

SIMPLE GUIDELINES FOR AESTHETIC SUCCESS WITH COMPOSITE RESIN—PART I: ANTERIOR RESTORATIONS

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Composite restorations have the advantage of being created in the dental office, which can lead to beautiful, natural aesthetics. Laboratory technicians tend to spend minimal time with the patient and reconstruct the restoration based on information provided by the clinician. Dentists, however, are at a great advantage, as they can refer to the surrounding tooth structure when building the restoration. Part I of this article will discuss various guidelines for treating anterior teeth using direct resin restorations, while Part II will address posterior restorations.

Learning Objectives:

This article discusses guidelines for the buildup of aesthetic anterior restorations with direct resin techniques. Upon reading this article, the reader should:

- Become familiar with a proposed checklist to follow for aesthetic success.
- Understand four basic signs that an anterior tooth exhibits as it ages and changes.

Key Words: anterior, resin, composite, aesthetics, aging, tooth

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To restore a patient to natural function and aesthetics, both the clinician and dental technician must possess an understanding of macro- and micromorphology of the dentition. The first step towards improving aesthetics entails analysis of the natural characteristics of each patient in order to create lifelike restorations. Consequently, it is important to develop a restorative concept with specific criteria. This allows the natural morphology of the tooth to be recreated in detail when one is building the composite restoration. The guidelines for this restorative concept will be detailed herein, and will give the practitioner a straightforward, goal-oriented approach to restoring anterior teeth.

Anterior Restorations

While patients are less demanding in their expectations of posterior restorations, clinicians are expected to provide a perfectly matching, "invisible" restoration every time they repair a tooth in the anterior region. While correct shade selection plays a crucial role in achieving an aesthetic restoration, reconstruction of the natural surface morphology is equally important, though frequently neglected. In the author's experience, unsatisfactory aesthetics tend to be associated with the practitioner's failure to include enough aspects of the natural tooth in the planning of the dental reconstruction. Often, the aesthetic aspects of the teeth are only given a brief look in the course of shade selection which, in addition, is erroneously performed according to prosthetic criteria.¹

Clinicians are accustomed to selecting an overall shade for a given restoration by using the Vita Shade Guide (Vident, Brea, CA). In the author's experience, this method only works because the shades are selected using multilayered sample teeth, which consist of a combination of enamel and dentin materials. The dental technician breaks down the shade selected by the clinician into the different color components and degrees of translucency. In short, clinicians are used to summarizing the overall optical impression of a tooth in a single shade. Tooth shade, however, is the result of two components: a comparatively light and translucent enamel shade and a relatively dark, opaque dentin shade. For instance, a tooth that exhibits a shade of A3 conveys this color impression because of the combined effect of a light enamel shade (eg, A1, A2) and a dark dentin shade (eg, A3.5, A4). For this reason, both the enamel and dentin shades should be determined when fabricating composite restorations. In the experience of the author, this is only possible if the natural enamel and dentin are fully visible and have not yet changed their appearance



Figure 1. The "positive smile line" is a gentle convex curve that parallels the curvature of the lower lip when a person smiles.



Figure 2. Facial view of a patient with young teeth. In aging teeth, the macro- and micromorphology of the tooth surfaces are smoothed away due to attrition.



Figure 3. Facial view of a patient with slightly aged teeth. The central ridge of the macrostructure disappears first.



Figure 4. Facial view of a patient with semi-aged teeth. The marginal ridges are retained slightly longer than the central ridge of the macrostructure.



Figure 5. View of a patient with aged teeth. As an individual ages, irregularities of the microstructure that create light reflections on the tooth surface are obliterated as the surfaces grow smoother.



Figure 6. Frontal view of a patient with aged teeth. Extrinsic stains are deposited on the tooth surfaces in varying degrees.

due to the restorative procedures. In other words, the enamel and dentin shades should be determined after the dentin has been exposed but the tooth has not yet been isolated and excavated; the tooth structure must not be dehydrated when performing shade selection.

