



APPROACHES to *Smile* Design

Mathematical to Artistic Interpretation

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Introduction

With advanced knowledge, techniques, and materials, dental professionals today have the ability to approach smile design cases in a variety of ways.¹ Often reliant upon culturally-based philosophies and ideologies, the way in which cases are handled can vary greatly depending on a dental professional's location.¹ There is no better example than the differences between European dentists, who tend toward a more artistic, "whole person" approach to smile design—taking into account age, gender, and replication of that individual's natural dentition—and dentists in the United States, who tend to focus more on brighter color, symmetrical/proportional, rules-governed ideal restorations that are not achievable in nature.^{2,3} Today, however, both sides are meeting in the middle, with European patients requesting a less natural look and American patients desiring more natural-looking smiles.⁴

Allowing for better insight and knowledge into what it takes to make a restoration truly perfect in the eye of the beholder, the concepts and practice of esthetic dentistry benefit from differing opinions and, therefore, are in a constant state of evolution.⁴⁻⁶ However, the need to develop reproducible restorative results has pushed dentists to quantify the smile design process with rules, formulas, and measurements, which may actually inhibit their esthetic perceptions and ability to identify and provide those individual nuances that create natural beauty.



Learning Objectives:

After reading this article, the participant should be able to:

1. Compare criteria and the principles of art and visual perception.
2. Understand how to use symmetry, asymmetry, and "perfect imperfection" to create a beautiful smile.
3. Contrast the different approaches when applied to treating individual patients.

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Defining Esthetics in Dentistry

It is a common misconception among some dental professionals that esthetic outcomes result solely from a set of well-defined rules.⁷ Although it is necessary to understand and follow fundamental principles and parameters of what constitutes esthetic smiles, limiting dental professionals to specific guidelines and quantified measurements would lead to generic, boring, and stereotypical results for patients.⁷ Following a stringent and rigid approach breaches any perception of “Mother Nature.”

Many publications historically have attempted to quantify the correct principles of smile design, but no one has demonstrated the inherent ability to teach the dental professional how to create a truly natural-looking smile.⁷ For example, a misconception guiding many smile design principles is that components of the smile (e.g., tooth shape and size, embrasure form, axial inclination, gingival morphology, arrangement, and silhouette) should be symmetrical, a phenomenon that simply does not occur in nature.⁷

Instead, a more comprehensive approach is advocated, one that requires consideration of the philosophies of beauty and art in combination with fundamental smile design principles. Like the human face and smile, there is no better example of this than the complementary functions served by each side of our brain.⁷

The Human Brain—Combining Reason and Creativity

Although the left and right sides of the brain may appear symmetrical under medical imaging, each side functions in a very specific way.⁸ While the left side

handles verbal, analytic, symbolic, temporal, rational, computing, logic, and linear functions, the right side of the brain is involved in non-verbal, synthetic, analogical, atemporal, non-rational, spatial, intuitive, and artistic functions. Individuals often mistakenly believe that traits of the right side of the brain are inherited, or that one must have a disposition toward artistic and creative talents. However, it is well documented in the literature that individuals are given creative potential and have the opportunity for expression through art.⁸

Art as a Skill

It has been shown that art is a medium through which individuals develop the skills needed for the brain to approach tasks more creatively. A side of neurological function that is all too often suffocated by mundane daily tasks, developing the functions of the right side of the brain allows individuals to perceive tasks and outside influences in a different way.⁸

Artistic ability is a global, or “whole,” capability requiring only a limited set of basic components that, when integrated, form a whole skill that, once learned, allows a person to create art. This progression, however, requires practice, refinement of technique, and learning the situations in which the skills should be used.⁸ Although artistic talents are referred to as such, they are actually perceptual skills that include five components (i.e., perception of edges, space, relationships, lights/shadows, and the whole, or the “gestalt”).^{8,9}

Overall, artistic talent is the ability of an individual to shift the state of the brain into a different mode of seeing and perceiving. When learning how to create art, individuals learn how to control the way the brain processes information.⁸ Shifting the brain to see in a particular way is the true challenge of

artistic ability. Through this global approach to the development of artistic skills, dentists in particular can form associations and reveal intimate structures that would otherwise go unnoticed.⁸ However, with familiarity comes competency.

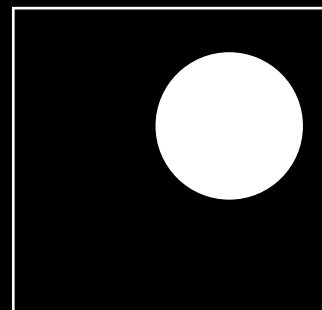
Applying the Artistic Process to Dentistry

The reason dental professionals often find it difficult to address esthetic cases is that they do not realize that there is actually no such thing as unesthetic dentistry; there is *only* esthetic dentistry. Every case, no matter what the patient presents with, should be addressed as an esthetic case. Therefore, when approaching dental care, dentists must put aside the belief that the ability to step outside of the logical “left-side thinking” and into the creative right side is a predisposed, inherited ability.¹⁰

However, doing so requires knowledge of the psychology of perception and of the manner in which the natural characteristics of the dental/smile architecture influence the overall perceived appearance of the patient. Consider visual fields (Figs 1 & 2). Although human perception is an agglomerate of certain aspects of an object, including colors, forms, movements, and dimensions, it is first an interaction between guided tensions. For any spatial relation, there is a precise distance that is intuitively decided upon by the eyes. The eyes are drawn to the center, as it is the major area of attraction and repulsion. At this center, all forces are balanced and the central position of an object is perceived as stable.

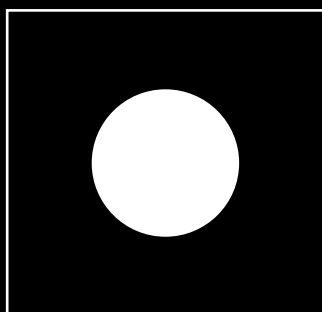
Additionally, balance is the distributive condition in which each situation reaches immobility; it is achieved when all forces of a system are compensating themselves. Balance is when the poten-

- By looking at the picture for just a fraction of a second it seems that the disc is closer to the center than it appears if we look at it slowly and dispassionately.
- This demonstrates that the physical and psychological systems show a very diffuse tendency of transformation to the lower level of tension.



