Soft Tissue Recession Around Implants: Is It Still Unavoidable?—Part II

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Implant therapy is a predictable method of replacing lost teeth and involves consideration of numerous surgical and restorative criteria. Part I of this article explained the behavior of the hard and soft tissue around the implant and reviewed various parameters that influence tissue remodeling. Part II emphasizes surgical factors (eg, tridimensional implant placement, platelet-rich fibrin, and the use of connective tissue grafts) and restorative factors as means of limiting soft tissue recession around implants.

Learning Objectives:
This article discusses tridimensional implant placement and the use of connective tissue grafting to complete the aesthetic restoration. Upon reading this article, the reader should:

- Become familiar with how platelet-rich fibrin enables the simple, effective, and predictable management of the gap between alveolar bone and an implant.
- Understand the benefits of connecting the final abutment at the surgical stage and leaving it undisturbed.

Key Words: gingival recession, implant, biologic width, platelet-rich fibrin (PRF), connective tissue graft (CTG), components

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Successful implant therapy can no longer be judged by whether or not the implant simply osseointegrates. Even precise ceramic duplication of the shade, contour, and translucency of natural dentition may still result in an aesthetic failure if the gingival profile, color, and texture are inadequate. Therefore, functional and aesthetic success of implant treatment in the anterior zone depend not only on the quality of the restoration, but also on the final aspect of the contour and stability of the marginal gingiva and the proximal papillae in harmony with the adjacent teeth.[1]

The presence of bone tissue around the implant collar seems to be a determining factor in aesthetic success. Therefore, the precise position and orientation of the implant in the tridimensional space during its placement are fundamental to the quality of the final result. The presence of the papilla and the maintenance of the harmonious gingival margin for anterior implant restoration depend on two parameters: implant placement and implant restoration.[2-4]

The buccal orientation of the implant will impinge upon the buccal cortical wall, inducing bone resorption, apical migration of the gingival margin and, consequently, a longer crown. Therefore, if immediate implant placement with non-functional temporization is indicated, the osteotomy is performed against the palatal wall, leaving a gap to prevent any trauma on the remaining (and usually thin) buccal cortical bone.[5]

Platelet-Rich Fibrin

For several years, various forms of platelet concentrates have been used topically during implant surgery. Platelet growth factors, along with their reported healing benefits, have assumed a unique form: platelet-rich fibrin (PRF). Quite different from other platelet concentrates,[6] PRF can be considered to be an autologous healing biomaterial: a fibrin clot that concentrates the leucocytes, platelets, and a large majority of the molecules beneficial for immunity and healing into one single membrane.[7] Within the past five years, the use of PRF has developed enormously and has continued to demonstrate its efficiency and its potential applications in bone grafting and mucogingival procedures,[8] including the prevention of peri-implant gingival recession.

Figure 1. Case 1. Initial clinical aspect with loose central incisors and internal haemorrhage.

Figure 2. Immediate adjacent implant placement with an advanced flap over the connective tissue graft and temporary crown.

Figure 3. View of soft tissue healing with harmonious contour six months postoperation.

Whether PRF functions by a purely mechanical action as a standard resorbable membrane, or whether it acts in combination with the different factors captured by its fibrin network, thus transforming it into an active biological membrane, it has been clinically proven that PRF enables the simple, effective, and predictable management of the gap between alveolar bone and implant. This, in turn, allows the prevention of secondary gingival recession by maintaining the future level of the biologic space.

This PRF can be used alone when there is a minimal gap between bone and implant. For a more substantial gap (or in the absence of one or more cortical walls,

Figure 4. Ceramic restoration with harmonious marginal and papilla contour one year postoperation.

Figure 5. View of the left side of the ceramic restoration one year postoperation.

dehiscence, or in an extraction site where immediate implantation is contraindicated), PRF will be used in conjunction with allogenic bone or with synthetic bone substitutes to minimize the number of surgeries. Lastly, in the case of crestal bone augmentation, either horizontal or vertical, the application of PRF membranes to cover autogenic or allogenic bone grafts is particularly useful.