Shade selection is best performed immediately before isolation, when the existing restorations and caries have been removed and visibility of the moist dentin and enamel is unobstructed. Before this stage is reached, however, several other aesthetic criteria that play an equally important role in dental reconstructions have to be assessed. Various characteristics of the natural tooth should be examined to achieve an appropriate aesthetic reconstruction of the tooth.² To do so, clinicians need to understand how anterior teeth change in appearance as they age. Teeth exhibit four basic signs of aging:

1. Loss of Incisal Contour

As the teeth become shorter by wear over time, they lose their specific angle characteristics. Consequently, the distal incisal edge loses its rounded shape and becomes angular. The mesial interproximal "V" shape also disappears as the teeth age (Figure 1).³ The "Golden Proportions" between length and width gradually give way to a squat shape.⁴ Furthermore, the tooth loses its translucency, as the thin translucent areas of the incisal edge are increasingly abraded. Having lost the translucent zones between the dentin mamelons, the tooth features a uniform, opaque appearance.

2. Loss of Vestibular Macrostructure

The central incisors normally exhibit a mesial, distal, and central ridge on the facial surface, while the lateral incisors have only two ridges—one on each side. By contrast, the canines show a pronounced central ridge and fine marginal ridges set back from the central ridge. As the teeth grow older, these ridges are smoothed by natural attrition as well as the wear resulting from intensive tooth brushing. In the process, the facial surface of the clinical crown becomes planed. The resulting change in light reflection makes the teeth look flat and dull (Figures 2 through 6).

On the positive side, the marginal ridges can be utilized to optically alter the shape of the tooth during the reconstruction. For instance, marginal ridges that ascend in a straight line from the gingival margin make the tooth appear longer and narrower, while marginal ridges that are curved towards the mesial convey the impression that the tooth is smaller and broader. These optical

effects are created by the reflection of incident light, while the planed surfaces, which reflect the light in a straight line to the object, decisively affect the dimensional perception of the tooth. The fine ridges on the tooth surfaces endow the tooth with a vivid appearance as they scatter the light, similar to the facets of a diamond. The resulting light effect largely contributes to the youthful, lively appearance of teeth.⁵

3. Loss of Surface Microstructure

The microstructure consists of horizontal developmental grooves (ie, perikymata), transverse ridges, as well as minuscule surface depressions and "pores." Similar to the macrostructure, the irregularities of the microstructure scatter light, creating light reflections on the tooth surface.^{5,6} As an individual ages, these irregularities are usually obliterated more quickly than the aforementioned ridges of the macrostructure (Figures 2 through 6). As the surfaces grow smoother, they reflect less light. Reproducing the microstructure is the best method to camouflage the transition between the tooth and composite restoration in the visible area. If they are reproduced and adjusted to the surrounding natural tooth structure with skill, these characteristics produce the same light reflections as the surrounding natural dentition. Consequently, slight differences in the shade and translucency of the composite material are virtually indiscernible at the transition to the natural tooth structure.

4. Color Change Due to Incorporation of Pigments

Extrinsic stains are deposited on the tooth surfaces

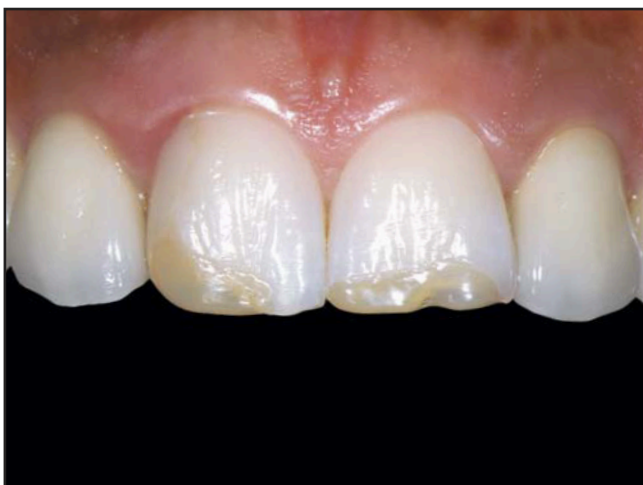


Figure 7. Two existing composite restorations on the central incisors require replacement.



Figure 8. The procedure is conducted via the six-point checklist. The aesthetic result is based on the correct shade selection and reproduction of all morphological details.

