

A SIMPLIFIED METHOD TO DEVELOP OPTIMAL GINGIVAL CONTOURS FOR THE SINGLE IMPLANT-SUPPORTED, METAL-CERAMIC CROWN IN THE AESTHETIC ZONE

Richard P. Kinsel, DDS* • Daniele Capoferri, CDT†



Prosthetic replacement of the missing single maxillary central incisor with an implant-supported crown represents a profound aesthetic challenge for the restorative dentist, laboratory technician, and surgeon. In addition to the visual fidelity of color, translucency, contour, and surface texture, the proper soft tissue outline is sacrosanct to the illusion of a natural tooth. The contrast between the uniformly round shoulder of the implant and the tooth's curvilinear cemento-enamel junction is particularly problematic. This clinical report demonstrates a simplified method that precisely controls the facial gingival and proximal soft tissue contours for implant-supported, metal-ceramic crowns in the aesthetic zone, using the cervical anatomy of the maxillary incisor tooth as a guide. A new role for the provisional crown that is intended to maximize the volume of keratinized tissue is also described.

Learning Objectives:

This article demonstrates a simplified method to precisely control the facial gingival and soft tissue contours. Upon reading this article, the reader should:

- Understand the advantages of developing the hard and soft tissues of the edentulous site prior to implant placement and restoration.
- Recognize the significance of the concavity of the root form.

Key Words: single-stage implants, metal-ceramic crowns, gingival morphology, osseous morphology, dental aesthetics

*Private practice, Foster City, California.

†Swiss Dental Design, Foster City, California.

Richard P. Kinsel, DDS, 1291 East Hillsdale Boulevard, Suite 143, Foster City, CA 94404
Tel: 650-573-8262 • E-mail: drcycle@aol.com

An optimal gingival frame surrounding implant-supported restorations is important in completing the illusion of natural teeth in the aesthetic zone.^{1,2} The osseous architecture surrounding healthy dentition follows the cementoenamel junction (CEJ) of teeth, which terminates approximately 2 mm apically, with a 3-mm gingival tissue overlay.³ The apical zenith of the facial gingival outline is located slightly distal to the mid-axis of the maxillary incisor (Figure 1).⁴ Although an implant-supported central incisor crown may closely duplicate the adjacent teeth, if the free gingival margins (FGMs) do not match, visual disharmony will ensue and the illusion will be lost (Figure 2).

Long-term maintenance of the surrounding hard and soft tissues is problematic due to the rotational restorative platforms of dental implants as opposed to the normal scalloped CEJ of natural teeth.^{5,6} In their comparisons of the vascular supply around teeth and implants, Buser et al and Berglundh et al found that the vascular supply surrounding teeth is derived from the supraperiosteal vessels lateral to the alveolar process and from within the periodontal ligament.^{7,8} The implant soft tissue blood supply, however, originates from the terminal branches of larger vessels from the bone periosteum at the implant site. While peri-implant soft tissues lateral to the implant have sparse blood vessels, soft tissue lateral to root cementum is highly vascularized.^{7,8}



Figure 2. The facial FGM of the implant-supported crown in tooth #8(11) lacked a distally inclined apex, which disrupted the overall harmony.



Figure 3. The challenge for the implant-supported crown lay in the transition from a flat rotational platform surface to the natural cervical anatomy.



Figure 4. The facial gingival contour of the implant-supported PFM crown on tooth #8 demonstrated harmonious gingival integration.

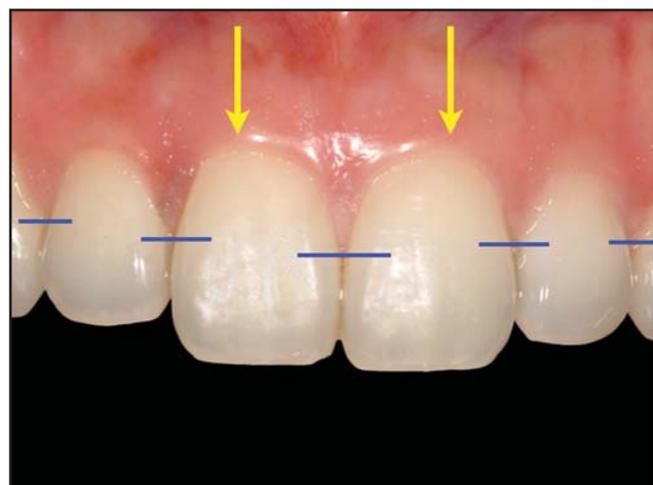


Figure 1. The appearance of healthy, natural dentition demonstrated the harmonious papillary positions and the zenith of the facial gingival margins, slightly distal to the mid-axis of the maxillary incisors.