Connective Tissue Graft

A thick biotype with a large amount of attached keratinized gingiva will have greater resistance to traumatic or inflammatory recession, whereas a thin biotype is more susceptible to peri-implant recession induced by the resorption of the thin labial cortical plate. The use of connective tissue grafts converts a thin gingival biotype into a thick one.[9] Gingival biotype also plays an important role in tissue levels achieved around implants; therefore, these grafts can enhance gingival margin stability and improve tissue management throughout the restorative treatment phase. An adequate zone of attached gingiva may also be necessary around implants to conceal the implant collar and the abutment/restoration interface interproximally.[3,10]

In a recent study, bioabsorbable barrier membranes and enamel matrix derivatives (EMDs) enhanced healing following the immediate placement of transmucosal implants into extraction sockets.[11] The membrane group, however, obtained more favorable results compared to the EMD group in terms of both the probing attachment level and the peri-implant position of soft tissue, enhancing hard and soft tissue healing, particularly in areas with high aesthetic demands (Figures 1 and 2).

Abutment and Restoration

In order to retain soft and hard tissue around the implant abutment, the transmucosal aspect connection of the abutment design should not be oversized and divergent but rather narrow and concave in shape in order to thicken and immobilize the circular soft tissue around connection. This will induce the thickening of the connective tissue and will increase the interface between the implant and the soft tissue, creating a connective tissue "O-ring," which will ensure long-term stability of the biologic width.[12]

Beneath the restoration, the abutment should provide maximum space to the soft tissue and clearly avoid a flared geometry. Its submergence profile needs to be negative to avoid compression on the soft tissue and allow maximum thickness and stability to the latter, as well as more room for the biologic space.[13] This feature proves to be beneficial to the soft tissue, which is thickened and immobilized. The mucosal O-ring resulting from this architecture prosthetically improves the biotype and creates a vertical gain in the level of the peri-implant mucosa in 70% of cases, and stabilizes this level in 25% of cases.[14]

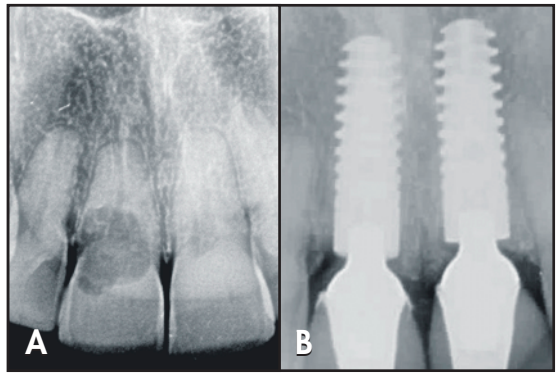

Figure 6A. An x-ray of the cervical bone on the implant platform one year after the restoration was placed.
6B. Initial x-ray of the central incisors showing internal resorption and short roots.

In order to avoid numerous connections and disconnections of prosthetic components and/or abutments, it is now suggested to connect the final abutment at the surgical stage and to leave it undisturbed, particularly in patients with thin and moderate biotypes. Therefore, installation of the final abutment at the time of implant placement transforms the two units into a single unit. The rationale for this transformation is the knowledge that soft tissue instability after implant placement may jeopardize the seal around the implant and affect aesthetics. When disruption of the biological width occurs, caused by the repeated connection of the abutment, the connective tissue and the junctional epithelium tend to migrate apically beyond the implant abutment junction (IAJ) until they can adhere again, which often results in marginal bone loss, particularly in thin gingival biotypes. Optimal aesthetics will result when the final abutment is installed at the time of implant placement and left undisturbed throughout the final restoration phase, improving the maintenance of bone and soft tissue architecture.[1]

Model-guided and computer-guided techniques are gaining ground in this specialty. They allow the implant abutment to be prepared in the laboratory prior to surgery and its design to be scanned (or impressed) before connection. Thus, a simple pick-up impression can take place at the time of crown fabrication without harming the mucosal seal, which will recede—often at the expense of the crestal bone, except in the case of thick soft tissue.

