

# TREATMENT PLANNING AND SMILE DESIGN USING COMPOSITE RESIN

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*Recent advances in dental materials and adhesive protocols have expanded the restorative procedures available to today's clinicians. Used in combination with proper treatment planning, these innovations enable dental professionals to provide enhanced aesthetic care that achieves the increasing expectations of their patients. Using a case presentation, this article will document the steps required to harmoniously integrate smile design, material selection, and patient communication that are involved in the provision of aesthetic dental care.*

## **Learning Objectives:**

This article discusses the utilization of composite resin as a tool to enhance the patient's smile. Upon reading this article, the reader should:

- Become familiar with a smile-enhancing technique which can be completed in one office visit.
- Realize the benefits that intraoral composite mockups offer in terms of prototyping and confirming patient satisfaction.

*Key Words: mockup, intraoral, composite, resin, smile design*

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Aesthetic dentistry involves the harmonious integration of smile design, material selection, and patient communication in order to meet the expectations of today's increasingly educated dental patient. This is accomplished by in-depth knowledge of facial aesthetics, tooth morphology, composite resin application technique, and communication skills. At the conceptual level, however, the procedure begins with an understanding of smile design. This article presents several of the key considerations managed by clinicians in this process and demonstrates their application in a clinical protocol using composite resin for smile enhancement.

### Aesthetic Principles

The smile is composed of the teeth, gingival tissues, and lips. In the ideal smile, the maxillary teeth will fill the area between the upper and lower lips, falling just short of the lower lip. Viewers typically see approximately 1 mm of the central incisors when the lips are at rest. As the maxillary central incisors are the visual focal point for the smile, they should be dominant and symmetrical.<sup>1,2</sup> The vertical midline of the smile coincides with the facial vertical axis and is generally perpendicular to the interpupillary line; the horizontal plane of the smile is parallel to this interpupillary line and is free from canting.

From the facial perspective, tooth proportions are guided by the "Golden Proportion."<sup>3</sup> These guidelines state that if the lateral incisor has a width value of 1, then the central incisor's is 1.618 and the canines are 0.618 accordingly (Figure 1).<sup>4,6</sup> Because this relationship is observed throughout nature, it creates a naturally harmonious appearance for the ideal smile. The Golden Proportion creates the perspective from this frontal

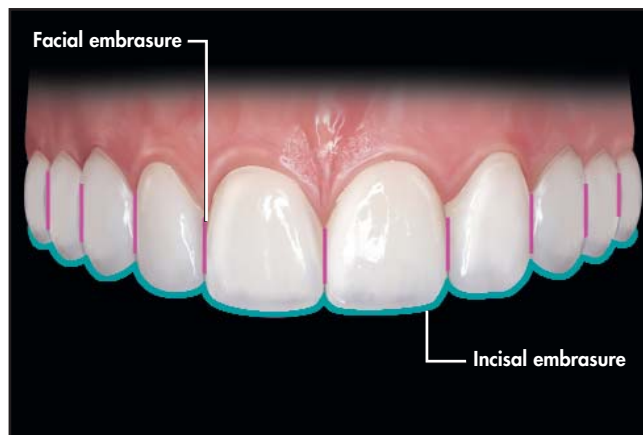


Figure 2. Diagram of incisal embrasures, which are progressively open as one views distally along the maxillary arch. The facial embrasures allow for curvature of the facial planes of the teeth.



Figure 3. Gingival embrasures and the gingival architecture are bilaterally symmetrical; the gingival zenith on the maxillary central incisors and canines is slightly to the distal.

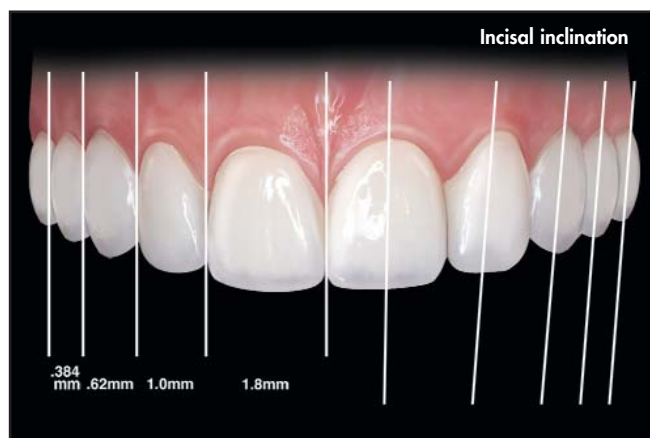


Figure 1. Diagram of the Golden Proportions and the axial inclination of the teeth in a natural, harmonious smile.

