

A NEW IMPLANT DESIGN FOR CRESTAL BONE PRESERVATION: INITIAL OBSERVATIONS AND CASE REPORT

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Following the exposure and restoration of two-piece dental implants, some change in the vertical level of the peri-implant crestal bone height has been reported. This change in crestal bone height has not, however, negatively impacted long-term implant success. This article describes how the concept of platform switching is incorporated into a new implant design as a means of reducing or eliminating the occurrence of crestal bone loss. Preliminary observations from clinicians utilizing this new implant design are herein presented.

Learning Objectives:

This article discusses an inflammatory mechanism involved in crestal bone loss following implant restoration. Upon reading this article, the reader should:

- Be able to identify a mechanism involved in crestal bone loss following implant exposure.
- Understand how the concept of platform switching as a means of reducing or eliminating this occurrence is incorporated into a new implant design.

Key Words: implant, bone, resorption, platform switching

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Postrestorative reductions in crestal bone height around endosseous dental implants have long been acknowledged to be a normal consequence of implant therapy involving two-stage hexed implants.¹⁻⁴ Such remodeling does not typically occur as long as the implant remains completely submerged, but rather develops when an abutment is connected during second-stage surgery, when a two-stage implant is placed and connected to an abutment in a one-stage procedure, or when an implant is prematurely exposed to the oral environment and bacteria.⁵

Research by Hermann, et al demonstrated that crestal bone loss typically occurs approximately 2 mm apical to the implant-abutment junction (IAJ).⁶ This position appears to be constant, regardless of where the IAJ is situated relative to the original level of the bony crest.⁶ The researchers also demonstrated that the addition of a textured, bone-holding surface within 0.5 mm of the IAJ fails to prevent bone resorption within 2 mm apical to the IAJ.⁶

Investigations by various researchers offered explanations on why the presence of the IAJ appears to trigger resorption in the adjacent bone. Ericsson, et al found histologic evidence of inflammatory cell infiltrate associated with a 1-mm- to 1.5-mm-tall zone adjacent to the IAJ.⁷ Berglundh and Lindhe concluded that approximately 3 mm of peri-implant mucosa is required to create a mucosal barrier around a dental implant.⁸ This suggests that crestal bone remodeling may occur to create space when inadequate soft tissue height is present so that a biological seal can be established, which will isolate the crestal bone and protect it from the oral environment.

These investigations have focused on implant systems in which the diameter of the implant-seating surface matches that of the abutment. This ubiquitous design positions the abutment inflammatory cell infiltrate in direct approximation to the crestal bone at the time of abutment connection.

Platform Switching

The concept of “platform switching” refers to the use of a smaller-diameter abutment on a larger-diameter implant collar; this connection shifts the perimeter of the IAJ inward toward the central axis (ie, the middle) of the implant.⁵ Lazzara and Porter theorize that the inward movement of the IAJ in this manner also shifts the inflammatory cell infiltrate inward and away from the adjacent crestal bone, which limits the bone change that occurs around the coronal aspect.⁵ Crestal bone preservation has been reported on other commercially available implant designs, purportedly



Figure 1. Diagram of the Certain Prevail implant. Note implant body and implant collar taper to the restorative platform for standard prosthetics.



Figure 2. Preoperative facial view of nonrestorable fractured and carious central incisors.

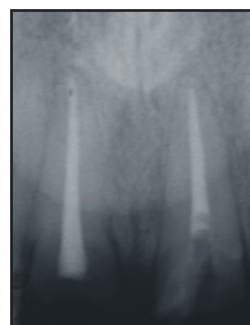


Figure 3. Initial radiograph where the central incisors had been endodontically treated and the margins were fractured apical to the crestal bone.

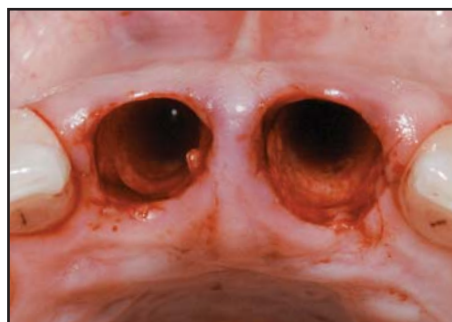


Figure 4. Occlusal view of the sockets taken after extraction. To avoid the risk of altering the soft tissue profile, a flap was not reflected.

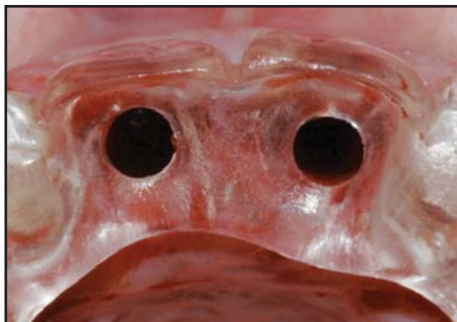


Figure 5. Clinical occlusal view of the surgical guide in place. The planned implant placement was identified by the holes in the surgical guide.