Biomaterials for prosthetic components should be limited to titanium, aluminum, or zirconium oxides, which are the only materials that will allow adhesion to the junctional epithelium, hemidesmosomes, and connective tissue fibroblasts. Gold or glazed ceramic materials should be avoided since they are not biocompatible transmucosally and induce the repositioning of the mucosal seal more apically on the implant neck, often at the expense of the bone.[15]

In implant/abutment connections, where a microgap is present, microbial leakage could lead to inflammation and marginal bone loss. Thus, it is important to minimize the bacterial presence in and around the IAJ. The seal provided by a locking-tapered design abutment has been demonstrated to be hermetic with regards to bacterial invasion in vitro.[16]

Two weeks after surgery, the recontouring of provisional crowns and chairside addition of self-cured acrylic should induce minimal pressure on the buccal margin, optimal pressure on the adjacent papilla, and apicalization of proximal contacts (Figures 3 through 6). This Cervical Pressure Concept is only valid proximally and not facially, where soft tissue and collagen bundles should be stretched or compressed for papilla stimulation.[17]

Figure 7. Case 2. Healed site displaying keratinized tissue, which is indicated for flapless surgery.

Figure 8. Flapless surgery was accomplished, and an internal connection implant (ie, Nobel Speedy Replace, Nobel Biocare, Yorba Linda, CA) was placed.

The platform switching concept utilizes a smaller-diameter abutment platform to allow the formation of the biological space on the remaining platform of the implant.[18] It incorporates a coronal-bevel design implant that medializes the IAJ. The undercontour of the prosthetic abutment, in comparison to the implant platform, allows the possibility to change the vertical biological space into a horizontal and a vertical component, keeping the same total biological dimension. The bone, located away from the implant prosthetic abutment connection, should not resorb as usual for the regeneration of the biological width. The total immobilization of the prosthetic abutment will prevent any micromovement responsible for cervical bone resorption and maintain the horizontal component of the biological width. This thickens the connective tissue and ensures improved microgap isolation. This concept achieves and potentially enhances crestal bone preservation, decreases the amount of peri-implant cervical bone resorption, and may attain a more predictable level of stability in the soft tissue.

Figure 9. An abutment (ie, prototype Concept Abutment, Nobel Biocare, Yorba Linda, CA) was selected to thicken and immobilize the soft tissue barrier, thus protecting the underlying bone.

Figure 10. The titanium biological abutment was customized chairside and connected to the implant. It would not be disconnected to prevent disruption of the mucosal seal.

On the buccal aspect, the emergence profile of the provisional and final restorations should be flat or concave (ie, undercontoured), keeping the free gingival margin more coronal. Any increased bulk is detrimental to the vertical level of the peri-implant soft tissue and is responsible for gingival recession.

As stated above, the presence of the papilla and the maintenance of the gingival margin for anterior implant restorations depend not only on the implant placement parameters, but also on the implant restoration parameters. Early placement of single-tooth implants may be preferable to the delayed implant placement technique in terms of early generation of interproximal papilla, the gingival margin level, and the achievement of an appropriate clinical crown height. But no difference in papilla dimension was seen 1.5 years after placement of the implant crown (Figures 7 through 12).[19]

Tooth form in natural dentition is classically described as square, elliptical, or triangular. If the above parameters are respected, decreasing distance from the interproximal bone peak to the apical point of the contact surface between the implant restoration and the adjacent tooth, or between implants, will result in a squarer tooth form, which will compensate for the loss of a portion of the interdental papilla by regenerating it. This is particularly true in the thin scalloped periodontium,[20] which may necessitate some type of restorative work on the adjacent tooth.

Occlusal Trauma

Excessive pressure causing deformation of the bone around titanium implants can cause fracture of the bone and can also induce bone resorption in an aseptic environment.[21] The biological response of the bone to mechanical tension around implants is similar—only the zone of stress concentration changes. It has been proven that an excessive occlusal load during function can cause the loss of peri-implant bone.[22] During the first year of function, bone loss around implants in poorly adapted bone follows a similar contour to that of the zone of tension.[23] The use of a tapered implant design decreases the stress on the implant, moving it away from the collar, and allows a better distribution of forces along the body of the implant, which will indirectly minimize cervical bone resorption. The control of horizontal occlusal forces during the first months of function is a determining factor in reducing stress in the crestal zone, in enabling bone adaptation, and in minimizing crestal bone loss.