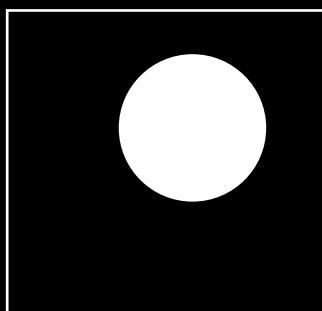
TENSION

Figure 1: Human perception is first an interaction between guided tensions.



- The disc gives us a greater impression of stability when its center fits with the center of the square.
- For every spatial relation there is a precise distance, perceived by the eye.
- The center is the place of major attraction and repulsion.
- At the center all forces are balanced; this means that a central position is perceived as stable.

Figure 2: Eyes are drawn to the center, where all forces are balanced and the central position of an object is perceived as stable.



- The position of the disc could be determined and described by measurements.
- We could then realize that the disc is not central.
- This finding is not a surprise—we do not need any measurements to see that the disc is not centered, we can easily see it with our visual judgment

VISUAL JUDGMENT

Figure 3: The eyes are intuitively able to find balance.

tial energy of a system is reduced to its minimum. With this, every visual situation is created by a fulcrum and a center of gravity. The eyes, when using the right side of the brain, can intuitively sense to find these factors and balance from there (Fig 3).

One of the most important factors in determining how art can be applied to dentistry is the way in which the visual weight of an object in view affects the way it is perceived. Typically, weight is also applied and used in conjunction with other defining characteristics. For example, spatial depth or the objects in depth are the first to draw attention in any figure observed. This characteristic is most notable when viewing a person's face, where the eyes and mouth draw the most initial attention. Another characteristic, color, affects how an object is perceived, with different colors creating different perceptions. For example, red has more visual weight than blue, and white has more weight than black, which is why a person's eyes often draw the most attention upon first glance (Fig 4). However, because white has more weight than darker colors, the viewer's eyes are immediately drawn to the teeth when the person smiles (Fig 5).

Dimension of an object plays an equally important role in defining weight, since the bigger the object, the more attention or weight it demands (Fig 6). Dimension, however, becomes irrelevant when discussing isolation, because an object in isolation will demonstrate a greater visual weight than any other object (Fig 7). In addition to the aforementioned characteristics, shapes are also important. The side on which an object is present (i.e., left or right) can affect the object's appearance (Fig 8). For example, all objects on the right are perceived as larger than those on the left. Therefore, one of the biggest mistakes that clinicians make with their patients is to allow them to analyze their smile in a mirror, because on a perceptual level they are speaking two different "languages." If they want to understand each other, they must evalu-

ate the smile in an image in such a way that the right and left sides are the same for both viewers.

The final characteristic, configuration, determines how an object appears and the visual weight it commands. Configuration, in general, is the determining factor in the physical form an object takes. It is the external aspect and visual weight that allows the eyes to see and capture the prominent features.

Given the right side of the brain's innate ability to undertake such functioning, dental professionals can apply the basics of the "artistic view," the foundation of which is the understanding that the whole cannot be achieved through the addition of small, isolated parts. Rather, considering the previously mentioned concept of "globality," dentists and technicians must first understand the overall integrated structure.^{8,10}

Artistic Perceptions of Smile Design Components

When designing a smile, it is important to understand the differences in tooth shape and structure based on the individual patient. It also is necessary to realize that characteristics like age and gender play an important role in how restorations should be completed. These characteristics are particularly significant in the central and lateral incisors and also are reflected in tooth shape and color (Fig 9).

Central Incisors

When restoring the central incisors, age is the determining factor in how the finished restoration should appear. In younger smiles, the central incisors tend to be long and rectangular. In younger patients, the central incisors should be longer than the lateral incisors, with a 65% width-to-length ratio and prominent incisal embrasures. Also, the mamelon pattern should follow greater thickness and volume of the enamel, which will ultimately lead to a pronounced halo. In younger dentition, there is an increase in irregularities and reflective diversity, including perikyma-

ta, stippling, and striation. With these effects, a lighter color goes along with an increase in value (Table 1).

In comparison, the central incisors in older dentition tend to be squarer and shorter, appearing equal to the lateral incisors and canines. With a 90% width-to-length ratio, mature dentition also display decreased incisal embrasures and smooth, higher-shine facial anatomy (craze lines). Mature central incisors are typically darker in color and show a decrease in value (Table 2).

In consideration of these principles and realizing the importance of central dominance, there are tools to aid in making an individual look older or younger. These principles are listed in Tables 3 and 4. Table 4 outlines strategies for treating older patients who desire much whiter teeth than would be age-appropriate. These simple tools will help make even the whitest of cases blend in due to the concepts of composition and consideration of "the whole," allowing for a sense of realism.

Lateral Incisors

Based on gender, the lateral incisors are evaluated on their size compared to the central incisors, the softness or hardness of their outline form, and their arrangement in the oral cavity. Even though dentists have at best a 50/50 chance of determining a patient's gender by looking at their laterals, there still can be seen a relative difference or varied perception when it comes to tooth shape, size, and anatomy. Therefore, the gender of the patient is often considered before any restorative work is completed.

Although not definitive, according to Lombardi,¹¹ Frush, and Fisher, the lateral incisors in males have typically been viewed as wider at the neck, with parallel proximal line angles and flatter incisal edges. The width of the lateral incisor also appears similar to the central incisors, with convex gingival embrasures.

In the restoration of female lateral incisors, differences from male patients are often observed and considered. For

Weight and Colors

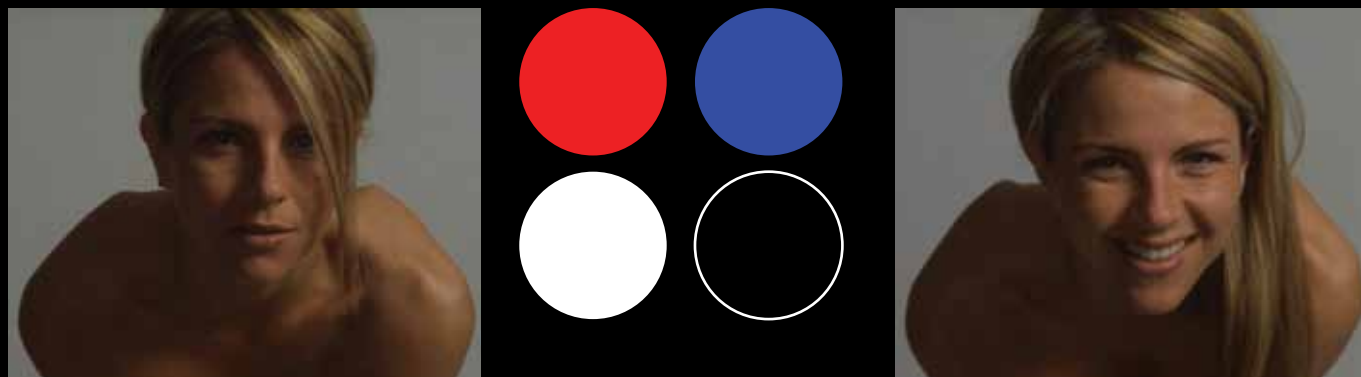


Figure 4: Red has more visual weight than blue, and white has more weight than black.



