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
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.1,2 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.”3 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).4-6 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 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 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).3-6 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.
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. 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).  

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.  

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. 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.
or with respect to the existing untreated dentition to ensure optimal aesthetics.9

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.3 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.3,6 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.10,11 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.12 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.
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 anesthesia (Figures 6 and 7). Then a custom matrix is made with bite registration material in a triple tray. In comparison to a quadrant or singlery 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 (e.g., 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 (e.g., Provision, 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. 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. Furthermore, the technique instills the patient technique. This material is extremely useful for creating incisal edges or building-up areas of cervical erosion.
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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, and occlusal evaluation of the proposed appearance. 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. 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 introral 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 contouring via a diode laser, were recommended along with a tray whitening procedure prior to restorative treatment.

Tooth Preparation

After successful tray whitening that altered the patient’s teeth from shade B2 (ie, of the maxillary central incisors) to B1, gingivoplasty was performed in order to show her what enhancement could be achieved for her smile. Eight direct composite veneers, with concomitant gingival contouring via a diode laser, were recommended along with a tray whitening procedure prior to restorative treatment.

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

Preparation started on the maxillary central incisors with a depth cut. After guide cuts were made, the underlying tooth was prepared. On the lateral incisors, a more incisal-oriented 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 33% 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 dermal mammals 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 OD2 as the first step. Application from the lingual aspect of the direct composite resin veneer. The 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 middle thirds of the tooth and cured for 60 seconds once dermal mammalons 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.

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.

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References