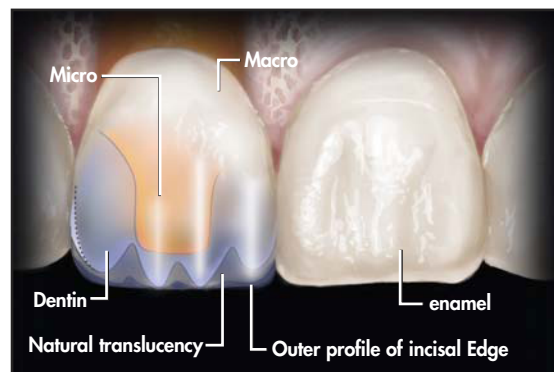


Figure 9. Various characteristics of the tooth need to be considered when building an aesthetic composite restoration.

in varying degrees, depending on the dental hygiene and dietary habits of the patient. The teeth of young individuals usually vary in shade from an A2 to A1. In patients over 50, a shade as dark as an A3.5 is not uncommon. Color changes are secondary signs of aging teeth. In contrast to the above changes in shape, this aging process can be reversed relatively easily by regular professional tooth cleaning and tooth-whitening procedures.

The previously described aging characteristics directly affect the restoration (Figures 7 and 8). While the effect of color change is obvious, the ways in which the other aging processes have a bearing on the dental reconstruction are less apparent. Loss of incisal edge contour (ie, the severity of incisal wear) indirectly determines the distance between the dentin mamelons and incisal edge. The space between the mamelons and incisal edge is seen as a translucent zone and, therefore, defines the height of the dentin core. The translucent zone, however, tends to vary considerably in



Figure 10. Tooth #7(12) demonstrates a defective edge buildup and cervical secondary caries.



Figure 11. View of the lateral incisor after isolation and completion of excavation.

individual teeth. For instance, some teeth feature hardly any translucency, causing a rather opaque incisal edge. In these cases, dentin composite material is applied to the height of the incisal edge to rebuild the mamelons. In the opposite case, some teeth may have large translucent zones that extend deeply beyond the proximal contact area—an aspect that needs to be equally considered in the dental reconstruction. The extent of the translucent zone, the outer profile, and the wear of the natural incisor all constitute parameters that need to be considered in the dental restoration.

Macro- and Micromorphology

Particular attention should be paid to the macro- and micromorphology of the tooth, as an adequate surface design is the most effective way to “camouflage” the dental restoration. To understand the importance of surface design, one must understand how a mirror works. A surface needs to be planed and polished to a high gloss in order to reflect light. Polished, smooth surfaces reflect incident light straight

back to the object. This is exactly the effect achieved by smoothing and polishing composite restorations with rotary disks. Even the smallest difference in shade, however, can be seen on polished plane surfaces. Restoration surfaces that contain artificially created surface structures scatter incident light and produce light reflections, endowing the tooth with a vivid appearance. These light reflections conceal the difference in shade between composite and natural tooth structure. Simulating the macro- and micromorphology of the natural tooth helps provide incisors with a “youthful and lively” appearance and, above all, offers the possibility of effectively camouflaging the restoration so that it is indistinguishable from the natural tooth structure. Reproducing the natural surface morphology plays as equally fundamental a role in anterior composite restorations as selecting the correct shades. Unfortunately, finishing the restorations with rotary disks may obliterate the envisaged effect, smoothing out the surface structures previously created.

After the restoration has been fully contoured, the macromorphology is re-created as the first stage in the finishing procedure. Finishing diamonds and rubber polishers are used for this purpose. In this context, the clinician should bear in mind that the external profile of a tooth can be visually manipulated by modifying the shape of its marginal ridges. The further the highest point of the ridge is placed towards the outside, the more squared the tooth will appear.

The final step before the restoration is polished to a high gloss includes reproduction of the microstructure. In this case, the basic principle that horizontal grooves (ie, perikymata) always overlay vertical grooves applies.



Figure 12. The reconstruction of the dentin mamelons has been completed. The chalky spots in the cervical region have been extended to the composite dentin core.



Figure 13. All six points of the checklist were carefully considered and contributed to the success of the completed restoration.

In other words, the vertical fissures typically found on the tooth surface are always applied first. They are carefully ground between the ridges of the macrostructure, using a diamond point without pressure. Only after this step has been completed are the developmental grooves applied in the cervical half of young teeth by guiding a coarse ledge diamond bur across the composite surface. In older patients, the pronounced grooves of young teeth have given way to pits. Pits can be created by using a slightly blunted Arkansas point at low speed. If the microstructure is inappropriately accentuated or the form inadequate, corrections can be easily applied with a silicon polisher.