view, where the maxillary teeth progressively decrease in size, and recede to vanishing points located at the far left and right of the labial commissures. This purposeful use of the Golden Proportion serves as a starting point and may vary depending on patient preferences, facial features, and lip position. Keeping in mind that total facial harmony is the desired end result, the principles of the Golden Proportion can be easily modified so as to create harmony with the patient's facial features and physiognomy.

Individual teeth show progressive mesial axial inclinations that increase along the arch distally (Figure 1).<sup>3,6</sup> The arch form is rounded, with the incisal edges and cusp tips in alignment with the curve of the arch. An imaginary line running from canine cusp tip to cusp tip should cross through the incisive papillae.



**Figure 4.** Pretreatment facial view demonstrates notable wear of patient's dentition and aesthetic compromise.



**Figure 5.** Using the intraoral composite mockup technique, porcelain veneers would be used to improve her aesthetics.

### **Embrasures**

Embrasures exist in facial, incisal, and gingival aspects. Starting from the vertical midline, the incisal embrasures open as one progresses distally, corresponding to the varying shape of the maxillary anterior teeth.<sup>3,6</sup> Progressing distally from this midline, the interproximal tooth contacts move gingivally, revealing additional incisal embrasure space (Figure 2). The facial embrasures allow for curvature of the facial planes of the teeth and reveal a more individualized look by creating depth at the interproximal contact areas (Figure 2).<sup>3,6</sup>

### **Aesthetic Tooth Proportions**

Both tooth form and morphology establish the individual appearance of each of the maxillary anterior teeth. The

reader should note the typical shape of each tooth in the anterior arch. The maxillary central incisor has typical dimensions of 8 mm × 10 mm (width × height) or 9 mm × 11 mm, where the width is nominally 75% to 80% of the height.<sup>6,7</sup> In reality, especially in the middle-aged patient and older, decades of gravimetric pull has induced sagging of the lower lip, thus requiring a lengthening of the maxillary anterior teeth, starting with the central incisors, so as to fill the area between the upper and lower lips. Accordingly, the maxillary lateral incisor ranges in dimension from 6.5 mm × 9 mm to 7 mm × 9.5 mm. The maxillary canine has dimensions of 7.5 mm × 10 mm. The maxillary premolar has dimensions of 7 mm × 8.5 mm.<sup>6</sup>

### **Surface Texture and Aesthetic Criteria**

The surface anatomy of the maxillary anterior teeth reveals three facial planes of contour in the profile view. Facial grooves are prominent features of the maxillary central incisors and will occur to a lesser extent on the lateral incisors and on the mesiofacial aspect of the canines. In cosmetic restorative treatment, it is the incorporation of these seemingly subtle attributes that will impart a natural-looking result. Textures may exist as horizontal striations (ie, analogous to perikymata), which are utilized in an age-appropriate fashion.<sup>6,8</sup> The color scheme should reflect that the maxillary central incisors are the lightest shade in the arch; the canines may be one to two shades darker.

Optical properties such as incisal translucency and midbody or cervical opacity should also be considered in the design. These nuances of color and optical effects are customarily utilized according to patient preference



**Figure 6.** A small-particle hybrid composite resin is placed on the pretreated-teeth in order to build up worn or missing tooth structure.

or with respect to the existing untreated dentition to ensure optimal aesthetics.<sup>9</sup>

The gingival tissue generally runs parallel to the upper lip. Its architecture should be bilaterally symmetrical; the zenith of this tissue on the maxillary central incisors and canines is skewed slightly to the distal.<sup>3,6</sup> The soft tissue height of the maxillary lateral incisors is approximately 1 mm to 2 mm incisal in comparison to the tissue height of the maxillary centrals and canines when a line is drawn from central incisors to canine tissue zeniths.<sup>3,6</sup> The gingival embrasures are bilaterally symmetrical and allow for the interdental papillary architecture to exist (Figure 3).