Figure 6. Clinical occlusal view of the implants in place. Note that the interdental papillae were maintained throughout the procedure.



Figure 7. Periapical radiograph taken immediately after implant placement. Note the vertical height of the interimplant bone.



Figure 8. Occlusal view of implants with healing abutments in place postoperation. The interdental papillae were not disturbed during the surgery.

attributed to microthreads at the coronal aspect of the implant, connection designs, occlusal schemes, or combinations thereof.⁹

In 1991, Implant Innovations, Inc. (3i, Palm Beach Gardens, FL) introduced 5-mm- and 6-mm-diameter implants with seating surfaces (ie, restorative platforms) of the same dimensions. These large-diameter implants, with a larger surface area, were intended to increase the amount of bone-to-implant contact when placing shorter implants in areas of limited bone height, such as under the maxillary sinus or above the inferior alveolar canal. The ability to increase the bone-to-implant contact by the use of wide-diameter implants also enhanced the likelihood of achieving primary stability in areas of poor-quality bone. At the time of the wide-diameter implants' introduction, no matching, similarly dimensioned prosthetic components were available. Hence, clinicians restored them with standard 4.1-mm abutments.

After a 5-year period, the typical pattern of crestal bone resorption was not observed radiographically in cases where platform switching was utilized. Lazzara and Porter theorize that this occurred because shifting the IAJ inward also repositioned the inflammatory cell infiltrate and confined it within a 90° area that was not directly adjacent to the crestal bone.

The ability to reduce or eliminate crestal bone loss can result in significant aesthetic and clinical benefits. In order to facilitate the practice of platform switching, the Certain Prevail Implant (3i, Implant Innovations, Inc., Palm Beach Gardens, FL) has been developed. Its design utilizes the Osseotite dual acid-etched surface, which maximizes the contact of bone to implant. The performance of the original Osseotite implant (an external-hexed, parallel-walled, hybrid design) has been shown in both in vitro and in vivo studies to perform differently from machine-surfaced versions.¹⁰⁻¹⁴

The coronal aspect of the Certain Prevail Implant is designed to be slightly wider than the diameter of the straight-walled implant body, flaring out at approximately a 30° angle and resulting in a collar diameter of 4.8 mm (Figure 1). This expanded collar can provide better engagement of the bone crest, better sealing of extraction sockets, and better primary stability. The collar then bevels back at a 15° angle to provide a color-coded restorative platform with a diameter of 4.1 mm. Restoring the 4.8-mm implant collar with the corresponding 4.1-mm prosthetic component shifts the IAJ inward, moving the inflammatory infiltrate away from the surrounding bone. To achieve this effect and maintain adequate soft-tissue depth, the implant should be placed crestally if sufficient soft tissue height and/or interocclusal space is present, or subcrestally if insufficient soft tissue height and/or interocclusal space is present.



Figure 9. Radiograph of the two implants with the 4-mm-diameter healing abutments in place. Note that the implant restorative platforms were subcrestal.



Figure 12. Two provisional crowns splinted together on the prepared implant abutments.



Figure 10. Occlusal view of master cast with soft tissue replicated in resilient material. The implant restorative platforms are color coded to simplify the restorative process.



Figure 11. View of the prepared abutments on the model. Platform switching is a design feature of the Certain Prevail Implant.

Case Presentation

A 28-year-old male presented with nonrestorable maxillary central incisors that had previously been treated endodontically, and then were subsequently fractured by trauma (Figures 2 and 3). The teeth were carefully extracted and, with the aid of a surgical guide, two 5.0-mm x 13-mm implants (ie, Certain Prevail, 3i, Palm Beach

Gardens, FL) were placed in a single-stage protocol (Figures 4 through 8). The specific implant diameters and lengths were selected by the clinician based on the size and shape of the individual sockets. The implants were placed in a flapless manner in order to protect the buccal cortical plate from injury to the vascular supply, which is often associated with a full-thickness flap. Moreover, great care was taken to avoid touching the buccal plate of the sockets during implant site preparation.

Healing abutments with 5-mm emergence profiles and 4.1-mm restorative platforms were immediately placed (Figures 9 and 10). The patient was then discharged with antibiotic and anti-inflammatory prescriptions.