Figure 5: White has more weight than darker colors, so the viewer's eyes are drawn to the teeth; the lines show how the pattern of eye movement travels on the face.

From: *Eye Movement and Vision* by Alfred L. Yarbus, Institute for Problems of Information Transmission, Academy of Sciences of the USSR. Moscow; 1967.

Weight and Dimension

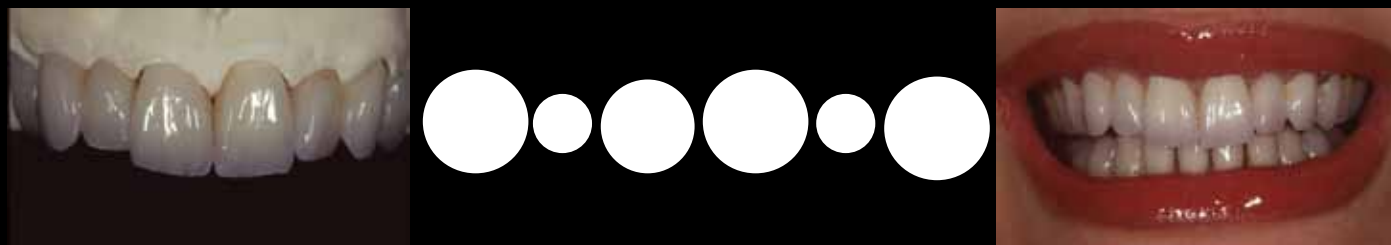


Figure 6: The bigger the object, the more attention or weight it commands.

Weight and Isolation

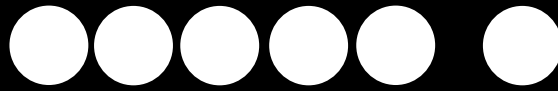


Figure 7: An object in isolation will demonstrate a greater visual weight than any other object.

Weight and Side



Left



Right

Figure 8: The viewer can appreciate how the deciduous canine is far more visible in the right-hand image than in the left-hand one.

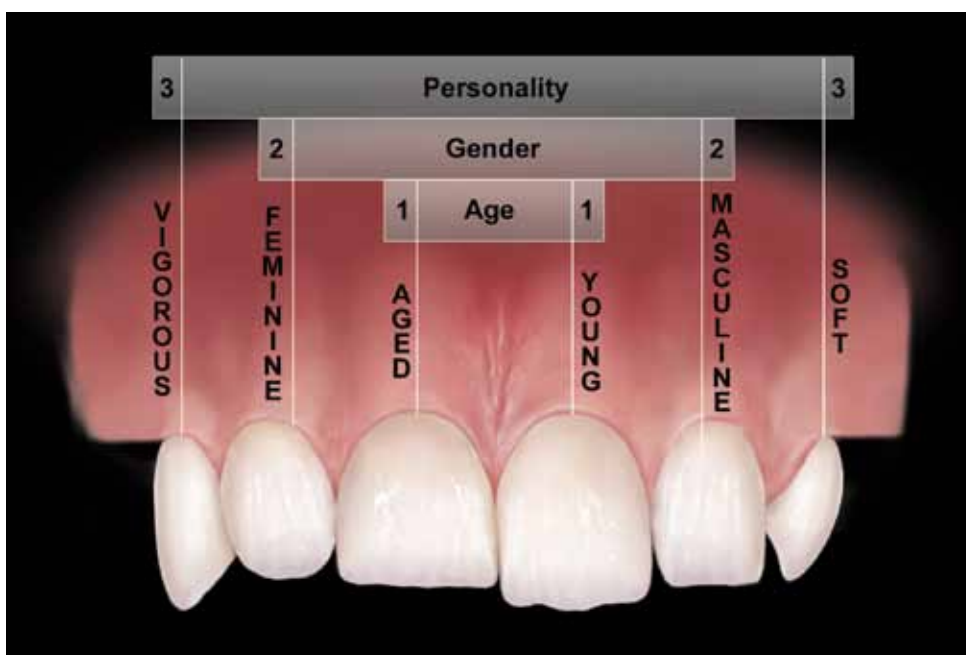


Figure 9: Lombardi,¹¹ Frush, and Fisher described the central and lateral incisors as imparting age and gender characteristics while playing into the dynamic negative space.

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TABLE 1: Characteristics Seen in Younger Teeth

- Long, rectangular shape to central incisor
- 65% W/L ratio
- Prominent incisal embrasures
- Mammelon pattern and greater thickness and volume of enamel leading to a pronounced halo
- Increased irregularities and reflective diversity (perikymata, stippling, striation)
- Lighter color and increase in value

TABLE 2: Characteristics Seen in Older/Mature Dentition

- Squarer shape to central incisor
- Central incisor shorter: equal to the lateral incisor or canine
- 90% W/L ratio
- Decreased incisal embrasures
- Sharp, angular incisor corners
- Smooth, higher shine facial anatomy (craze lines)
- Darker color and decrease in value

TABLE 3: Characteristics or Tools to Aid in Making Someone Look Younger

1. Creating centrals dominance is key.
2. Make the teeth lighter in color, with the centrals the brightest.
3. Design centrals that are longer (60-65% W/L ratio) and laterals that are shorter than a line drawn from the centrals to the cuspids.
4. Bring centrals slightly more facially than laterals.
5. Show more central below intercommisure line and fill more of the smile space.
6. Increase incisal translucency in the centrals and laterals.
7. Add more texture and anatomy to the centrals and laterals.
8. Characterize the incisal edge using mammelons and avoiding straight incisal planes.
9. Round incisal line angles and create incisal embrasures with depth and volume.
10. In the relaxed lip position or "M" position, have tooth display of 3-4 mm.

