SEQUENTIAL TOOTH PREPARATION FOR AESTHETIC PORCELAIN FULL-COVERAGE CROWN RESTORATIONS

Brian S. Vence, DDS*

The fabrication and delivery of functional, biocompatible restorations with a natural appearance have become the definitive goals of restorative dentistry. Although contemporary ceramic materials allow light to be manipulated in restorations to replicate the natural dentition, this objective can be difficult to achieve when tooth preparation is not performed properly. This article presents a sequential approach that can be used to render the proper shape and margin design critical to the fabrication of full-coverage crown restorations that are indistinguishable from the adjacent natural teeth.

Key Words: preparation, subgingival, margin, reduction, natural

For years, the fabrication and delivery of restorations with the longevity of gold and the appearance of natural teeth have been the goals of aesthetic dentistry. While advances in aesthetic techniques have enabled clinicians to achieve these objectives, one significant obstacle has been the physical composition of dental materials (Figures 1 and 2). Technical advances in dental ceramics throughout the past decade, however, have allowed laboratory technicians to fabricate restorations that are "enduring with an inherent sense of realism."[1-3] Concurrent clinical advances in orthodontics,[4] periodontics,[5] and prosthodontics[6,7] have allowed clinicians to reposition teeth, alter the vertical dimension of occlusion,[8-10] and resect, preserve, reposition, or augment soft and hard tissues[11-15] to maximize aesthetic results.

The diagnostic waxup and provisional restoration[16,17] allow the clinician to develop facial aesthetics,[18] smile design,[19,20] tooth form and contour, occlusion and function,[21,22] marginal integrity, and emergence profiles.[23] Provisionalization allows the restorative team to verify the aesthetic modifications and biological compatibility of the proposed restoration (Figure 3). The reproduction of natural light transmission (ie, refraction, reflection, translucency), however, can occur only through the ceramic material.[24] Inadequate tooth preparation relative to the definitive form of the restoration and soft tissue parameters can, nevertheless, hinder the delivery of an aesthetic result. Tooth preparation is determined by the final form of the restoration, as dictated by facial aesthetics. This includes smile design and artistic arrangement, occlusion, function, interproximal position of the adjacent teeth and contact zone, soft and hard tissues, and size and position of the pulp. As aforementioned,

Figure 1. Preoperative facial view of 20-year-old porcelain-fused-to-metal restorations exhibits opaque porcelain buildup, metal margins, and interproximal space.

*Private practice, West Dundee, Illinois.

Brian S. Vence, DDS
700 Willow Lane, Ste. G
West Dundee, IL 60118

Tel: 847-426-1522
Fax: 847-426-1581
E-mail: vencedds@msn.com

these parameters can be manipulated clinically to ideally position teeth relative to the definitive restoration for optimal aesthetics and tooth preparation. Such preparation must adhere to precise criteria for shape and margin design in order to be compatible with contemporary ceramic technology.

Clinical Applications

Due to the recent expansion of the clinician's armamentarium, the definitive restoration can be fabricated from a combination of numerous metal-ceramic or glass-ceramic porcelain systems and their various corresponding copings (Table). The definitive restoration should be selected collaboratively by the clinician and laboratory technician following tooth preparation and completion of the provisionalization phase. The members of the restorative team can review and compare the models, photographs, and clinical history of the patient recorded preoperatively — as well as following preparation and provisionalization — to determine the appropriate restoration that satisfies the established objectives. When full-coverage crown restorations are used to accurately replicate natural teeth, all preparation shapes and margin designs should be identical. Regardless of the type of restoration selected, the preparation should have a shoulder margin since the definitive crown will have a 360° porcelain margin. Tooth preparation can be classified into three fundamental categories: technology, shape, and margin design.

Technology

Technological improvements (eg, electric handpieces, magnification, and illumination) are essential for the delivery of precise, lifelike restorations. Use of a high-torque, low-speed electric handpiece (eg, Intra K-LUX 196, Intramatic LUX 3 25 LHAS, Kavo America, Lake Zurich, IL) allows enhanced speed control and operates more concentrically than a traditional air turbine handpiece. Such a handpiece also provides the clinician with an improved tactile sense for enhanced preparation (Personal communication, R. Winter, 1999). High-speed tooth preparation

Table

Porcelain Systems and Compressive Strengths (MPa)

Feldspathic refractory	< 100
Alumina jacket	120
Leucite	180
Magnesium oxide	280
Magnesium oxide (milled)	350
Fluorapatite (0.8 mm)	350
Alumina oxide	560
Alumina oxide (milled)	680
Zirconia oxide	800

Figure 2. Magnified facial view demonstrates the inflamed gingiva and compromised marginal integrity.

