard tissue ridge deformities are prevalent in areas of tooth loss and trauma and can compromise esthetic outcomes. Only a full understanding of the severity of the dimensional defects, the reconstructive techniques available, and the functional and esthetic needs of the final implant restoration will allow the design of a treatment approach that will achieve the desired outcome. This article emphasizes the synergistic relation of the osseous, gingival, and restorative triad in treatment planning. In addition, a systematic approach to the enhancement of this triad, in the partially edentulous patient, is outlined as part of a revised protocol for achieving optimal esthetics in implant therapy.

REFERENCES


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