Discussion

The use of a dental implant to replace a single tooth is considered a predictable and successful treatment.[24] Nevertheless, to replace a missing single anterior maxillary tooth with an implant is a challenge because of the high aesthetic, functional, and biological demands.[25,26] Thus, patient motivation and plaque control, systematic presurgical scaling and root planing of remaining teeth (with or without periodontal procedures), and the commitment to comply with a rigorous periodontal follow-up and maintenance are imperative to the potential success of the different protocols of aesthetic therapy.

In the mature healing site, various degrees of osseous resorption and concomitant soft tissue deformity inevitably take place. Aesthetic deficiency relates to the lack of original osseous formation and to the loss of a soft tissue profile, and occurs in either horizontal, vertical, or combined dimensions.[27] To restore the aesthetics of these profiles, it is necessary to use the two-stage approach with a bone graft membrane and/or a connective tissue graft over the buccal and/or incisal aspect of the ridge. After a few months, the implant is placed with or with-

Figure 11. Postoperative view of the alumina-based digital-ceramic crown. Note the harmonious soft tissue integration.

Figure 12. In this procedure, where the abutment was never disconnected, the stability of the crestal bone level can be observed.

out a healing abutment of a height coincident with the tips of the adjacent interdental papillae, to create a base of dense connective tissue.[28]

After three months, there is no difference between crestal alveolar absorption with or without the placement of an implant. Placing an implant in an alveolar extraction site makes it impossible to fight against bone resorption. As a result, the positioning of an implant in an alveolar extraction must take into account future crestal resorption.[29]

Rough surfaces, a deeply located junction in relation to the prosthesis, undersized prosthetic pillars, proximity between implants, gingival biotypes—all of these phenomena are now the subject of more advanced research in order to minimize tissue resorption that was once thought to be unavoidable. A multi-center study during a 36-month period has provided statistics on the biological variations of the gingival-osseous at cervical peri-implant contours, showing 1 mm to 2 mm of bone resorption in 83% of the cases and 1 mm to 2 mm of gingival recession in 94% of the cases.[30,31]

All peri-implant mucogingival techniques originate from periodontal surgery. Peri-implant recession can be prevented by the overbuilding of the site and the addition of bone on the buccal cortical plate before or in conjunction with implant placement. In addition, connective tissue grafts can be added in combination with implant placement or during the integration phase, and/or at the abutment connection/temporary restoration. A palatal pedicle flap could also be used to improve the papilla and soft tissue.[32,33] A buccal pedicle flap—combined with a connective tissue graft—could be used as a treatment alternative as well in a thick-flat biotype, where there is a great width and thickness of tissue on the teeth adjacent to the peri-implant recession.

In a recent study, there was no significant relation between marginal bone loss and aesthetic satisfaction or success. This means that bone loss can occur with a satisfactory aesthetic result in case of a thick biotype. The clinician should be aware of the fact that marginal bone loss might not influence or impair the aesthetic result. In this study, bone loss did not impact upon the aesthetic outcome. This could be attributed, among other causes, to the biotype thickness, which was not studied therein.[34]

Conclusion

Advances in surgical techniques and implant materials have moved implant treatment beyond functional integration and towards restoratively driven principles with a heightened awareness that favorable results will also depend on biological driven therapy. Avoiding soft tissue recession, especially in thin and moderate biotypes, requires that several criteria be respected. Among them, biological principles are essential, which at present force clinicians to alter the design of the implant/collar and abutments in order to prevent or reduce crestal bone remodeling and to increase and stabilize the volume of the soft tissues. Surgically noninvasive procedures, that are flapless surgeries, are recommended. Yet, when raising the flap is mandatory, grafting soft tissue is favorable, which improves the biotype and creates a certain level of soft tissue stability. Immediate implantation after extraction has recently proven that it does not preserve hard and soft tissue, but is highly favorable to the aesthetic outcome if some surgical and prosthetic rules are respected.[29]