Figure 3. Facial view of the aesthetic provisional restoration. The parameters of the final form of the restoration are identical to those for tooth preparation.

Figure 4. Facial view of the preparation of the maxillary central incisors.

Figure 5. Breaking contact with the adjacent tooth is facilitated with a thin carbide bur or, as depicted, the removal of the existing restoration.

Figure 6. The preexisting preparation does not demonstrate the elements that are necessary to achieve a precise restoration with a natural appearance.

Figure 7. A periodontal probe is used to sound down to the osseous crest. To preserve the biologic width, the crest must be a minimum of 3 mm from the free gingival margin.

with ultracoarse diamonds has been demonstrated to induce thermal damage in pulp tissues.[25] The copious irrigation and low speed of the electric handpiece can assist in the prevention of irreversible thermal damage to the pulp and warrants additional investigation.

The success of any rigorous restorative or surgical procedure is also highly dependent upon the clinician's ability to obtain adequate visibility. Magnification and illumination in the form of loupes, surgical microscopes, and headlamps (eg, Ultralite, Luxtec Corporation, Worcester, MA; Global Surgical Corporation, St. Louis, MO) dramatically improve the operator's view of the treatment site and are essential for the preparation and delivery of precise restorations that replicate the natural dentition.

Shape

Preparation shape has three specific purposes that influence the appearance and longevity of the definitive restoration (Figure 4). It allows for a maximum thickness of ceramic material from 1.5 mm (axially) to 2 mm (incisally/occlusally) to manipulate light and establish a depth of translucency and space for the development of incisal effects. The shape of the preparation also provides an adequate retention form and eliminates undercuts, which facilitates the fabrication and retention of the full-coverage crown restorations. Furthermore, it allows a shoulder margin to be developed for resistance form and a porcelain margin to be established.

Shaping the preparation involves the inscription of a finish line to determine the subgingival level of the shoulder margin, to obtain maximum reduction for layering the ceramic material, and to develop the final form of the anticipated restoration.

Finish Line

In order to initiate shaping of the preparation, a definitive finish line must be clearly established. Contact with the adjacent teeth is broken utilizing a carbide bur (#1700, Brasseler USA, Savannah, GA). If the teeth have been restored previously, the existing restorations are removed

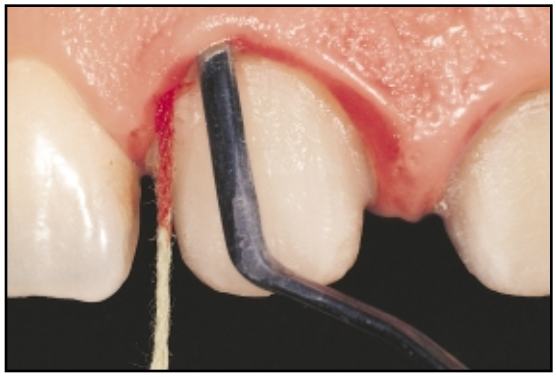

Figure 8. Cord is placed into the sulcus to protect and retract the gingival tissues, which allows the margin of the restoration to be placed 0.5 mm to 1 mm into the sulcus.

(Figure 5). Once the restorations have been removed, the inadequacies of the previous tooth preparation can be assessed (Figure 6). These preparations must be designed to satisfy specific parameters in order to establish a natural appearance for the restoration. To determine the position of the final margin relative to the hard and soft tissues, a periodontal probe is utilized to sound down to bone to determine if 3 mm of tooth structure is available from the free gingival margin to the osseous crest for biologic width (Figure 7).[26] A braided retraction cord (0a, Van R Dental, Oxnard, CA) is subsequently packed intrasulcularly to act as a buffer for the gingival attachment and to retract the gingival tissue in order to assist with margin placement 0.5 mm to 1 mm below the free gingival margin (Figure 8).[27] Tissue fluid is controlled by constricting the blood vessels with an astringent (Styptin, Van R Dental, Oxnard, CA) (Figure 9). A coarse-grit diamond (#6856 313 029, Brasseler USA, Savannah, GA) is utilized to reduce the facial and lingual contour of the tooth along the long axis of the tooth or along the direction of draw of the restoration (Figures 10 and 11). The soft tissues are shielded facially and lingually with a gingival protector (Zekrya, Zenith Foremost Dental, Englewood, NJ) and interproximally with a plastic instrument (Ash Plastic PFIA 6, Hu-Friedy, Chicago, IL). In this manner, the finish line is inscribed at the level of the retracted free gingival margin, relative to the soft and hard tissues following the osseous scallop, to respect biologic width.[28] The inscribed finish line serves as an indicator for the axial reduction to initiate maximum reduction.