In the in vivo application of smile design, the above features are applied in accordance with the intended treatment. That is, is a new smile being created, or is a single tooth being restored to harmoniously integrate with the existing natural dentition? When considering Bacon's quote that, "There is no excellent beauty that has not some strangeness in the proportion," some gentle variation of shape and dimension may be appropriate when creating this beautiful new smile.

### The Intraoral Mockup Technique

Establishing a shared vision for the intended aesthetic result among patient and clinician is critical to the success of the proposed treatment. In the intraoral mockup technique, composite resin and tooth preparation are used to create the new smile intraorally for verification by the patient.<sup>10,11</sup> If only the addition of tooth structure is needed to enhance the smile, as in a diastema closure or the repair of a fractured tooth, this process is completely reversible. More frequently, however, a combination of addition and reduction procedures is necessary to deliver the intended outcome. Although this technique is primarily used for indirect restorative cases in the aesthetic zone, it is extremely useful in a variety of applications (eg, smile design, Class IV fractures, direct veneers).

In the mockup process, composite resin is added temporarily (ie, without etching or application of a bonding agent), in areas of insufficiency; tooth reduction is performed in areas of excess. In this process, teeth are shortened or lengthened, rotated, moved facially and lingually, or any combination thereof.<sup>12</sup> Because of its sculptability, Venus microhybrid composite (Heraeus Kulzer, Armonk, NY) is the author's material of choice for this procedure. Due to its thixotropic nature, flowable composite (ie, Venus Flow, Heraeus Kulzer, Armonk, NY) serves in a supplemental fashion, allowing the clinician to create the nuances for this intraoral composite mockup



**Figure 7.** The composite is sculpted into position. Phosphoric acid etching may be performed if greater retention is required.



**Figure 8.** View of the temporary veneers created from loading the custom matrix with self-cured temporary composite resin.



**Figure 9.** View of the established and verified right lateral excursion with canine-protected occlusion and posterior disclusion.



**Figure 10.** Left lateral excursion with canine-protected occlusion and posterior disclusion.



**Figure 11.** The anterior guidance is established and verified.



**Figure 12.** Postoperative view following placement of porcelain veneers that were designed using the intraoral mockup technique.



**Figure 13.** Preoperative view of the patient's smile. Her chief complaints were the diastemata present and the shade of her existing dentition.



**Figure 14.** An intraoral mockup was performed as an aesthetic preview in order to show the patient what improvement could be achieved.

technique. This material is extremely useful for creating incisal edges or building up areas of cervical erosion.

The intraoral composite mockup technique is typically performed at the time of treatment just prior to tooth preparation (Figures 4 and 5). This demonstrates the proposed smile design to the patient and enables the fabrication of a matrix template for the provisional restorations. When using the technique for porcelain veneer cases, the intraoral composite mockup is performed as the first step under local anesthetic (Figures 6 and 7). Then a custom matrix is made with bite registration material in a triple tray. In comparison to a quadrant- or single-tray approach, the triple tray provides greater positional stabilization from the opposing arch.

The teeth are then prepared and the final impression is made. A desensitizing agent (ie, Gluma Desensitizer, Heraeus Kulzer, Armonk, NY) is subsequently applied to the prepared teeth in order to reduce sensitivity during the provisionalization stage. The custom matrix is then filled with a self-cured provisional composite (ie, Prevision, Heraeus Kulzer, Armonk, NY) and replaced in the mouth. The patient bites lightly into this matrix until the temporary material has set, and then the matrix is carefully removed, revealing the provisional restorations. Finishing and removal of flash may be performed with a periodontal scaler or a fine diamond bur (Figure 8), and flowable composite may be added in voids or to refine the smile.

Just prior to taking the custom matrix, occlusion is determined and developed directly in the mouth. Centric occlusion is set and then the lateral excursions with canine protected occlusion and posterior disclusion are established and verified bilaterally (Figures 9 and 10). If needed, the lingual surfaces of the maxillary canines can be built up with composite to set this occlusal scheme. Anterior guidance is established and verified (Figure 11).