After 3 days, two 4.1-mm customizable abutments (ie, GingiHue Posts, 3i, Palm Beach Gardens, FL), prepared by the dental technician on the master cast were inserted into the internal interface of the implants and torqued to 20 Ncm (Figures 11 through 14). These titanium abutments have a gold-nitride coating that eliminates graying of the marginal gingival tissue. Two acrylic provisional crowns were then luted to the abutments with temporary cement and adjusted out-of-occlusal contact, following the protocol of immediate nonocclusal loading (Figure 15).¹⁵ An intraoral radiograph was taken (Figure 16), and the patient was instructed to avoid loading the crowns for any purpose for at least eight weeks. Gentle brushing with a toothpaste containing chlorhexidine, was recommended.

Following a 2-month healing period (Figure 17), clinical osseointegration was confirmed and two metal-ceramic crowns were placed. The prognosis for maintenance of the interdental papillae was excellent. The definitive crowns were constructed on duplicate abutments made from a surgical index at the time of implant placement.

No additional implant-level impression procedure was required due to the technical prosthetic protocol, which allowed the construction of the definitive crowns



Figure 13. View of the peri-implant soft tissues and implant restorative platforms three days after placement. Note advanced healing of the soft tissues.

on a duplicated model and their subsequent delivery chairside (Figures 18 and 19).

Discussion

Clinical observation of the bone-preserving effects of platform switching has been ongoing for more than a decade. This procedure has been used by a number of clinicians successfully around the world.

The procedure requires that the “switch” be in place from the day the implant is uncovered or exposed to the oral cavity in either a one- or two-stage approach. It cannot be utilized after the establishment of the biologic width around a conventional implant-abutment interface configuration to regain crestal bone height. Potential applications include situations where a larger implant is desirable, but the prosthetic space is limited, in the aesthetic zone; where preservation of the crestal bone can lead to improved aesthetics; and where shorter implants must be utilized.

It is important to note that sufficient tissue depth (approximately 3 mm or more) must be present to accommodate an adequate biologic width. In the absence of sufficient soft tissue, bone resorption will likely result, regardless of the implant geometry.¹⁶⁻¹⁹ This sometimes requires that the implant platform be placed below the bone crest to obtain adequate tissue depth. Additionally, sufficient ridge width (ie, a minimum of 6.8 mm) must be present to accommodate the flared 4.8-mm implant collar. Case selection and management, however, may influence the clinical outcome and radiographic evidence of crestal bone preservation.

While bone preservation has been observed for some time as a result of the use of a standard-diameter abutment on a wider-diameter implant, the potential for confusion has existed for clinicians who have attempted to employ this strategy while using standard components. Laboratories and restorative dentists are accustomed to



Figure 14. Facial view of the prepared abutments in place. Their gold-colored titanium nitride coating helps to mask the metallic color of the titanium abutments.



Figure 15. Facial view of the provisional crowns immediately after cementation. The peri-implant soft tissues will adapt to the provisional crown contours.

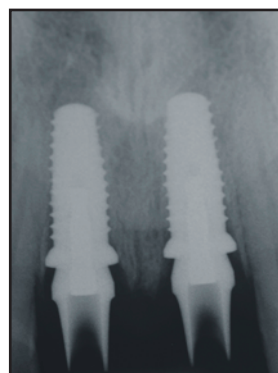


Figure 16. Radiograph at abutment connection, three days after implant placement. The implant restorative platforms of the abutments and implants are subcrestal.

working with matching-diameter implants and abutments. The color-coordinated scheme of the Certain Prevail Implant has been designed to ensure that the diameter of the implant-seating surface and the restorative platform of the abutment match, minimizing the possibility of confusion at the time of component selection, dental-laboratory processing, and prosthetic selection.



Figure 17. Clinical view of the soft tissue healing eight weeks after implant placement. The underlying bone supports the interdental papillae.

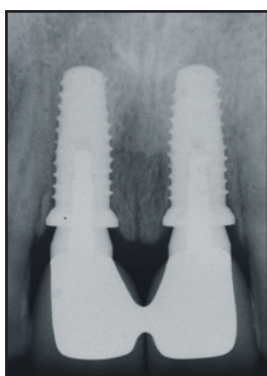


Figure 18. Radiograph of the definitive restoration. Note minimal remodeling of the interproximal bone and the absence of bone loss relative to restorative platforms.



Figure 19. Postoperative facial view of the definitive restoration in place. The final crowns were splinted for greater stability at the request of the patient, who had had the provisionals splinted.

Conclusion

Preliminary evidence suggests that the anticipated bone loss that occurs around two-stage hexed implants may be reduced or eliminated when implants are restored with smaller-diameter abutments, a practice termed platform-switching.⁵ A new implant design has been developed that facilitates this practice,

and initial clinical observations indicate the preservation of crestal bone results. Definitive clinical trials are currently underway.

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