Maximum Reduction

In order to approximate the shape of the tooth preparation, axial reduction of 1.5 mm and incisal or occlusal reduction of 2 mm must be achieved. This is initiated with 1 mm of axial reduction, which is required for porcelain margin materials at the level of the margin. While this distance should be verified radiographically, this degree of reduction does not appear to impinge biological imperatives on a tooth that is properly positioned in the alveolus. At the previously inscribed finish line, the tooth is reduced 1 mm axially with a coarse-grit diamond (#5856-016, Brasseler USA, Savannah, GA) (Figure 12). The diamond bur is used to its full depth to produce the 1 mm of axial reduction at the level of the margin, and is held parallel to the reduction of the previous bur

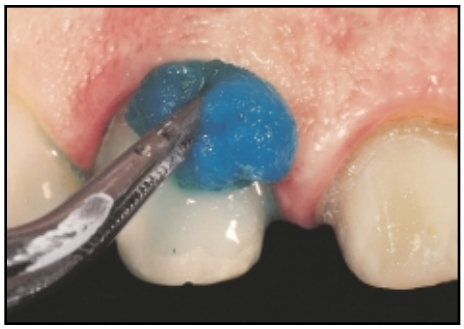

Figure 9. An astringent (Styptin, Van R Dental, Oxnard, CA) is placed to constrict the blood vessels and control tissue fluid.

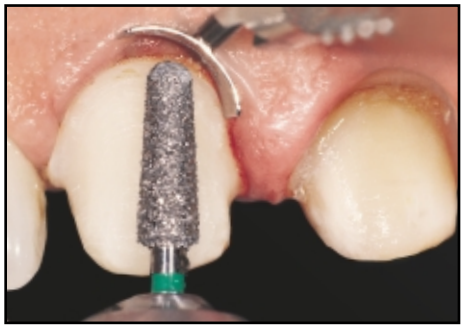

Figure 10. Facial and lingual tooth contours are flattened, and a finish line is established at the level of the retracted free gingival margin.

Figure 11. The finish line is extended interproximally to establish a continuous finish line from the facial to the lingual aspects of the tooth.

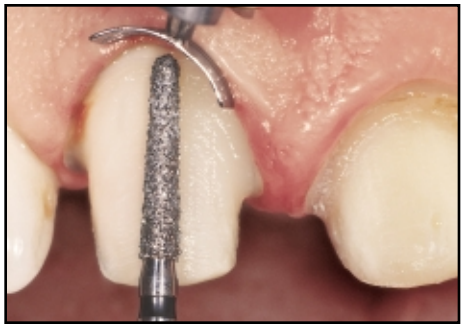

Figure 12. The shape of the preparation is refined using a coarse diamond (Ø 1 mm) to establish a shoulder reduction of 1 mm at the finish line.

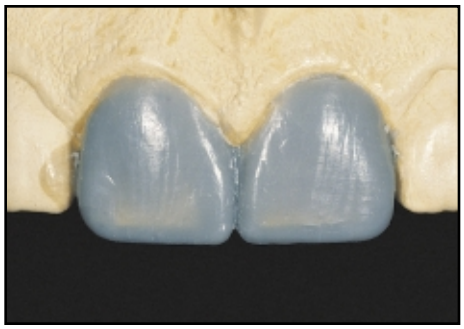

Figure 13. Facial view of the diagnostic waxup of the proposed restoration on the model.

Figure 14. A template of the waxup is used to guide tooth reduction and acts as a matrix to fabricate the provisional restoration.

Figure 15. Protection is not necessary since the bur is advanced counterclockwise and the air vortex pushes the tissue away from the bur.

