

A NEW CONCEPT FOR OPTIMIZING SOFT TISSUE INTEGRATION

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In implant dentistry, soft tissue integration is the essential criterion of restorative success since osseointegration has become a routine and predictable phenomenon. In the anterior zone, the architecture, position, contour, and stability of the peri-implant mucosa – along with interproximal papillae – determine the aesthetic outcome of implant procedures. Yet in the literature, marginal bone remodeling of 1mm to 1.5mm and soft tissue recession are often considered unavoidable.¹ Therefore, clinicians acknowledge that implant placement in the anterior area can be risky, especially in thin periotypes, because some gingival recession frequently occurs after abutment connection. This is why the grafting of biomaterials, autogenous bone, and/or connective tissue is performed prior to or during implant placement in order to thicken the peri-implant mucosa and to provide some measure of stability to the soft tissues.² This helps prevent recession even though some bone loss occurs. Is there a less invasive and nonsurgical procedure that allows one to avoid gingival recession? As demonstrated herein, the behavior of the soft tissues can be dramatically improved through the use of transmucosal components with an altered design (Figures 1 through 3).

While conventional abutments with divergent walls will compress and repel the peri-implant soft tissues, making them thinner and stretching the collagen bundles, the authors propose a paradigm shift. The transmucosal components' design should be concave, inwardly narrowed in order to positively impact the soft tissues. Of course, they should be composed of a biocompatible material (eg, titanium, alumina, or probably zirconia) that allows adhesion of epithelium and connective tissue cells and avoids gold alloys and glazed laboratory ceramic.

Gingival recession occurs with implants that have displayed some bone loss because their mucosal barrier is quite different from the seal around teeth.³ On natural teeth, the gingival ligament has a major role in attaching the gingivae to the roots through collagen bundles deeply inserted into the cementum (ie, Sharpey's fibers). The network of collagen bundles is also more cross-linked and is more firm with four types of bundles (eg, transeptal, circular, dentoperiosteal, dentogingival).



Figure 1: Root fracture of tooth #8 (11) following trauma. The teeth are splinted as an emergency treatment.



Figure 2: Provisional crown after 4 weeks. Note the soft tissue quality and the improvement of its vertical position.



Figure 3a: Preoperative view of root fracture.



Figure 3b: Radiograph of the Concept abutment (Nobel Biocare, Yorba Linda, CA) on the seated implant.

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Figure 4a: The length of the mucosal seal is 3 mm when vertical distance between prosthetic chamfer and implant platform is only 2 mm in height.



Figure 4b: Abutment design.



Figure 5a: Mucosal ingrowth creates a connective tissue O-ring that augments soft tissue thickness.



Figure 5b: View of mucosal thickening, with the O-ring effect clearly visible.

On implants, such an insertion of collagen fibers is currently impossible.⁴ The mucosa is never really attached to smooth surfaces but simply adherent to them. Therefore, the mechanical resistance of the connective tissue adhesion is low. When bone support is lacking, the mucosa easily recedes because of connective tissue detachment from the smooth titanium or zirconium oxide surfaces. Recently, rough transmucosal surfaces have been proposed, and histological studies are showing that the collagen fibers penetrate the pores of the oxide surface. This improvement, along with a more perpendicular orientation of the fibers, may improve mucosal adhesion.⁵ Yet at present, the network of collagen bundles is only composed of circular and transeptal fibers, giving a less cross-linked, weaker, less vascularized structure. This is one of the reasons why long interdental papillae may not be compared to short interimplant papillae made of mucosal scar tissue.

Clinically, in order to optimize the aesthetic results, efforts must be made essentially in two directions: 1) to optimize the soft tissue seal, or 2) to prevent bone remodeling.⁶ The Concept Abutment and biological interface aims at improving both aspects. It has been used in the authors' study with a prototype Nobel Biocare implant with TiUnite grooves up to the top, comparable to the Nobel Speedy Replace implant (Nobel Biocare, Yorba Linda, CA).

Optimizing the Soft Tissue Seal

For years, conventional abutments displayed a transmucosal design with divergent walls. This classical architecture in the

submerged area mechanically compresses the peri-implant mucosa, making the periotype thinner and thus making the tissue even more fragile. Natural teeth never display such a contour below the cemento-enamel junction. Thus, this feature clearly results from a wrong prosthetic interpretation of the emergence profile in the transmucosal zone. In combination with the lack of true anchorage of connective tissue fibers into implant/abutment surfaces, this compressive effect of voluminous and divergent abutments is responsible for the recession of soft tissues. On the contrary, a convergent, narrow, and concave negative profile induces thicker and more stable and tighter peri-implant mucosa (Figure 4). This design establishes a mechanical interlocking of the mucosa three-dimensionally.

A concave profile at the transmucosal level creates an empty chamber where a blood clot will form, which will be composed of connective tissue cells. The result is a thickening of the connective tissue by a regenerative and nonsurgical method, comparable to a localized connective tissue graft. This concave transmucosal design permits a length of 3 mm for the mucosal seal (eg, the biologic width) despite only a 2-mm distance between the implant platform and the crown margin.

A tight biological barrier of the soft tissues at the implant component's level is mandatory in order to protect the underlying bone crest from the external environment. A length of 3mm to 3.5mm is necessary to obtain this sealing effect around biocompatible implant components. Therefore, in the aesthetic zone, this reduced distance of 2mm has a positive effect and does not warrant placement of the implant at an

Table 1

No. of Patients	No. of Implants	Parameters of the Study			
		12 Months	9 Months	6 Months	3 Months
58	79	22	26	20	17

Table 2

Vertical Soft Tissue Behavior			
Vertical Gain	No. Vertical Loss	Recession <0.5 mm	Recession >0.5 mm
37 (~70%)	13 (~25%)	4	0
54 Internal connection implants placed in a one-stage approach with immediate function			

infrabony level that will then induce additional bone remodeling.