### Benefits of the Composite Resin Mockup

This technique allows the practitioner and patient to envision the intended results before treatment is finalized.<sup>10,11</sup> In essence, it creates the prototype for the new smile (Figure 12). Secondly, the intraoral composite mockup permits the fabrication of the custom matrix for the provisional restorations. The mockup can eliminate the need for a laboratory-fabricated diagnostic waxup. The intraoral composite mockup technique allows treatment to start immediately. No preparation guide is needed, nor is a preparation index required of the laboratory.

The intraoral composite mockup also serves as a communicative tool between the patient, operator, and ceramist.<sup>10</sup> Furthermore, the technique instills the patient



**Figure 15.** Postoperative facial view of the completed direct resin veneers. Note the harmony of the patient's restorations in the new smile design.



**Figure 16.** The definitive restorations exhibited a harmonious, natural form and achieved the aesthetic expectations of the patient.

with confidence, as he or she can witness firsthand the clinician's sculpting of the restorations. Computer imaging software shows how a *computer* can change a smile, while the mockup technique demonstrates what the *clinician* can achieve.

This procedure also conveys critical information concerning the exact features and dimensions of the teeth. Sending the ceramist photos and models of the provisional veneers portrays exactly what is to be created. The mockup technique provides an opportunity for aesthetic, phonetic,<sup>13</sup> and occlusal evaluation of the proposed appearance.<sup>10</sup> This can determine whether or not changes to the tooth proportion need to be made so as to create harmony with the facial features, facial symmetry, and balance.

In diastema closures or in the restoration of a fractured tooth, this technique of temporary composite placement can be used for case presentation purposes. Finally, the intraoral composite mock-up technique develops expertise in direct composite resin veneers.

### Direct Composite Resin Veneers

One of the most challenging procedures in dentistry is the composite or direct veneer. Composite resin bonding does offer, however, the quickest and most economic means of providing aesthetic enhancement.<sup>9</sup> The placement of direct composite resin veneers empowers the operating dentist with the ability to create a dramatic aesthetic change in a single appointment. Mastery of direct composite resin veneers is an essential skill in cosmetic dentistry and can be developed by utilizing the intraoral mockup technique. In this case, Venus microhybrid composite will be utilized in the placement of eight direct composite veneers. Venus is a microhybrid composite indicated for such

use because, along with its sculptable nature, it will not slump, even when left uncured for extended periods of time.

### Preoperative Evaluation

A 19-year-old female presented with a chief complaint of diastemata and a request for whiter teeth (Figures 13 and 14). Clinical and radiographic evaluation revealed that diastemata were present between all the maxillary anterior teeth. Additionally, the patient's maxillary lateral incisors exhibited altered passive eruption, creating a smile that was immature in appearance. Furthermore, the gingival architecture of the maxillary central incisors displayed excessive contour. Shade analysis (eg, Vita, Vident, Brea, CA) revealed an existing shade of B2 for the maxillary central and lateral incisors and D2 for the canine and premolar teeth. Her occlusion was Class I with no temporomandibular joint pathology present. In lateral excursions, canine rise was present bilaterally. In protrusion, incisal guidance was present on the central incisors. Posterior disclusion existed in both lateral and protrusive movements.

As the patient declined orthodontic treatment, an intraoral mockup was performed in order to show her what enhancement could be achieved for her smile. Eight direct composite veneers, with concomitant gingival recontouring via a diode laser, were recommended along with a tray whitening procedure prior to restorative treatment.

### Tooth Preparation

After successful tray whitening that alterned the patient's teeth from shade B2 (ie, of the maxillary central incisors) to B1, gingivoplasty was performed with the diode laser. Assessment of the biological width and existing sulcus

depth permitted the gingival architectural changes without invading this protective envelope.

Preparation started on the maxillary central incisors with a depth-cutting bur. After guide cuts were made, the remaining tooth was prepared. On the lateral incisors, a more incisolingual preparation was performed, as these teeth would be extended incisally. Upon completion of the preparation of the eight maxillary teeth, microabrasion was employed to ensure a meticulously clean surface. The incisal edges of the opposing mandibular anterior teeth were smoothed by polishing discs, and a retraction cord was placed into the sulci of the prepared maxillary teeth.