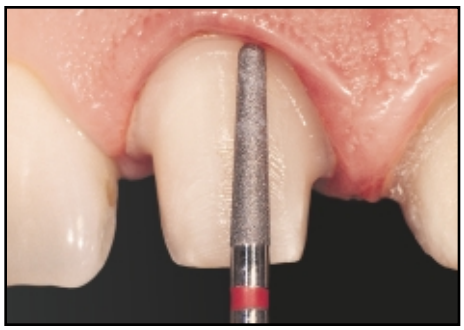

Figure 16. Preparation margins are developed with the medium-grit diamond bur (Ø 1.25 mm), which follows the previous 1 mm axial reduction.

following the long axis of the tooth or direction of draw of the restoration. The facial, interproximal, and lingual aspects of the tooth are connected and uniformly reduced 1 mm following the contour of the root cavosurface of the tooth. The occlusal or incisal aspect of the tooth is subsequently reduced 2 mm, which is facilitated by depth cuts from a carbide bur (#330, Brasseler USA, Savannah, GA). After the occlusal or incisal surfaces have been reduced, they can be blended and smoothed with additional burs.

Final Form

Once the shape of the preparations has been approximated, it is important to visualize the final shape of the preparation relative to the definitive form of the restoration. A diagnostic waxup can be utilized to determine the exact form and contour of the anticipated restoration (Figure 13). In order to obtain an accurate template for preparation and provisionalization, particular attention to detail is essential (W. Gebhardt, personal communication, 1998). A cast of the diagnostic waxup and an accurate template can be fabricated from a pressure-forming machine (Biostar, Great Lakes Orthodontics, Tonawanda, NY) or a silicone index. The template is used to ensure maximum reduction of the tooth preparation (Figure 14), which is essential to the final form of the restoration. Ideally, the reduction should be 2 mm occlusally or incisally and 1.5 mm axially, and should have 1.25 mm of reduction at the level of the final margin placement.

The aforementioned template — fabricated from the diagnostic waxup — is utilized to verify the uniform and maximum reduction of the restoration relative to its final form. This phase is critical to avoid the use of transfer copings to correct inadequate reduction for the definitive restoration. Uniform reduction of the preparation allows an even thickness of provisional material to be utilized, which satisfies strength requisites during provisionalization. The template also serves as the matrix for the fabrication of the provisional restoration, which allows the clinician to develop a rendition of the proposed final prosthesis — essentially transferring the diagnostic waxup to the mouth in a provisional material.

Margin Design

The shoulder margin determines the appearance and longevity of the definitive restoration by allowing the use of porcelain margin materials and correction bakes

that result in unsurpassed marginal integrity. This design also provides space for the use of shoulder porcelains that eliminate opacity in the cervical third, eliminate root shadowing, and create a fiberoptic effect that brightens the gingiva. Furthermore, it permits the laboratory technician to alter the emergence profile and establish a highly polished surface for cleansability without compromising soft tissue integration.[29]

Three elements are involved in margin development: 1) uniform 1.25 mm shoulder reduction, 2) polished margin shoulder surface to facilitate the fabrication of the porcelain margin, and 3) appropriate subgingival margin placement (0.5 mm subgingivally on the facial aspect and 0.5 mm to 1.5 mm interproximally), which depends on the osseous crest and the need to influence the emergence profile.

Uniform Shoulder

Since the maximum depth of axial reduction at the margin has already been initiated with a 1 mm coarse-grit diamond bur, a medium-grit diamond that has a 1.25 mm diameter tip (#8856-018, Brasseler USA, Savannah, GA) can be used in an electric handpiece to complete the shoulder preparation. The use of the handpiece provides improved tactile sensation for the clinician, and the air vortex around the bur prevents the gingival tissue from contacting the bur as it is advanced in a counterclockwise direction. As gingival protectors are not required during this stage, the head of the handpiece can be guided by the clinician's free hand to attain uniform reduction, eliminate undercuts, and establish walls with 6° to 8° taper (Figure 15). The bur with the finer grit smoothes the axial walls, which allows a cleaner impression, die pour, and working model to be achieved (Figure 16). The preparation walls are refined as the clinician creates a uniform shoulder that has been reduced 1.25 mm from the cavosurface of the tooth margin, which was defined by the finish line and the initial preparation.