A zone of avascular connective tissue is directly adjacent to the implant surface, whereas the connective tissue fibers are inserted into the dentin coronal to the bone and provide support for the soft tissues surrounding teeth.^{7,8} The differences in these histologic features explain why periodontal augmentation procedures that are predictably successful in natural dentition are often difficult to duplicate around dental implants.

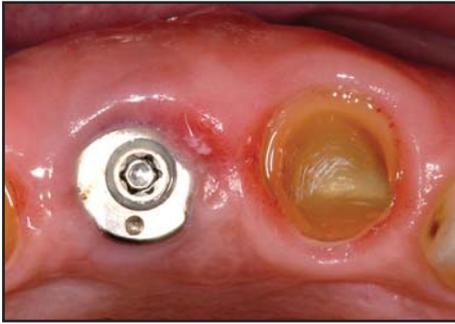


Figure 5. Excessive soft tissue was present in both the facial and coronal dimensions, and there was a lack of optimal papillary height.



Figure 6. No attempt was made to modify the soft tissue surrounding the implant.

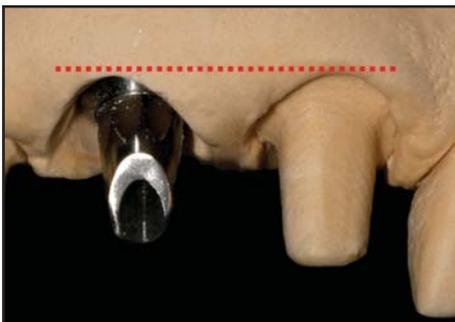


Figure 7. The master cast was modified to yield a facial gingival margin and emergence profile consistent with the adjacent central incisor.

It is, therefore, advantageous to develop the hard and soft tissues of the edentulous site prior to implant placement and restoration.⁹ Once this has been accomplished, the surgeon must place the implant in a position that considers the potentially negative influence of the vertical and horizontal components of biologic width.¹⁰⁻¹³ Alveolar bone has been shown to resorb approximately 2 mm apically and 1.4 mm laterally to the implant-crown

interface (microgap). The three-dimensional orientation of the implant coronal platform should preserve the proximal and facial alveolar bone.¹⁴ Excessive apical and facial placement of the implant restorative platforms may lead to bone loss when the physiologic dimensions of the biologic width are re-established.¹⁴ As the underlying bone support resorbs, the risk of apical migration of the gingival margin increases.¹⁴ In the one-piece, single-stage implant design, Buser et al have recommended that the implant shoulder be placed approximately 1 mm palatal to the emergence of the adjacent teeth and 1 mm apical to the CEJ.¹⁴

Stein and Nevins have cited the importance of the provisional restoration to develop optimal gingival contours for single-tooth implant restorations.¹⁵ Once the interim crown has established the desired gingival margin and emergence profile, this information may be transferred to the master cast as a guide for the dental technician in the fabrication of the definitive restoration.¹⁶

It is important that the restorative dentist and dental technician understand that the outline of the facial gingival margin is dictated by the location of the CEJ relative to the root surface (Figure 3). A maxillary central incisor tooth that is horizontally sectioned along its long axis reveals the facial-distal prominence near the CEJ. In the presence of adequate soft tissue, duplication of this convexity outline in the definitive crown moves the facial gingiva into a position that emulates



Figure 8. Facial view of the definitive metal-ceramic crown restoration.

natural dentition. The result is an implant-supported crown that is in visual harmony with the surrounding dentition (Figure 4).

Clinical Technique

The purpose of this article was to demonstrate a simplified and precise method of developing optimal gingival contours that simulate the natural dentition in the aesthetic zone. The case presented was the restoration of a one-piece, tissue-level implant (ie, Standard Plus, Straumann USA, Andover, MA) that was placed in the position of a missing maxillary right central incisor. A connective tissue facial augmentation procedure was performed at implant insertion with an interim removable partial denture serving as the provisional restoration (Figure 5). No attempt was made to contour the soft tissue prior to fabrication of the master cast (Figure 6).