### **Resin Application**

The maxillary right central incisor was isolated with a Mylar strip and etched with 35% phosphoric acid gel. The tooth was dried, and a dental adhesive (ie, Gluma Comfort Bond, Heraeus Kulzer, Armonk, NY) was applied. Enamel-shaded (B1) resin (ie, Venus, Heraeus Kulzer, Armonk, NY) was applied onto the cervical and middle thirds of the tooth and cured for 60 seconds once dentinal mammelons had been sculpted into this layer. At this point, a thin line of Effect Color CF1 was placed at the incisal edge and cured for 40 seconds. Then, a layer of Venus T3 was packed into the incisal third, sculpted gingivally across the middle third of the tooth, and cured. The other central incisor was built up in a similar fashion.

Subsequently, each tooth was microabraded prior to etching, so as to ensure that it was contaminant-free. The maxillary lateral incisors required placement of Venus dentin shade OB2 as the first step. Application from the lingual aspect of the tooth created the necessary mesio-incisal extension. After this layer of composite was cured, placement of the B1 body shade began. The lateral incisors were constructed using the same protocol as the central incisors with one exception. The mesial half of the tooth received enamel shade B1; on the distal half, shade A1 was applied. For masking purposes, the respective shades coalesced in the middle of the tooth with overlapping feathered edges. The remaining canines and premolars were treated in Venus shade A1 using the same protocol.

### **Finishing**

Partial finishing of each veneer was performed prior to the placement of the adjacent restoration. Interproximal contact areas were finished to completion in order to prevent the composite veneers from bonding together.

Initial contouring was performed using a carbide finishing kit, at which time occlusion was evaluated. Since the surface morphology was sculpted during resin placement, minimal finishing was necessary. Finishing cups and points were used to polish the entire surface of the veneers, and polishing paste was used to establish their final luster (Figures 15 and 16).

### **Conclusion**

Using the elements of smile design, practiced and perfected using the intraoral mockup technique for various cases, an operator can develop expertise in direct composite resin veneers as demonstrated in this case presentation. The aesthetic goals set during the patient's consultation were accomplished. The fact that this patient's smile was transformed in one visit is truly the most amazing aspect of the direct composite resin veneer. The enhancement of a person's self-image from this cosmetic procedure cannot be underestimated.

### **Acknowledgment**

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### **References**

1. Touati B. Defining form and function. *Pract Periodont Aesthet Dent* 1998;10(7):800-807.
2. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 1973;29:358-382.
3. Feigenbaum NL. Aspects of aesthetic smile design. *Pract Periodont Aesthet Dent* 1991;3(3):9-13.
4. Levin EI. Dental esthetics and the golden proportions. *J Prosthet Dent* 1978;40:244-252.
5. Ricketts RM. Divine proportion. In: Goldstein RE. *Esthetics In Dentistry*. 2nd ed. Hamilton, Ontario: BC Decker, 1998:187-206.
6. Magne P, Belser U. Natural oral esthetics. In: Magne P, Belser U. *Bonded Porcelain Restorations in the Anterior Dentition: A Biomimetic Approach*. Carol Stream, IL: Quintessence Publishing, 2002:57-98.
7. Chiche G, Pinault A. *Esthetics of Anterior Fixed Restorations*. Carol Stream, IL: Quintessence Publishing, 1990.
8. Adolfi D. Surface texture and superficial gloss. In: Adolfi D. *Natural Esthetics*. Carol Stream, IL: Quintessence Publishing, 2002:55-72.
9. Goldstein RE. Composite resin bonding. In: Goldstein RE. *Esthetics In Dentistry*. 2nd ed. Hamilton, Ontario: BC Decker, 1998:277-338.
10. Terry DA. Contemporary composite resins. In: Terry DA. *Natural Aesthetics With Composite Resin*. Mahwah, NJ: Montage Media Corporation, 2004:20-37.
11. *Cosmetic mockups*. In: *Reality*. 15th ed. Houston, TX: Reality Publishing Co, 2001:429-432.
12. Kim J, Chu S, Gurel G, Cisneros G. Restorative space management: Treatment planning and clinical considerations for insufficient space. *Pract Proced Aesthet Dent* 2005;17(1):19-25.
13. Kessler JC. Dentist and laboratory: Communication for success. *J Am Dent Assoc* 1987;(Spec No):97E-102E.