TABLE 4: Characteristics or Tools to Aid in Making Someone Look Older

1. Create teeth that have the signs of wear and use mandibular teeth going into protrusive and lateral excursive movements as a guide.
2. Make centrals and laterals approximately on the same plane.
3. Make centrals shorter with a 85+% W/L ratio.
4. Make incisal edges straighter and little/minimal to no incisal embrasures.
5. Show less tooth structure in the relaxed lip position or "M" position.
6. Make teeth darker, especially the cuspids.

Tables 1-4 show principles taught in the UCLA Aesthetic Continuum Course and Advanced Anterior Esthetic Course: LeSage B, Morley J, Eubank J.



Figure 10: (A) "S" curve on the mesial showing the transition line angle. When line angles are well established, the camera flash will pick them up as reflective zones. (B) Reverse "S" curve showing reflective zone and transition line angle on distal of tooth #8. (C) "S" curve position will aid in determining reveal of tooth and give uniformity with variety to outline forms.

example, female lateral incisors have typically been viewed as narrower at the neck and constricted at the gingival aspect, with diverging proximal line angles. With this, the incisal edge appears rounded, and the lateral incisor appears narrower than the central incisor, with concave gingival embrasures.¹⁰

Although mentioned in the literature, these male and female defining characteristics are to be used only as a starting point when restoring the dentition, not as definitive rules. These parameters, at best, can be used as a guide; when applying the right side of the brain, color, spatial depth, dimension, weight, configuration, and globality weigh as heavily. When attempting to determine gender by the morphology of the teeth, however, it is challenging.^{12,13} The authors liken this to a local forensic office attempting to determine the gender of the deceased using only the morphology of the dentition, which often returns non-definitive results.^{12,13} Simplified, consider these as society-imposed guidelines.

Tooth Proportion/Size/Symmetry

Among the objective criteria to be evaluated when planning a smile design case, proportion, size, and harmony also are important. Harmony, a form of balance, is further described as the weight of objects on either side of a midpoint in equilibrium. The proportion of the teeth, or width-to-length ratio, should range between 70% and 85%. The average size of the central incisors, for example, should be a length of between 10 to 11.5 mm, with an average length of 10.5 mm.^{14,15} To facilitate proper harmony, line angles should be based on the "S" curve and the reverse "S" curve (Fig 10). Altering the "S" and reverse "S" curve will affect weight and balance and is an excellent way to create uniformity with variety.

When developing harmony, it is also important to consider the outline form, profile, embrasures, and contact points, which should be moved from the incisal to a more apical position from the central incisor to the canine (Fig 11). When creating this progression, the smile line should be mimicked using the intuitive and artistic (right) side of the brain¹⁶ The eyes perceive any one shape of an element (tooth) secondarily to the shape of a series of elements (teeth). Isolation is the exception, as a tooth completely out of position will dominate the whole and lead to problems. Stein described it best as "perfect imperfections."

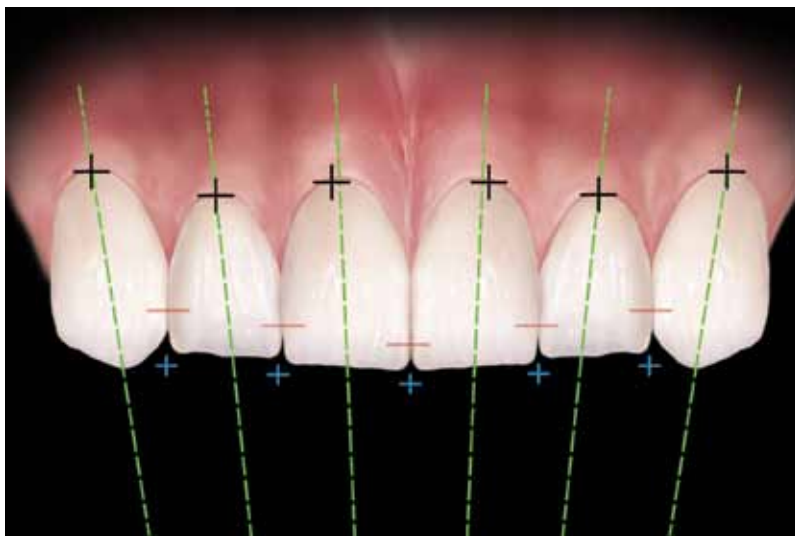


Figure 11: As the embrasures gain depth and volume from the central incisors posteriorly, the contact is moved more apical. This shortens the contact "zone," which defines the 50:40:30 rule.

Midline

The most important focal spot in an esthetic smile, the midline is an imaginary line dividing the midline lobe of the philtrum, or midpoint of the intercommisures (also referred to as "Cupid's Bow"), in the center of the upper lip into equal and balanced halves (Fig 12).¹⁷ Patients tend to relate their midline to the upper lip, rather than to other facial features that are further from the mouth.^{11,18} However, a properly placed midline, in conjunction with a long, solid interproximal contact relationship between the two central incisors, produces cohesiveness of the smile composition.¹¹ This effect is desirable in esthetic cases and



Figure 12: Left: Midline. (A) Cupid's bow. (B) Midpoint to intercommisural line. (C) Actual dental midline. Right: Full-face image showing balance in facial-dental esthetics.

enhances the appearance of the dentition and facial features.¹¹ The incisal plane must be at a right angle to the midline, but most importantly, parallel to the patient's natural horizontal head position, since parallelism implies harmony and is the starting point of weight, balance, and composition of the smile.

Golden Proportion

The "golden proportion," which does not apply to natural smiles because nature does not know symmetry,¹⁹ is considered the established criteria of an average smile (Fig 13). Based upon the ratio of 1.6:1, the golden proportion should not be interpreted as the rule, but rather considered a biological guideline.⁶ In fact, in Preston's study, none of the subjects followed golden proportion. Most consider it too distracting, and its judicious use must be emphasized.¹⁹

A preferred, more natural ratio to follow is one in which the laterals are 65% the width of the central, and the canine is 75% to 80% the width of the lateral.^{6,19} Further analysis would have female teeth at 61% to 65% the width of the centrals, and males having closer to 65% to 70% the width of the centrals. However, this also can be too oversimplified and rigid.