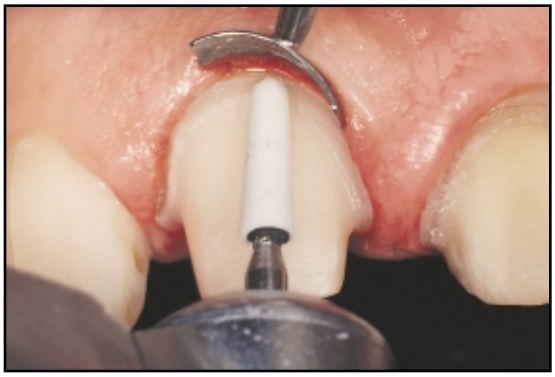

Figure 17. Final polishing of the shoulder margin is accomplished with a modified Arkansas stone and gingival protection.

Figure 18. The template of the diagnostic waxup is utilized to fabricate the provisional restoration.

Figure 19. The provisional restoration is refined and the emergence profile is developed to sculpt the soft tissues. The restoration guides tissue healing to facilitate impression making.

Figure 20. Right lateral view of the soft tissues 3 weeks following preparation and provisionalization. A final evaluation of functional and aesthetic criteria is performed.

Subgingival Placement

Subgingival margin placement should ideally be established 0.5 mm below the free gingival margin and 2.5 mm above the osseous crest to respect the biologic

Figure 21. Magnified view of the soft tissues 3 weeks following provisionalization.

Figure 22. Since the provisional restoration has preserved the health of the soft tissues, a 360° intrasulcular polyvinylsiloxane impression can be made.

Figure 23. Postoperative facial view of the definitive restorations (Empress2, Ivoclar Williams, Amherst, NY) demonstrates enhanced translucency and healthy gingival integration.

width.[30,31] Final margin placement can be rendered with a modified Arkansas stone (#649-420, Brasseler USA, Savannah, GA) in a high-torque, low-speed handpiece. The preparation margin is placed at the free gingival margin with the tissue retracted; a 0.5 mm gain in tissue height is expected following cord removal. If the margin of the previous restoration was placed deeper than 0.5 mm and the necessity of crown lengthening has yet to be determined, subgingival margin placement may require adjustment. If more than 3 mm of soft tissue exists from the free gingival margin to the osseous crest (eg, the interproximal tissue of the maxillary anterior teeth where the gingival scallop is more pronounced than the osseous scallop), the subgingival margin placement can be greater than 0.5 mm. This is essential for the aggressive subgingival margin placement necessary to influence the soft tissue emergence profiles, which can be used to attain specific aesthetic goals (ie, closure of diastemata or black triangular spaces). When subgingival margin placement is not ideal, it is performed according to the biological context for a particular biotype.[32] With regard to a patient's genetically programmed biotype, the biologic width throughout the individual's mouth is constant.[33] When sounding to bone, the sulcus and the attachment on the facial surface of the teeth are probed throughout the patient's mouth to determine biologic width. In order to evaluate soft tissue response, the provisional restorations are seated for 6 months.

Polished Surface

The preparations are subsequently polished with the modified Arkansas stone in an electric handpiece to obtain a smooth, continuous 90° margin (Figure 17). This smooth polished surface is required to facilitate the fabrication of accurate porcelain margins in the laboratory. In order to achieve accurate marginal integrity when utilizing a porcelain margin, a "J"-shaped margin and "stair stepping" of the preparation must be avoided.

Since considerable effort is invested in margin development, this process could also be termed "finishing." This technique is essential to the fabrication and delivery of an accurate restoration that is virtually transparent or indistinguishable from the patient's natural dentition. Finishing

Figure 24. Magnified facial view of the definitive full-coverage crown restorations postoperatively. (Ceramist: Don Cornell.)

provides laboratory technicians with proper margins and space necessary to maximize their use of contemporary ceramic systems. This process increases the potential of infringing upon the biologic width, however, which can jeopardize the restoration and the health of the tissues. Impression making is also exacting due to the subgingival placement of the margins. Nevertheless, each process is essential when the definitive restoration is intended to be harmoniously integrated with the natural teeth.

Provisionalization and Final Impressions

Prior to final impressions, a provisional restoration is fabricated to facilitate soft tissue management (Figures 18 and 19).[34] This restoration shapes and sculpts the soft tissues and guides healing to attain a fully keratinized gingiva 360° around the preparation. Once the soft tissue contour has been developed (ie, following 3 weeks to 6 months), the final impression is made (Figures 20 and 21). At this stage, a 360° circumferential intrasulcular impression is recorded to provide the laboratory technician with all the essential information necessary to fabricate a precise definitive restoration that will be indistinguishable from the natural dentition (Figure 22). When the laboratory phase has been completed, the definitive restoration is tried in, adjusted as necessary, and cemented in place with the appropriate luting agent (Figures 23 and 24).