An abutment (ie, synOcta, Straumann USA, Andover, MA) was adapted to fit within the contours of the definitive crown using a matrix of the diagnostic wax-up for the metal framework design. Stone was selectively removed from the master cast with a scalpel to simulate the desired gingival facial margin and emergence profile that was harmonious with the adjacent central incisor (Figure 7). The modified cast permitted the ceramist to create the definitive metal-ceramic crown with the CEJ convexity at its prescribed apical position and contour (Figure 8). When the implant coronal platform had been properly placed, the contours of the CEJ and root surfaces of the crowns closely resembled those found in the natural central incisor tooth.

The abutment was inserted into the implant and the securing screw was tightened to the torque recommended by the manufacturer (Figure 9). The excessive soft tissue prevented the complete seating of the metal-ceramic crown; therefore, trial cementation with a provisional luting agent (ie, ZONE, DUX Dental, Oxnard, CA) was used for one week. Upon initial seating of the crown, blanching of the adjacent gingiva was evidenced, but dissipated in approximately 10 minutes (Figure 10). The one-week follow-up showed the precise positioning of the gingival margin as dictated by the crown form (Figure 11). In such cases where the implant-supported crown was adjacent to natural teeth that have normal osseous support, the deficient proximal



Figure 9. Excessive keratinized gingiva could be seen in the occlusal aspect.



Figure 10. Trial cementation of the crown using a provisional luting agent compressed the adjacent tissue, which caused initial blanching.



Figure 11. One week postoperatively, the facial gingival had conformed to the CEJ of the crown.



Figure 12. The one-piece, tissue-level implant was placed and a the abutment was inserted.



Figure 13. The CEJ convexity outline was placed approximately 1 mm incisal to the desired location in the definitive crown, and the root concavity was increased to promote migration of the FGM.



Figure 14. The provisional restoration was cemented. Initially, the facial and proximal soft tissues were in an apical location.



Figure 15. Following the six-week osseointegration period, the FGM and the interdental papillae had moved coronally.



Figure 16. Postoperative periapical radiograph.

papillae will generally reform because the connective tissue fibers insert into the dentin coronal to the alveolar bone.^{3,17} The final cementation of the metal-ceramic crown using a glass-ionomer luting agent (ie, Fuji PLUS, GC America, Alsip, IL) was completed at this appointment.

The Role of the Provisional Crown

Implant site preparation with adequate soft and hard tissue support combined with proper positioning of the implant restorative platform enhances the potential for a successful aesthetic result.¹⁴ The provisional restoration, therefore, serves the primary purpose of maximizing the volume of surrounding soft tissue both facially and coronally.¹⁸ To facilitate this goal, the CEJ convexity of the provisional restoration is placed more incisal than the desired final gingival margin.

In the following case, the implant was placed using a modified tissue punch without flap reflection, which minimized disruption of the surrounding blood supply.¹⁸ The dimension of the soft tissue that was removed to expose the osteotomy site was less than the outside diameter of the implant's coronal platform. When the tapered neck of the implant was inserted, the crestal keratinized gingiva was displaced in a facial and incisal direction, further increasing the soft tissue volume.

A solid abutment was inserted into the implant immediately following surgical placement, and the provisional was relined to adapt to both the abutment and the implant platform (Figure 19). The facial contour of the provisional crown was adjusted to promote incisal migration of the soft tissue by increasing the root concavity apical to the CEJ (Figure 13).¹⁹ The provisional crown was placed immediately and, following the six-week osseointegration period, the facial soft tissue migrated into a more coronal position (Figures 14 and 15). The definitive metal-ceramic crown had contours that simulated the left central incisor and molded the FGM into the desired position (Figures 16 and 17).

Discussion

Several clinicians have reported on techniques using the implant-supported provisional crown to form the optimal gingival frame.^{20,23} Considerable effort and time was then devoted to transfer this information to the master



Figure 17. Postoperative appearance demonstrated aesthetic reformation of the proximal papillae due to the support provided by the alveolar bone of the adjacent teeth.

cast as a guide for the ceramist. The rationale for the restoration of the implant-supported, maxillary single central incisor crown presented in this report defines a new role for the provisional and definitive crowns.