Significance of Gingival Esthetics

Dental and gingival esthetics combine to provide a smile with harmony and balance.²⁰ The quality of the dental restorations will not compensate for a defect in the surrounding tissues. Gingival tissues should appear pink, stippled, and firm, and should display a matte surface.²⁰ The papillae should be pointed and fill embrasures to the contact area (Fig 14).²¹ Demonstrating distances of the papillae of 5 mm or less, 6 mm, and 7 mm from the interdental bone to the apical extent of the contact area, the incidences of papillae being present are 100% (5 mm), 56% (6 mm), and 27% (7 mm), respectively.^{22,23}

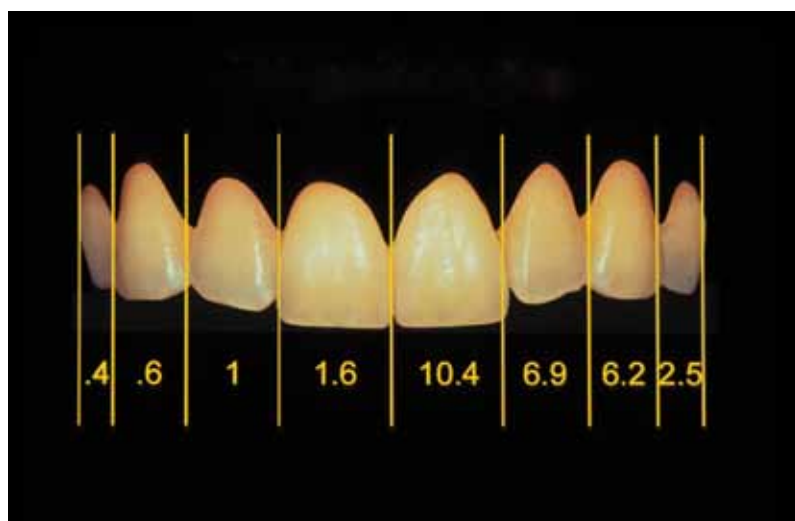


Figure 13: The ratio of 1.6:1, as depicted here, rarely exists in nature. Compare the reveal as measured in this dentition. Repeated ratio exists between central and lateral but is violated from the lateral to the cuspid and the cuspid to the first premolar.



Figure 14: View showing gingival health and gingival papillae in a restored case demonstrating good fill in of embrasure spaces to the contact areas.



Figure 15: (A) Smile view showing primarily gingival papillae. Incisal curvature paralleling the lower lip demonstrates the dynamic negative space filling 85% of the smile space. (B) Full-face view demonstrating harmony and balance between the dentition (white esthetics) and gingival tissues (pink esthetics).

Gingival Display

In a typical smile, the gingival display should be 0 to 3 mm at full smile (Figs 15a & 15b). The symmetry of the tissues also should be nearly equal, with harmony between the dentition and gingival tissues. For example, the central incisor and cuspid should display the same gingival height, and the lateral incisor should fall 1 to 2 mm incisal to a line drawn from the central incisor to the cuspid, not apical (Fig 16).

Creating dynamic negative space, a correct inter-incisal distance among the centrals, laterals, and canines is necessary.¹¹ These distances ultimately will lead to the creation of an attractive incisal curvature that parallels the inner curvature of the lower lip (Fig 17).¹¹ This also has been referred to as “black esthetics” and, in the dynamic range of lip movement from full smile to the relaxed lip position, a sense of the whole (“gestalt”) will determine the outcome. Excessive tooth display in the relaxed lip position or full smile showing excessive gingivae or deficient vestibular reveal can be “pink esthetic” issues that lead to visual tension in the smile (Fig 18).

Axial Inclination

Axial inclination is determined by two anatomical landmarks. Gingivally, it is at the highest point of the gingival crest (tangent) and the midpoint of the incisal edge. The line drawn between these two points defines the perceived axial inclination. Maxillary anterior teeth should have a mesial axial inclination. Worn incisal edges and/or gingival irregularities will lead to zenith and axial inclination issues (Figs 19a & 19b).



Figure 16: Harmony and balance in the gingival morphology with healthy, stippled tissues that fill the interdental embrasure space. Lateral crest is shy of a line drawn from the central to the cuspid’s gingival contour.



Figure 17: Relaxed lip position showing the ideal tooth display: 3 mm for a female in her 30s.



Figure 18: Left: Patient's controlled smile demonstrating average lip mobility of 6 to 8 mm. Average gingival display with right side lip asymmetry. Right: Patient's full smile showing excessive gingival display.



Figure 19: (A) Preoperative image showing altered gingival levels, zeniths, incisive papillae, and axial inclinations. (B) Postoperative image showing improved zenith points and balance from right to left. Notice the intimate relationship between tooth shape and gingival morphology.

Color

When discussing color in smile design, it is important to note the difference between shade selection and shade reproduction. The selection of color (also referred to as hue), relies upon the use of shade guides (e.g., Vitapan Classic Shade Guide, Vident; Brea, CA) that employ letters to represent different hues. Typically, "A" represents a red/orange-brown color, "B" represents red/yellow, "C" is equal to gray, and "D" displays as red/gray. When discussing hue, consideration of the chroma or saturation of color (also referred to as the intensity of color) is necessary as well. Dentists and technicians can choose from a light red/yellow (B1) to a darker, richer red/yellow (B4).

Coloring of restorations also involves the value and brightness (grayness) of a particular color. It is im-

portant to note that when value is increased, so is brightness. However, when increasing the value and brightness, the grayness of a restoration decreases. The translucency, opalescence, and fluorescence of the restoration also are considered during shade selection. In a simplified typical case, the central incisors will be the brightest, the lateral incisors will be slightly lower in value, and the canines will have a higher chroma (Figs 20a-20c). These determining factors can more easily be accessed in the three-dimensional or linear guide (Vita Linear guide).

Color mapping is often considered a good way to communicate shade with the technician, but this is not necessarily the case (Fig 21). In fact, whoever is fabricating the restoration should complete the color mapping. Transferrence of the color-mapping information

among team members is additional information, but its validity is doubtful. Photography is the most reliable way to communicate color to an off-site user.

The Points of Smile Design

It is important to remember when undertaking any smile design case that, although the aforementioned parameters and those below are typically used, nature is not numerical, symmetrical, rigid, or restricted to a set of rules. These design points are merely guidelines that can be followed in an attempt to replicate nature and create restorations that mimic the natural dentition as closely as possible.