Conclusion

The ability to manipulate the position of the maxilla and mandible, the root structures of teeth, and the periodontal tissues of patients has been a clinical reality for years. Laboratory technicians who work with contemporary ceramic systems can fabricate restorations that mimic natural teeth — provided they have an optimal preparation. This article has demonstrated that the dentition can be ideally positioned in relation to the anticipated position and form of the definitive restoration. Once this objective has been satisfied, occlusal relationships, aesthetics, and tooth preparations can be optimized for the fabrication and delivery of precise porcelain restorations that are harmoniously integrated with the adjacent natural teeth.

References

1. Winter R. Visualizing the natural dentition. J Esthet Dent 1993; 5(3):102-117.
2. Touati B. Defining form and position. Pract Periodont Aesthet Dent 1998;10(7):800-807.
3. Ahmad I. Geometric considerations in anterior dental aesthetics: Restorative principles. Pract Periodont Aesthet Dent 1998;10(7): 813-822.
4. Kokich V. Esthetics and anterior tooth position: An orthodontic perspective. Part III: Mediolateral relationships. J Esthet Dent 1993;5(5):200-207.
5. Sonick M. Esthetic crown lengthening for maxillary anterior teeth. Compend Contin Educ Dent 1997;18(8):807-816.
6. Mack MR. Perspective of facial esthetics in dental treatment planning. J Prosthet Dent 1996;75(2):169-176.
7. Shavell HM. Bioesthetics of complete porcelain occlusal rehabilitation using the Sunrise ceramic system: A case report. Int J Periodont Rest Dent 1990;10(4):256-279.
8. Mack MR. Vertical dimension: A dynamic concept based on facial form and oropharyngeal function. J Prosthet Dent 1991; 66(4):478-485.
9. Kois JC, Phillips KM. Occlusal vertical dimension: Alteration concerns. Compend Cont Educ Dent 1997;18(12):1169-1177.
10. Shavell HM. The art and science of complete-mouth occlusal reconstruction: A case report. Int J Periodont Rest Dent 1991; 11(6):438-459.
11. Ingber JS, Rose LF, Coslet JG. The "biologic width"—A concept in periodontics and restorative dentistry. Alpha Omegan 1977;70(3):62-65.
12. Nevins M, Skurow HM. The intracrevicular restorative margin, the biologic width, and the maintenance of the gingival margin. Int J Periodont Rest Dent 1984;4(3):30-49.
13. Fugazzotto P, Parma Benfenati S. Preprosthetic periodontal considerations. Crown length and biologic width. Quint Int 1984;15 (12):1247-1256.
14. Gargiulo A, Krajewski J, Gargiulo M. Defining biologic width in crown lengthening. Chicago Dent Soc Rev 1995;88(5):20-23.
15. Garber DA, Salama MA, Salama H. Where is the bone? American Academy of Esthetic Dentistry Annual Meeting. August 1999; British Columbia, Canada.
16. Shavell HM. The periodontal-restorative interface in fixed prosthodontics: Tooth preparation, provisionalization and biologic final impressions. Part I. Pract Periodont Aesthet Dent 1994:6(1):33-44.
17. Shavell HM. The periodontal-restorative interface in fixed prosthodontics: Tooth preparation, provisionalization and biologic final impressions — Part II. Pract Periodont Aesthet Dent 1994;6(3): 49-60.
18. Roblee RD. Interdisciplinary Dentofacial Therapy: A Comprehensive Approach in Optimal Patient Care. Carol Stream, IL: Quintessence Publishing, 1994.
19. Rufenacht C. Fundamentals of Esthetics. Carol Stream, IL: Quintessence Publishing, 1990.
20. Chiche G, Pinault A. Esthetics of Anterior Fixed Prosthodontics. Carol Stream, IL: Quintessence Publishing, 1993.
21. Shavell HM. The aesthetics of occlusion: Form, function, finesse. Pract Periodont Aesthet Dent 1993;5(3):47-55.
22. Dawson PE. A classification system for occlusions that relates maximal intercuspation to the position and condition of the temporomandibular joints. J Prosthet Dent 1996;75(1):60-66.
23. Reeves WG. Restorative margin placement and periodontal health. J Prosthet Dent 1991;66(6):733-736.
24. Sieber C. Voyage: Visions in Color and Form. Carol Stream, IL: Quintessence Publishing, 1994.
25. Ottl P, Lauer HC. Temperature response in the pulpal chamber during ultrahigh-speed tooth preparation with diamond burs of different grit. J Prosthet Dent 1998;80(1):12-19.
26. Kois JC. Altering gingival levels: The restorative connection. Part I: Biologic variables. J Esthet Dent 1994;6(1):3-9.
27. Kopp FR. Esthetic principles for full crown restorations. Part I: Tooth preparation. J Esthet Dent 1993;5(1):25-28.
28. Kois JC. New paradigms for anterior tooth preparation: Rationale and technique. Oral Health 1998;88(4):19-30.
29. Cornell DF. Soft tissue-ceramic interface: True parameter for successful esthetics. J Esthet Dent 1995;7(2):81-86.
30. Becker W, Ochsenbein C, Becker BE. Crown lengthening: The periodontal-restorative connection. Compend Contin Educ Dent 1998;19(3):239-246.
31. Kois JC. The restorative-periodontal interface: Biological parameters. Periodontol 2000 1996;11:29-38.
32. Sanavi F, Weisgold AS, Rose LF. Biologic width and its relation to periodontal biotypes. J Esthet Dent 1998;10(3):157-163.
33. Vacek JS, Gher ME, Assad DA, et al. The dimensions of the human dentogingival junction. Int J Periodont Rest Dent 1994; 14(2):154-165.
34. Kopp FR. Esthetic principles for full crown restorations. Part II: Provisionalization. J Esthet Dent 1993;5(6):258-264.

