The Effect of Implant Abutment Design on Long-Term Soft Tissue Stability: A Clinical Case Report

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Prosthetic rehabilitation of malpositioned anterior dental implants can be challenging. Interdisciplinary treatment planning and precise execution of biologically acceptable prosthetic and surgical protocols are essential to achieve optimal esthetic results and while avoiding and managing esthetic complications. This case study focuses on the restorative aspect. Two sets of custom gold abutments were used prior to and following surgical correction of a pre-existing soft and hard tissue ridge defect surrounding maxillary central incisor implant restorations. A stable and esthetically pleasing result was documented 7 years following delivery of definitive esthetic central incisor implant restorations.


The long-term esthetic outcome of anterior implant-supported crowns depends on a multitude of factors, including systemic and local disease, specific anatomy of the region, oral hygiene, and restorative design and execution.1,2 Controlled studies are impossible because no two patients are alike and few volunteers would likely be available to participate. Thus, the best way to learn is from well-documented clinical cases. Case reports of successes and failures, especially taken together, may provide clues as to which restorative approaches work best. This article reports on a case that presented with an esthetically unsatisfactory restorative situation. The patient was retreated with preprosthetic surgery and subsequent restorations, and the esthetic outcome was not only significantly better but stable over a follow-up period of 7 years. It is the purpose of this article to report the clinical procedures used and discuss the rationales behind them. Specifically, it reports how the combination of surgical pretreatment and concave restorative contouring led to an esthetic result that was stable and in harmony with the adjacent dentition.

A 30-year-old woman presented with a chief complaint of an “artificial” appearance and discoloration of the gingival tissues around the maxillary central incisor implants (Fig 1). The periodontal...
probing depths were 2 to 3 mm in this area, with the exception of midfacial depths of 5 to 6 mm at the sites of the central incisors. A thin gingival biotype was noted at the marginal soft tissue around the central incisor implant sites and the adjacent lateral incisors and canines. The mucosal tissues beyond the mucogingival margin were thin, discolored, and lacking support due to an underlying osseous ridge defect. Radiographic examination using periapical radiographs (RVG 5100, Carestream Health) and cone beam computed tomography images (Kodak 9500, Carestream Health) revealed that the implants were well integrated in acceptable mesiodistal and apicocoronal positions (Fig 2).

**Surgical Treatment Plan**

The surgical treatment plan consisted of simultaneous hard and soft tissue augmentation using autogenous bone, Bio-Oss (Geistlich), platelet-rich plasma (PRP), and a non-cross-linked Bio-Gide membrane (Geistlich) for guided bone regeneration (GBR). The goal was to eliminate the osseous ridge defect and provide proper support for the soft tissues.

The prosthetic treatment plan was to place new porcelain-fused-to-metal custom abutments and ceramic (IPS e.max, Ivoclar Vivadent) crowns on the existing implants in the sites of the maxillary central incisors and porcelain veneers on the adjacent lateral incisors. The sequence of treatment steps consisted of the initial provisional prosthetic phase, surgical procedures, the second provisional prosthetic phase, and the final prosthetic phase.

**Initial Provisional Prosthetic Phase**

A preliminary set of custom abutments and provisional restorations for the implants at the site of the maxillary central incisors was fabricated using a silicone index taken from a wax-up. The provisional restorations were temporarily cemented to allow the soft tissues to heal and assume their final contour. The abutments had a highly polished concave design and a supragingival finish line (2 mm) for
maximal coronal positioning of the grafts and cover flaps (Fig 3).

Surgical Procedures

A composite graft using a 1:1 ratio of Bio-Oss and autogenous trabecular bone harvested from the maxillary tuberosity was used. PRP was used to stabilize and mold the composite graft over the implants and to repair the peri-implant soft tissue dehiscence defects. A Bio-Gide membrane was placed over the composite graft and secured with the application of PRP. In addition, a connective tissue graft was harvested from the maxillary tuberosity using a scalpel with a 15c blade to ensure that the graft thickness was approximately 2.5 mm. A curvilinear papilla augmentation flap was then released with a periosteal incision, coronally advanced over the composite graft, and secured to a prepared connective tissue bed that included the adjacent marginal gingiva surrounding the lateral incisors. This was performed to provide a more natural and harmonious esthetic gingival outcome despite preexisting loss of the interdental and interimplant bone crest height and the corresponding support for the papilla.

Second Provisional Prosthetic Phase

At 3 months after surgery, the accessible intrasulcular finish lines were located approximately 1.0 to 1.5 mm within the sulcus. The provisional abutments were relined, repolished, and recemented for an additional 3 months to allow maturation and stabilization of marginal tissue (Fig 3).