Several changes need to be implemented in the implant hardware and surgical procedures in order to reduce or prevent tissue remodeling. Rough-surface implants with a micro-groove design present better bone-implant

contact in the collar area. The micro-grooves reduce crestal bone loss and allow for a better healing when the implants are loaded.[35] Prosthetic procedures should avoid multiple connections/disconnections of prosthetic components and involve biocompatible materials transmucosally. Therefore, model-guided and computer-guided techniques are recommended. They allow the preparation of customized abutments, along with an accurate surgical template and provisional restorations in the laboratory prior to any surgical sequence. Thus, abutments can be scanned or impressed before stage one, and a simple pick-up impression of the ceramic coping performed a few weeks after—which will not disrupt the mucosal seal. Since peri-implant stability is a complex multifactorial issue, summarizing the ideal approach is not an easy task. Additional research and development is needed, along with a better understanding of the biological environment, to address this problem for everyday practice.

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Continuing Education (CE) Exercise No. 3

To submit your CE Exercise answers, please use the answer sheet found within the CE Editorial Section of this issue and complete as follows: 1) Identify the article; 2) Place an X in the appropriate box for each question of each exercise; 3) Clip answer sheet from the page and mail it to the CE Department at Montage Media Corporation. For further instructions, please refer to the CE Editorial Section.

The 10 multiple-choice questions for this Continuing Education (CE) exercise are based on the article "Soft tissue recession around implants: Is it still unavoidable?—Part II," by André P. Saadoun, DDS, MS, and Bernard Touati, DDS, MS. This article is on Pages 81-87.

1. Platelet-rich fibrin (PRF) can be used in conjunction with allogenic bone or synthetic bone substitutes. This will minimize the number of surgeries.
a. Only the first statement is true.
b. Only the second statement is true.
c. Both statements are true.
d. Neither statement is true.

2. Titanium, aluminum, and zirconium oxides are the only materials that will allow adhesion to:
a. The junctional epithelium.
b. Hemidesmosomes.
c. Connective tissue fibroblasts.
d. All the above.

3. Adding a connective tissue graft during implant placement or at the time of implant exposure will:
a. Provide resistance to inflammatory recession.
b. Prevent resorption of the cortical plate and peri-implant gingival recession.
c. Convert a thin biotype into a thick biotype.
d. All the above.

4. Prosthetic procedures should avoid multiple connections/disconnections of prosthetic components. They should also involve biocompatible materials transmucosally.
a. Only the first statement is true.
b. Only the second statement is true.
c. Both statements are true.
d. Neither statement is true.

5. Nowadays, the final abutment should be connected and left undisturbed. This is particularly true in patients with thick biotypes.
a. Only the first statement is true.
b. Only the second statement is true.
c. Both statements are true.
d. Neither statement is true.

6. In order to retain hard/soft tissue around the implant, the transmucosal abutment should be:
a. Oversized.
b. Divergent.
c. Convex.
d. Concave.

7. The negative profile of the abutment submergence profile will NOT:
a. Thicken the soft tissue.
b. Improve the biotype.
c. Violate the biological width.
d. Enhance the aesthetic result.

8. Biomaterials for prosthetic components should be limited to:
a. Titanium.
b. Aluminum.
c. Zirconium oxides.
d. All of the above.

9. What statement about the switch platform concept is NOT correct?
a. It allows the formation of the biological space partially on the platform.
b. It changes the biological space formation in horizontal and vertical components.
c. It enhances cervical bone preservation.
d. It achieves peri-implant soft tissue recession.

10. Different morphological changes have occurred in implant design and on surfaces. Which of the following statements is correct?
a. Micro-grooves inside the thread activate the osseointegration process.
b. Micro-grooves at the collar are one of the most effective designs to maintain the marginal bone level against functional loading.
c. Both a and b.
d. None of the above.