When approaching smile design cases, it is beneficial to integrate the principles of esthetics, including harmony of white, pink, and black esthetics (line angle, outline form,

When learning how to create art, individuals learn how to control the way the brain processes information.

profile, and embrasures), while considering dominance, composition, and repeated ratios.^{5,24-26} Symmetry, if mentioned, refers to harmony and balance and not absolute symmetry. This involves locating the midline and direction, determining the size of the central incisors (width-to-length ratio), establishing the position of the incisal edges, creating age, possibly accounting for gender, and adding personality.^{5,24,27} Thresholds must also be established through investigation into the individual's perception of graduated degrees of abnormality. When all elements are joined together in appropriate proportions, guided tension, weight, and balance, they will act in synergy to create a beautiful, natural-looking smile (the whole).

Tolerance of Abnormalities

When approaching abnormalities, the overall condition and appearance of the oral cavity is typically examined.²⁷ Crown length, for example, should create harmony and balance for the centrals, which should not be shorter than the laterals. Crown width-to-length ratios should also be considered and idealized for the centrals. This is a very crucial principle. If presented with an esthetic scenario in which the canine-canine distance is narrow, clinicians should evaluate the case using a significant portion of the space on the centrals, allowing for narrower laterals or creating some overlap onto the centrals.

The incisor angulation of the restoration, or midline cant, should be viewed as unacceptable beyond 1.0 mm. Midline discrepancies in the vertical plane can be hidden by keeping it perpendicular to the horizon. This was found to be tolerated up to 4 mm.²⁷

Any black triangles present, or the lack of gingival closure, after gingival embrasures are opened, should be kept at 1 to 2 mm. While central harmony (not symmetry) and proportions are important to the gingival margin, if shorter laterals exist, both should have the same proportion and balance. Also requiring consideration in the tolerance of abnormalities, the incisal plane becomes less detectable as it moves further from the midline, and the acceptable gingiva-to-lip distance in a gummy smile is 2 to 4 mm maximum.



Figures 20a-20c: (A) Color image of no-prep veneers on laterals and bonded incisal edge of tooth #8. (B) Desaturated (black and white) image of A. Values of centrals are the highest tooth in the mouth, or value of the laterals is slightly lower than the centrals. (C) Portrait showing the integration of white, pink, and black esthetics with the face in mind.

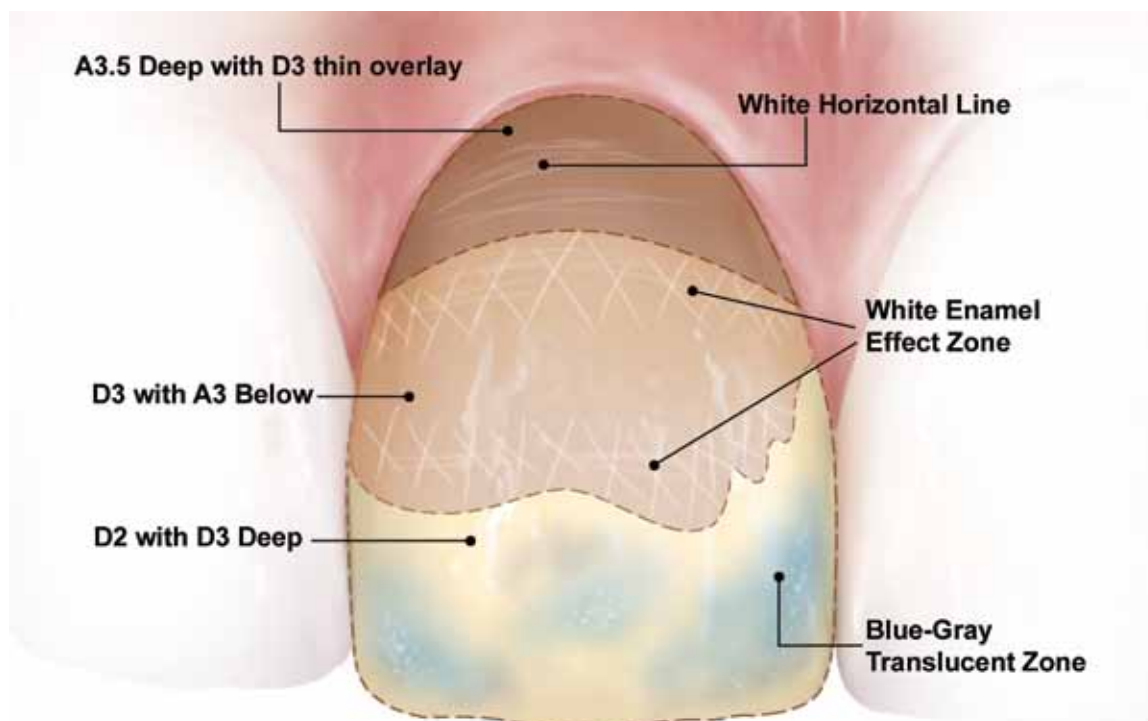


Figure 21: Example of a color map drawn by the clinician and used for a direct bonding case.

The Artistic View and Biological Smile Design

After considering the artistic view, dentists and technicians can develop a treatment plan that encompasses not only esthetics, but also the biological, functional, and structural needs of the case.²⁸ When approaching restorative/esthetic dental cases, it is necessary that all parties, including the dentist, technician, and most importantly, the patient, have full involvement in the case.^{29,30} By informing patients of all options, benefits, and risks, and allowing them to make an educated and informed decision, the overall health of the patient and the likelihood of satisfying their esthetic expectations will improve.^{6,7} Ultimately, when a policy of open communication is implemented and followed, the best in function, esthetics, and standard of care can be achieved.^{29,31}

Criteria

To fully understand how a smile design case is completed, there are fundamental objective (i.e., left side of the brain) criteria that first must be addressed (Table 5). Once these areas have been analyzed, addressed, understood, and implemented, the dental team can apply subjective criteria (i.e., right side of the brain) to further develop the case and provide the expected outcome for the patient (Table 6). Initially, much of this is predicated on seeing and understanding the need for a check-off list. As the dentist's training leads to fluency in the details, their eyes will envision the final outcome with consistency and ease, and they no longer will tolerate anything short of perfect imperfections.