At 6 months after surgery, the lateral incisors were prepared for veneers. Provisionals were made of Bis-acrylic material (Luxatemp, DMG) for all four teeth (Fig 4). Additive wax-up was used on casts mounted in maximum intercusption on a semi-adjustable articulator. The emergence profiles were shaped to distalize the zenith positions of the central incisors for improved esthetics. Provisional restorations were polished and glazed to minimize plaque accumulation.

Fig 3 (right) First set of provisional crowns and custom abutments before and after surgery.

Fig 4 (below) Diagnostic wax-up (a) and mock-up (b) with Bis-acrylic of the maxillary central and lateral incisors.
Prosthetic Phase

The second set of provisionals was left in place for 3 weeks. At that time, the prepared lateral incisors were cleaned and polished and the final impression was taken. Double gingival retraction cord (Ultrapak, Ultradent) was used for the right central and lateral incisors. Two impression copings were placed on the central incisors. A one-step final impression was taken using a closed-tray technique with polyvinyl siloxane material (Exaflex, GC). The permanent custom abutments (UCLA) were cast with a high-noble porcelain alloy (88% Au, 10 % Pt) to give the tissue a warm color. An opaque porcelain and fluorescent opaque dentin ceramic was used to camouflage the metal color to improve the luminosity of the restoration and optimize esthetics (Fig 5). A concave design was chosen to allow adequate space for the peri-implant connective tissues and minimize the risk of their apical retraction (Fig 6). A Duralay jig (Duralay pattern resin, Reliance) facilitated precise positioning of the custom abutments (Fig 7). Crowns and porcelain laminate veneers were made of porcelain (e.max Press LY, Ivoclar Vivadent) (Fig 8). The rubber wheel was used to retouch the tooth axis and interproximally to drive the healing and maturation of soft tissue more coronally and to enhance papilla growth. A long contact area was designed due to the preexisting short papillae to reduce the appearance of a black triangle (Fig 9).

The cementation procedure included the use of retraction cords. The inner surfaces were etched with 4.5% hydrofluoric acid (Ivoclar Vivadent) for 20 seconds, thoroughly rinsed with water, cleaned in an ultrasonic bath with alcohol for 5 minutes, air dried, silanized (Monobond-S, Ivoclar Vivadent), and dried again for 60 seconds. Tooth preparations were cleaned with pumice.
and rubber burs, enamel etched for 30 seconds with 37.5% phosphoric acid (Ultra-Etch, Ultradent), rinsed, and dried. A light polymerizing resin cement was applied to the veneers (Syntac, Ivoclar Vivadent; Variolink II, Ivoclar Vivadent) and a dual-cure resin cement (RelyX U100, 3M ESPE) was used to cement the restorations. The access holes of the abutments (Fig 10) were covered with an opaque composite (OB2, Gradia).

Clinical and radiographic examinations were performed at 2 weeks, 3 months, 7 months, 1 year, 2 years, and 7 years following delivery of the definitive restorations to monitor the biologic stability (Figs 11 and 12).

Discussion

The criteria for successful osseointegration of dental implants have been well documented.\textsuperscript{3–6} A multitude of factors determine the esthetic outcome of the soft tissue environment around implants and the restorations they support.
The success of this case is consistent with a recent pilot study that found concave abutment design preceded by soft tissue shaping to be advantageous. The literature suggests that a concave design reduces pressure on the margins of the cover flaps and allows for better blood circulation in this area. The concave gingival portion of the abutment can also help to guide tissue growth after hard and soft tissue augmentation surgery. The literature reports that platform switching (ie, smaller abutments allowing concave profiles) promotes more robust soft tissue thickness, stability, and adhesion, resulting in a better seal.

This case report discusses the rationales for the chosen design aspects and the clinical methodology of implementation. It is hardly possible to come to final conclusions regarding how similar clinical cases should be treated. However, by combining this report with others that may follow and with the reader’s own clinical experiences, a consensus may eventually emerge.

Conclusions

This case report suggests concave abutment design and a correct emergence profile of ceramic crowns have a positive and stable effect on soft tissue stability around implant-supported restorations that have undergone hard and soft tissue augmentation procedures. Furthermore, successful implementation of hard and soft tissue implant site development procedures facilitate the subsequent dynamic prosthetic soft tissue shaping procedures required to achieve optimal labial marginal tissue morphology and peri-implant soft tissue stability.

After 7 years, the length of the central incisor crowns appears shorter. This could be explained as functional, biologic, and esthetic integration of the restorations. Apicalization of the soft tissue around the implants improved significantly in relation to the emergence profile design of the abutments.

Precise interdisciplinary planning and execution of evidence-based and biologically acceptable surgical and prosthetic protocols were responsible for returning this patient’s beautiful smile and lost social confidence. An excellent esthetic result was achieved and maintained for a 7-year observation period in this particular case.

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