Specific shade characteristics (eg, white spots, fluorosis, discolored enamel cracks) are often ignored in the buildup of composite restorations. The transition between the restoration and natural tooth structure is immediately visible if specific shade characteristics stop just below the transition. To avoid this, clinicians are often tempted to overly extend the preparation. This is not necessary, as shade irregularities represent an excellent opportunity to camouflage the transition between composite and tooth structure. This can be achieved without an additional expenditure of time, simply by applying one of the intensive shades of the composite range offered by most manufacturers. To simulate surface discolorations, such as white spots or fluorosis, the appropriate shade can be applied onto the dentin material, polymerized, and then overcoated with enamel material.

Guidelines for Aesthetic Anterior Restorations

The criteria mentioned thus far illustrate that shade selection alone is not enough to create a perfectly matching composite restoration. Instead, an entire collection of

information on the various characteristics of the tooth needs to be considered (Figure 9). Developing a perceptive eye for the details of the tooth is, therefore, the first step towards achieving an aesthetic composite restoration. The suggested guidelines can aid the clinician during this process by guiding him or her to systematically examine the criteria that need to be considered in the restoration during the preparation stage:

- Enamel and dentin shade;
- Outer profile of incisal edge;
- Zone of natural translucency at the incisal edge;
- Macromorphology;
- Micromorphology; and
- Specific shade characteristics.

Only after checking the surrounding natural dentition against the proposed guidelines can the clinician gather enough information to appropriately plan the aesthetic reconstruction of the tooth (Figures 10 through 13). Having the ability to spend extra time examining the tooth closely prior to preparation will result in a better aesthetic outcome for both the clinician and the patient.

Conclusion

Building a composite restoration that involves the use of several materials in different shades and degrees of translucency does not involve significantly more effort or time, as composite materials are applied in several increments to compensate for shrinkage. The application of intensive shades only requires an additional few seconds. The aesthetic result of the restoration is largely determined by the clinician's ability to accurately assess the specific characteristics and appearance of the surrounding natural dentition and integrate this information into the restoration.

Acknowledgment

The author declares no financial interest in any product referenced herein.

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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 "Simple guidelines for aesthetic success with composite resin—Part I: Anterior restorations," by Wolfgang M. Boer, DDS. This article is on Pages 000-000.

1. Which of the following often occur to an individual's teeth as he or she ages?

- a. The distal incisal edge becomes angular.
- b. Teeth become rougher.
- c. Teeth become more translucent.
- d. Both a and c.

2. Micromorphology:

- a. Occurs immediately prior to macromorphology and involves reproduction of the microstructure.
- b. Requires the use of a finishing diamond and rubber bur to modify the marginal ridge.
- c. Involves applying vertical THEN horizontal fissures.
- d. Refers to polishing the restoration to a high gloss.

3. Which of the following characteristics should be considered during restoration building in addition to shade selection?

- a. The outer profile of the incisal edge.
- b. The zone of natural translucency of the incisal edge.
- c. Macromorphology.
- d. All of the above.

4. The translucent zone:

- a. Rarely varies much between individuals.
- b. Generally becomes more evident between the dentin mamelons as an individual ages.
- c. Defines the height of the dentin core.
- d. None of the above.

5. Tooth shade is the result of:

- a. The translucent enamel shade and the opaque dentin shade.
- b. The opaque enamel shade and translucent dentin shade.
- c. The enamel shade only.
- d. The dentin shade only.

6. The microstructure consists of:

- a. Perikymata.
- b. Surface depressions and pores.
- c. Transverse ridges.
- d. All of the above.

7. What are some of the ways in which the marginal ridges optically alter the shape of a tooth during reconstruction?

- a. Marginal ridges curving away from the mesial make the tooth look smaller and broader.
- b. Marginal ridges that ascend in a straight line make the tooth appear longer and narrower.
- c. Both a and b.
- d. Neither a nor b.

8. The _____ normally exhibit a mesial, distal, and central ridge on the vestibular surface, while the _____ have a pronounced central ridge and fine marginal ridges.

- a. Central incisors; lateral incisors.
- b. Lateral incisors; central incisors.
- c. Central incisors; canines.
- d. Canines; lateral incisors.

9. As a tooth ages, its shade can change from:

- a. Shade A3 or A3.5 to shade A2 or A1.
- b. Shade A2 or A1 to shade A3 or A3.5.
- c. Both a and b.
- d. Neither a nor b.

10. Shade irregularities:

- a. Should not be present below the transition, if the tooth is expected to look natural.
- b. Can be used to camouflage the transition between the composite and tooth.
- c. Should be applied after the dentin material is coated with enamel material.
- d. None of the above.