Criteria Deficits

Although the criteria for biological smile design provide insights into a predictable way to treatment plan and un-

dertake a case, there are many areas that may lead to stumbling blocks. These criteria questions should be asked prior to undertaking restorative treatments and evaluated throughout treatment and again upon the completion of the dental makeover (Table 7). Table 7 was developed by the AACD/American Board of Cosmetic Dentistry® (ABCD) for the Accreditation credentialing process. It is invaluable in any restorative case involving the smile zone.

Microinvasive Dentistry

Today, in minimally invasive dentistry, the intent is to preserve as much anatomical tooth structure as possible. The "artistic view," when applied to smile design treatments, inherently advocates a minimally invasive approach that maintains a patient's natural tooth characteristics, such as simple bleaching and/or recontouring of the teeth, orthodontics, internal bleaching, and/

Table 5. Fundamental Objective Smile Design CriteriaModified from Magne and Belser,²⁰ p. 59, with permission from the author.

- | |
|---|
| 1. Facial and lip balance (midline) |
| 2. Tooth size and shape (outline form) |
| 3. Tooth axial inclination |
| 4. Tooth proportion |
| 5. Interdental contacts and embrasures |
| 6. Tooth profile (three facial planes) |
| 7. Gingival health |
| 8. Gingival morphology and contour |
| 9. Gingival papillae |
| 10. Gingival zenith |
| 11. Smile line and occlusal cant |
| 12. Vestibular reveal (buccal corridor) |

Table 6. Subjective Smile Design ConsiderationsModified from Magne and Belser,²⁰ p. 59, with permission from the author.

- | |
|---------------------------------------|
| 1. Variations in tooth form |
| 2. Tooth arrangement |
| 3. Tooth texture and characterization |
| 4. Tooth color and shade progression |
| 5. Dynamic negative space |

Table 7. Biological-Based Questions for Smile Treatment Evaluations

Based on the American Academy of Cosmetic Dentistry Accreditation Criteria

- | |
|---|
| 1. Is the periodontal health optimal? |
| 2. Is margin placement and design appropriate? Are the margins visible? |
| 3. Has underlying tooth color been properly managed to allow for an optimal cosmetic result? |
| 4. Does the restoration have "show through" of tooth structure or the fracture line under the material? |
| 5. Are the surface finish, polish, and luster appropriate? |
| 6. Is the labial anatomy (primary, secondary, and tertiary) appropriate? Are there three planes for the labial contour of the central incisors? |
| 7. Have line angles been properly developed? |
| 8. Is the color (hue, value, and chroma) selection appropriate/natural, not monochromatic? |
| 9. Are incisal translucency and halo effect appropriate? |
| 10. Is the interproximal contact or connector proper in length and position? |
| 11. Is the midline appropriate? |
| 12. Is the axial inclination appropriate? |
| 13. No dark triangles? |
| 14. Is the cervical/incisal tooth length symmetrical from right to left? |
| 15. Are contralateral teeth in harmony in terms of size, shape, and position? |
| 16. Are the cervical embrasures proper? |
| 17. Are effects of internal and surface color characterizations appropriate? |
| 18. Is the buccal corridor properly developed? |
| 19. Are incisal edges in harmony with the smile line? |
| 20. Is the tooth preparation inappropriate or excessive? |

Table 8. Armamentarium Approach for Microinvasive and Artistic View Dentistry

| |
|--|
| 1. Balance search in a composition by eliminating tensions without reaching symmetry |
| 2. Mock-ups |
| 3. Additional Veneers (e.g., partial veneers or no-prep veneers for treating additional teeth) |
| 4. Shells/Provisionals |
| 5. Orthodontic Therapy |
| 6. Tissue Contouring and Conditioning |
| 7. Second and Third Provisionals, and Grafting |

or direct composite bonding. When considering an indirect restoration, veneers often are the best tool to achieve this goal, as minimal correction of the anatomical surface of the teeth is often all that is required to make the most significant corrections to all aspects of the face.

Therefore, the philosophy of microinvasive dentistry—which holds that the less the dentist does to the teeth, the better it is for the patient and their oral tissues—can be combined with the artistic perception view to produce naturally esthetic restorative results. Fortunately, there are several restorative components and tools that can be used for smile design cases that incorporate both the artistic view and microinvasive dentistry (Table 8).

Case #1

Having had orthodontics five years prior, a 28-year-old female with multiple diastemas declined further orthodontic care (Figs 22a & 22b). The patient was given two options: orthodontics, which would eliminate the need for multiple veneers; and minimal preparation veneers on teeth #6 through 11 and all-ceramic restorations on teeth #12 and #13. Replacement of the crowns on #12 and #13 was necessary due to a food trap. The patient elected to undergo veneers after being informed of the advantages, risks, longevity, and prognoses of both treatment options.

Minimal preparation veneers (CL-II using the LeSage veneer classification system) were prepared with the aid of a bis-acrylic preparatory guide. This guide virtually eliminates the over-preparation of anterior restorations.

Esthetic issues discussed were multifactorial. Between the isolation of #10 and the weight of the centrals, guided tension existed. A borderline reverse smile line, distal axial inclination of #10, white maverick coloring, and diastemas mesial and distal of the laterals were other esthetic concerns. Additionally, the patient had incisal edge irregularities of the centrals and cuspids, as well as gingival asymmetry of the centrals, which highlighted the white,



Figure 22: (A) Retracted view showing esthetic issues. (B) Preoperative smile view of the patient's smile showing diastema and inclinations.



Figure 23: (A) Retracted view showing gingival health, harmony, and balance. (B) Postoperative smile, showing exceptional harmony and balance. (C) Portrait showing pleasing smile.

pink, and black esthetic violations. The color was acceptable, but balance, weight, and dimension were inclusive in the globality issues.

The definitive all-ceramic restorations (Figs 23a-23c), including a gingivectomy on #8, led to a pleasing smile defined by harmony and balance using the rules, tools, and strategies of esthetics, with an overriding influence of right-side artistic beauty.

Case #2

A 44-year-old male presented with a very dark tooth #9 and a large midline diastema (Figs 24a & 24b). Color was the dominant issue, and #9 overpowered his smile. With the diastema contributing to guided tension and the reverse smile line very noticeable, the patient was self-conscious about his teeth. When analyzing his smile using specific guidelines, many

parameters were problematic, especially the gummy smile in the posterior sextant. The latter did not bother the patient, nor was he looking to change his general composition, dimensions, and unique outline form, rotations, axial inclinations, embrasures, or general silhouetting of the incisal edges. He liked his slightly quirky gestalt.