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 "Sequential tooth preparation for aesthetic porcelain full-coverage crown restorations" by Brian S. Vence, DDS. This article is on Pages 77-84.

Learning Objectives:

This article presents a sequential approach for the aesthetic fabrication of full-coverage crown restorations. Upon reading the article and completing this exercise, the reader should:

- Have an understanding of the preparation requirements for proper shape and margin design during crown fabrication.
- Be aware of various technical advances in the fabrication of aesthetic porcelain full-coverage crown restorations.

1. The following conditions should be met for the preparation of full-coverage crown restorations EXCEPT:
a. All preparation shapes and margin designs should be identical.
b. The preparation should have a shoulder margin.
c. The restoration should be selected collaboratively by the clinician and ceramist.
d. The crown should be fabricated using an all-ceramic system.

2. Tooth preparation can be classified into the following categories EXCEPT:
a. Placement.
b. Technology.
c. Shape.
d. Margin design.

3. Which advantages have been demonstrated with the utilization of a high-torque low-speed electric handpiece for preparation of full-coverage crown restorations?
a. Reduced preparation time.
b. Reduced soft tissue damage.
c. Reduced thermal pulp damage.
d. Increased visibility.

4. Which of the following is one of the purposes of preparation shape?
a. To establish an appropriate finish line.
b. Provides for retention form.
c. To facilitate rapid tissue healing.
d. Manipulates the space development of the gingival sulcus.

5. The first step in shaping a tooth preparation involves:
a. Maximum reduction.
b. Final form.
c. Establishing a finish line.
d. Placement of the subgingival margin.

6. Why must axial and incisal or occlusal reduction occur?
a. To ensure the fit of the diagnostic waxup.
b. To approximate the shape of the tooth preparation.
c. To ensure an accurate provisional fit.
d. To satisfy the biological imperatives for a properly positioned tooth.

7. Which of the following is the best way to ensure correct preparation form?
a. Estimate the preparation adjacent to the unprepared dentition.
b. Use a template from the diagnostic waxup.
c. Use a template of the previous restoration.
d. Make sure the preparation fits in a prefabricated provisional from the laboratory.

8. The shoulder margin should be polished for each of the following reasons EXCEPT:
a. To facilitate fabrication of accurate porcelain margins in the laboratory.
b. To obtain a smooth, continuous 90° margin.
c. To decrease the potential of infringing upon the biologic width.
d. To approximate the appearance of the patient's natural dentition.

9. Subgingival margin placement is essential to:
a. Prevent recurrent decay at the margins.
b. Prevent toothbrush abrasion.
c. Prevent root sensitivity.
d. Influence soft tissues with the emergence profile of the restoration.

10. What is the primary purpose of the provisional restoration?
a. To facilitate soft tissue management.
b. To protect the teeth while the crown restorations are fabricated.
c. To determine the definitive appearance of the final restoration.
d. To facilitate positioning of the teeth for a natural appearance.