Surgical augmentation and judicious contouring of the provisional restoration were directed toward increasing the surrounding soft tissue volume, rather than defining the final FGM position. In order to properly modify the master cast and emulate the CEJ curvilinear profile of a natural tooth, the restorative dentist and laboratory technician must have a basic knowledge of the crown and root morphology. The definitive metal-ceramic crown, specifically the convexity outline of the CEJ, ultimately determines the gingival frame.

Conclusion

The successful restoration of the missing single central incisor was a compilation of the implant team's collaborative skills. Clinicians have previously presented a variety of procedures to create an implant-supported restoration that is in harmony with the surrounding hard and soft tissue. The case presented describes a simplified method to precisely duplicate the facial gingiva and proximal soft tissue contours for single, implant-supported crowns in the aesthetic zone. The role of the provisional restoration was directed toward increasing the soft tissue volume and subsequent precise movement of the gingival margin using the definitive metal-ceramic crown.

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CONTINUING EDUCATION (CE) EXERCISE No. X

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 "A simplified method to develop optimal gingival contours for the single implant-supported, metal-ceramic crown in the aesthetic zone," by Richard P. Kinsel, DDS and Daniele Capoferri, CDT. This article is on Pages 000-000.

1. Why is collaboration between the implant surgeon, restorative dentist, and dental technician important?

- a. Input from all members of the treatment team is beneficial for an optimal result.
- b. Replacement of missing teeth in the aesthetic zone requires the totality of the implant team's skill and experience.
- c. Both a and b are correct.
- d. Neither a nor b are correct.

2. The facial outline of the maxillary central incisor cemento-enamel junction:

- a. Is symmetrical.
- b. Has an apical curvature zenith that is located mesial of the midline.
- c. Has an apical curvature zenith that is located distal of the midline.
- d. Is not important for the implant-supported crown.

3. Differences between natural teeth and implant crowns include:

- a. An osseous architecture that follows the CEJ and supports the overlying soft tissue.
- b. A curvilinear CEJ versus a rotational restorative platform.
- c. Insertion of connective tissue fibers into dentin versus a zone of a vascular connective tissue in direct contact without insertion to the implant surface.
- d. All of the above.

4. One result from establishing biologic width around a dental implant restoration is:

- a. Bone resorbs approximately 2 mm apically and 1.4 mm laterally from the implant-crown interface.
- b. Biologic width only is applicable to natural dentition and does not account for bone loss surrounding dental implants.
- c. Bone loss found surrounding the implant's coronal platform caused solely by adverse mechanical forces applied to the implant restoration.
- d. Excessive placement of the implant-crown interface apical to the crestal bone will not result in the loss of alveolar bone with gingival recession.

5. The outline of the facial gingival margin is dictated by the location of the CEJ relative to the root surface.

- a. This statement is true.
- b. This statement is false.

6. Which of the following statements are true?

- a. Periodontal techniques to correct gingival defects surrounding implant-supported crowns are less predictable than natural teeth.
- b. The vascular and connective tissue structures surrounding implants complicate regenerative surgical procedures.
- c. The maintenance of the proximal papilla is less predictable between adjacent implant crowns placed adjacent to natural teeth.
- d. All of the above.

7. In the presence of sufficient keratinized gingiva:

- a. Facial convexity tends to move gingiva apically.
- b. Concavity tends to encourage incision migration.
- c. Highly scalloped, thin biotype facial gingiva is more favorable than thick biotypes.
- d. Both a and b are correct.

8. One advantage of the technique described in this article is:

- a. Increased treatment time.
- b. Precise control over the facial gingival outline and emergence profile.
- c. That the provisional crown is necessary to develop the final soft tissue contours.
- d. The need to transfer the soft tissue contours to the master cast.

9. A major role for the provisional implant crown in the aesthetic zone is to:

- a. Maximize the volume of keratinized tissue.
- b. Precisely determine the final facial and proximal gingival contours.
- c. Restore full occlusal function.
- d. Serve as a guide for the surgeon during periodontal corrective procedures.

10. The definitive implant crown is initially luted using provisional cement because:

- a. Excess surrounding soft tissue prevents complete seating of the definitive crown.
- b. The patient can evaluate the appearance by the patient prior to final cementation.
- c. The establishment of the facial gingival contour position is unpredictable.
- d. Both a and b are correct.