As with all diastema closure patients, orthodontics was a treatment option. The patient was getting married soon and had an extremely busy work schedule. His fiancée had veneers, and they were looking for a very straightforward solution. Complete disclosure (information about advantages, disadvantages, risks, and longevity of the restorations, including how many times they would need to be replaced in his lifetime) was provided. After observing the minimal-preparation

veneer option, the patient decided upon that treatment.

A 0.5 to 0.7 mm preparation (CL-III in the LeSage veneer classification system) was performed on the dark #9, and virtually prepless (CL-I) all-ceramic restorations were provided for ##6-10. A natural smile was achieved that combined the patient's desires for uniqueness (maintaining his personality and character) and today's contemporary approach to smile design (Figs 25a-25c).

Case #3

[Editor's Note: Case #3 is a European case and uses the international numbering system.] A 58-year-old woman presented with #11, #13, and ##21-23 worn by bruxing activity; and a post and core and crown on #12 (Figs 26a-26f). Her main complaint was that her smile looked "old." On a perceptive level, the flat in-



Figure 24: (A) Preoperative view showing the patient's diastema and unique smile characteristics. (B) Retracted preoperative view showing very dark #9.



Figure 25: (A) View of the minimal preparations completed for the patient. (B) Postoperative view showing all-ceramic restorations. (C) Portrait showing a natural smile.



Figure 26a: Postoperative image showing flat incisal edge of the front teeth worn from bruxing.



Figure 26b: Try in of porcelain additional veneer of #9; note the extension of the incisal edge.



Figure 26c: Porcelain restorations on the cast.



Figure 26d: Retracted clinical image showing porcelain crown on #7, and porcelain full additional veneers on #6 and ##8-12.



Figure 26e: Preoperative facial view.



Figure 26f: Postoperative facial view.



Figure 27a: The patient before treatment.



Figure 27b: Clinical situation before treatment.



Figure 27c: Full additional veneers on #7, #9, and #10 and partial additional veneer on #8 (no preparation).



Figure 27d: Postoperative smile.



Figure 27e: The patient after treatment.

Every case, no matter what the patient presents with, should be addressed as an esthetic case.

cisal edge of the front teeth was very noticeable compared with the lower lip line, indeed giving her smile an aged appearance. In addition, all the front teeth needed to be elongated.

To overcome the aged-looking smile, it was decided to make the centrals longer to attract the most visual weight and simulate what often is seen in youthful smiles. Particular attention was applied to the tooth surface texture and stain characterizations in order to simulate natural dentition. Treatment consisted of replacing the restoration on #12 with a new porcelain-fused-to-metal restoration, full porcelain veneers without preparation on #11, #21, and #22, and additive partial veneers on #13 and #23 to replace the original anatomy worn by years of parafunction.

Case #4

[Editor's Note: Case #4 is a European case and uses the international numbering system.] A 40-year-old woman presented with chromatic and alignment problems on ##13-23 (Figs 27a-27e). Her main complaints were the dark color of #21 and #22, and that the front teeth were slowly moving outward. On a perceptive level, all the visual weight was dominated by the diastema between the two central incisors, and the elongated #21 created much visual tension and an unpleasant smile.

The treatment consisted of periodontal scaling and root planing. After achieving complete inflammation control, she underwent orthodontic treatment to align #21 and #22. Bleaching was performed, and three full additive veneers were placed on #12, #21, and #22, while #11 was treated with a partial additive veneer to compensate for the lack of papillae between #11 and #12.

Conclusion

By understanding the fundamentals of smile design and the artistic approach, including psychology and visual perception, dentists today have the ability

to provide their patients with restorations based on individual characteristics, personality, needs, circumstances, and desires.^{3,4,6} It is imperative to balance formulas with artistic views. The smile is a function of weight, balance, dimension, configuration, and gestalt in the patient's smile and face.

Simultaneously, the outcomes of treatment can satisfy clinical requirements for function and longevity, as well as today's emphasis on minimally invasive protocols.^{29,30} At a time when dentistry is experiencing a paradigm shift from aggressive smile makeovers to those that are conservative and functional as well as esthetic, it behooves clinicians to inform patients of the benefits and consequences of choosing aggressive treatments and unnatural-looking esthetics over appropriate treatments and more natural-looking results. This upholds the duty to do no harm; it requires better communication, consent, treatment planning, and material selection; and a commitment to achieving the patient's objectives for the best in function, longevity, and esthetics.

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The 10 multiple-choice questions for this Continuing Education (CE) self-instruction exam are based on the article, "Approaches to Smile Design: Mathematical to Artistic Interpretation" by Drs. Brian LeSage and Luca Dalloca. This article appears on pages 126-147.

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1. When evaluating facial esthetics and how a color is perceived, the patient should realize that

- a. blue colors have more weight (or "dominance") than reds.
- b. darker colors have more weight than lighter colors.
- c. white has more weight (or "dominance") than darker colors.
- d. color weight (or "dominance") has little visual effect in dentistry.

2. In discussing shapes, the side (right or left) to which an object is positioned

- a. can affect its appearance to the viewer.
- b. is irrelevant if natural symmetry is used.
- c. will be optically correct when viewed in a mirror.
- d. allows the object to appear larger if it is on the patient's right.

3. Central incisors of older patients

- a. are displayed as long and rectangular, equal in length to the canines.
- b. display decreased incisal embrasures and a smoother facial anatomy.
- c. are typically darker in color and show an increase in value.
- d. have a mamelon pattern demonstrating thick enamel.

4. Lateral incisors in males are typically viewed as having

- a. a wider profile at the neck with divergent proximal line angles and a flatter incisal edge.
- b. divergent proximal line angles, flatter incisal edges, and convex gingival embrasures.
- c. rounder incisal edges, convex gingival embrasures, and wider necks.
- d. convex gingival embrasures, flatter incisal edges and parallel proximal line angles.

5. According to this article, female lateral incisors

- a. are narrower at the neck and constricted at the gingival aspect.
- b. show converging proximal line angles.
- c. have a more rounded incisal edge and appear as wide as the central incisors.
- d. have more convex gingival embrasures.

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