After maturation of the connective tissue regenerated into the empty chamber delineated by the implant's concave profile, an O-ring of tissue is formed (Figure 5). This O-ring mechanically locks and stabilizes the mucosa, giving long-term protection to the biologic seal against tearing upon strains and trauma.

The mobility of the peri-implant mucosa is highly deleterious because when tearing of connective tissue occurs with microbleeding, the protective role of the junctional epithelium induces the apicalization of the latter. By consequence, a layer of connective tissue of 1mm (in average) has to reform more apically – often at the expense of the bone crest.

In a multicenter retrospective study, a prototype implant design was used in combination with this Concept Abutment design. The prototype implant design consisted of a screw-type design with treads extending to the top (ie, the prosthetic platform) of the implant. The surface was a TiUnite surface. The aim of this preliminary study with the prototype implant and abutment was to observe the soft tissue behavior and vertical soft tissue stability. Soft tissue levels at day 1 were compared with the soft tissue level at 3, 6, 9, and 12 months after implant placement and abutment connection. In this study, 79 implants were placed in 58 patients. Of these, 54 implants were placed in a one-stage approach with immediate loading. These 54

implants were evaluated for vertical soft tissue behavior. For 58 implants, the observation period was more than 6 months. With this abutment prototype, in approximately 70% (n=37) of the implants a vertical gain was observed; 25% (n=13) of the implants showed no vertical loss and only four implants showed a recession of less than 0.5 mm. Since it is widely accepted in the literature that osseous and soft tissue remodeling occurs within a 6-month period and because an average vertical soft tissue loss of 0.5 mm to 1 mm is considered in the literature to be normal, these data and observations can be considered to be noteworthy. The thickening of the peri-implant mucosa has a positive effect on the tissue stability and even created in 70% of cases a vertical gain (Tables 1 and 2) due to the volume of mucosal augmentation (Figures 6 and 7).

Preserving the Bone Level

Marginal bone remodeling is obviously a multifactorial issue.⁶ The surgery-induced trauma can be highly detrimental for the release of a flap and induces some cell death, which provokes an inflammatory process and brings mediators of bone resorption. The more the bone is exposed and dried by suction, the more bone resorption occurs.⁷ This is the rationale for the use of conservative surgical approaches in these procedures.

Another factor that can have a major impact is the shear



Figure 6: View of tooth #8 beside implant in site #9(21). Concept abutment (Nobel Biocare, Yorba Linda, CA) was connected at stage-one surgery.



Figure 7: Postoperatively, the peri-implant mucosa shows no recession. In most cases, augmentation of mucosal volume creates a vertical growth in the incisal direction.

stress force that can appear at the bone/implant interface upon occlusal loading. Bone can hardly bear shear forces that will induce remodeling, while compression is stimulating for this tissue. The clinical result is that marginal bone remodeling will happen after the placement of the final restoration in zones where no effective three-dimensional interlocking between bone and the implant surface exists, while the chances for preserving an intact bone level will increase with the presence of retention elements up to the top of the implant. The Concept implant has grooves up to its top, thus allowing preservation of an intact bone level after final loading as observed in the radiographs (Figure 8). It must be observed that this bone is preserved despite the presence of the abutment/implant interface in direct contact with this bone level, demonstrating the absence of any detrimental effect of the so-called "microgap" on bone remodeling.

Conclusion

For optimal soft tissue integration, implant therapy should be biologically driven.⁸ Especially in thin and moderate periotypes, the respect of the mucosal seal is essential to prevent bone remodeling and soft tissue aesthetic repercussions. A shift in paradigm requires a concave transmucosal design for implant abutments made entirely of biocompatible materials that allow cell adhesion. The negative transmucosal profile induces an increase of thickness and immobilizes the soft tissues, creating a mucosal O-ring that nonsurgically improves the biotype. This mucosal growth provoked a vertical augmentation in 70% of the cases in the authors' study. Apart from abutments, it is clear that the subgingival aspect of provisional and definitive crowns should avoid a convex and flared profile except when one wishes to more apically relocate the free gingival margin around implants.

This new architecture allows more volume for the three-dimensional biological space, and this is why platform switching techniques have clinically proven to be successful in recent years. The Concept design can be implemented in one-piece alumina or zirconia implants and in narrow healing abutments. The preliminary multicenter study has shown promising results, confirming that a biological approach should now dictate the design of implant heads and abutments.

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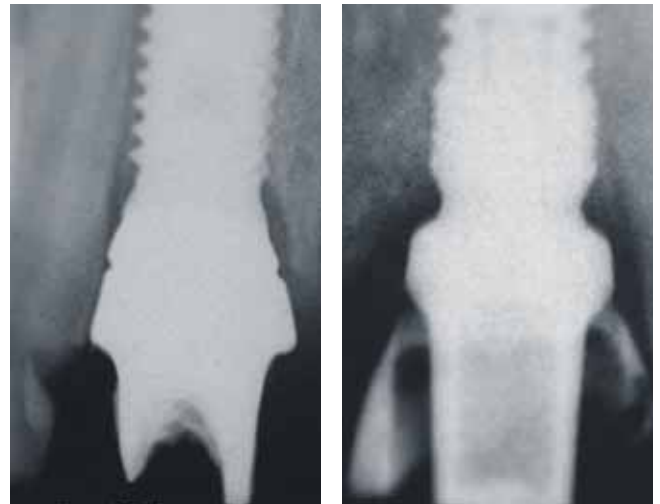


Figure 8a: Conventional abutment connection.

8b: Due to Concept abutment design, peri-implant mucosa is thickened; the crestal bone shows minimal remodeling.

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