

Dental Smile Esthetics: The Assessment and Creation of the Ideal Smile

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Esthetic considerations continue to become more relevant in dental treatment planning. Patients are becoming increasingly conscious of the significance of a beautiful smile in relation to facial beauty. Traditionally, dentists have focused on restoring health and functional elements of the dentition. Contemporary smile design is a relatively new concept, and techniques and philosophies are constantly evolving. This article describes the factors that need to be considered in the assessment and creation of the ideal smile, with emphasis on the integration of all the essential components of a smile: facial, gingival, and dental esthetics of the teeth. (Semin Orthod 2012;18: 193-201.) © 2012 Elsevier Inc. All rights reserved.

Increasing numbers of patients are requesting cosmetic dental procedures to achieve the perfect smile. In the past, the public's and clinicians' perception of dental esthetics was limited to modification of the individual teeth. However, although any type of tooth restoration can be performed as a single unit or in multiples, the cumulative visual impact of the anterior dentition often transcends the sum of the individual parts.¹ To optimize dental smile esthetics, it is imperative that the modern-day clinician appreciates the components of a smile so that improvements can be made. This requires an understanding of the intricate relationship between the teeth, the gingival scaffold, and the lips. With the advances in modern restorative techniques and orthodontics, it is possible to create optimal smile esthetics, assuming that the components of the smile are understood.²

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The Ideal Smile

Margaret Hungerford wrote in 1878 that "beauty is altogether in the eye of the beholder"; in other words, it is subjective. Therefore, it is almost impossible to define the ideal smile because there is much variation across individuals, ages, cultures, and civilizations. Despite these variations, the media have tended to depict an almost uniform image of the ideal smile, as a row of perfectly aligned ivory teeth encased in an envelope of bright red lips. The ideal smile is also associated with perceived good health and success. A dentition free of inflamed gingiva and calculus deposits, together with the absence of discolored unsightly teeth and fractured restorations, portrays an image of good self-care. Ruelkellerman found that people with well-aligned teeth were perceived to be more conscientious, sincere, and kind.³

With increasing esthetic demands from our patients, it is important that we understand their needs and satisfy their demands. All of our patients are unique individuals with unique traits and characteristics. Simply superimposing a standardized smile to every individual is not esthetic dentistry. Achieving the ideal smile requires that the clinician combine the scientific esthetic principles with artistic creativity to match the individual personality. The essential features of a smile are based on the relationship developed between the hard and soft tissues. Although interrelated, for the purposes of dis-

cussion, this article segregates smile esthetics into 3 distinct components: the lip framework, the gingival tissues, and the dentition.

The Lip Framework

The lips form the frame of a smile and so define the esthetic zone; they are muscular structures and so must be assessed at rest and in function.

At Rest

The rest or static position is when the lips are slightly parted and the teeth are out of occlusion, with the perioral muscles relatively relaxed.⁴ Prosthodontic guidelines have generally recommended arranging the upper incisor teeth so that between 2 and 4 mm of tooth is displayed at rest. The factors that influence the degree of tooth exposure at rest are lip length, age, race, and sex.⁵ The length of the upper lip varies from 10 to 36 mm, with the average being 20-22 mm, measured from the base of the nose to the edge of the upper lip.⁶ Individuals with increased maxillary lip length will generally show less of their maxillary teeth and more of their mandibular teeth.

The age of a person will also influence the degree of tooth exposure at rest. The aging process results in the loss of tonicity of the facial muscles and reduced elasticity of the upper lip. As a consequence, with increasing age, there is a reduction in maxillary tooth display and an increase in mandibular tooth display. Gender also influences tooth display, with females generally displaying significantly more tooth structure than their male counterparts.

In Function

In function, the lips can produce 2 types of smile. The posed smile is a voluntary smile, which is fairly reproducible, and may not be linked with emotion. The spontaneous smile is an involuntary smile often linked with emotion and involving larger facial movements, including squinting of the eyes, flaring of the nostrils, and maximum elevation of the lips.²

The extent of tooth display during a smile is influenced by the skeletal pattern, the mobility, and the length of the upper lip and size and positioning of the teeth. Upper and lower smile

lines can be described as being high, low, or medium. A low smile line will display the incisal third to half of the teeth below the inferior border of the upper or lower lip. Medium smile lines will display the teeth in their entirety, as well as the interdental papillae and 1-2 mm of the gingival margin. A high smile line, also described as a "gummy smile," will expose a large portion of the soft tissue, extending from the inferior border of the lip to the free gingival margin. The medium smile line is generally considered the most desirable, with a nominal exposure of 1-2 mm of the gingival margin. The extent of soft-tissue display during a smile is not the most critical esthetic factor per se; however, the way this soft tissue is arranged relative to the teeth and lips is of esthetic concern and warrants further discussion.⁷

Within the lip framework, the harmony and symmetry between the gingival tissues and the dentition make a smile esthetic. Of critical importance is the development of a sense of parallelism between the gingival tissue, the teeth, the lips, and the rest of the face. Any disturbance in this linear harmony will result in asymmetry and an unattractive smile. When a patient smiles broadly, the clinician can draw an imaginary line through the corners of the mouth, termed the commissural line. For optimal smile symmetry to exist, the commissural line and the occlusal line (defined by the cusp tips) should coincide with the interpupillary line (Fig. 1).

The dental midline, which forms the focal point within the lip framework, is also important. Achieving balance and harmony in the anterior dentition, on either side of the midline, provides a sense of symmetry. In the composition of a beautiful smile, this symmetry between the right and left sides makes a smile attractive (Fig. 2).

The Smile Arc

The smile arc is defined as the relationship of the curvature of the incisal edges of the maxillary incisors with the curvature of the lower lip in a posed smile.⁸ In an esthetic smile, the incisal edges of the maxillary anterior teeth should follow a somewhat convex course that coincides with the curvature of the lower lip (Fig. 3). The incisal edge curvature should be parallel and just above the level of the lower lip. During a mod-



Figure 1. The commissural line and the occlusal line should be parallel to the interpupillary line. (Color version of figure is available online.)

erate smile, the lateral incisors should ideally remain at a distance of 0.5-1.5 mm from the lower lip, whereas the central incisors and canines should be in close relationship with the lower lip line.



Figure 2. Symmetry is shown in this example. The maxillary and mandibular dental midlines should be coincident. The gingival heights between the central incisors, lateral incisors, and canines should be balanced. From the central incisors, moving distally from the midline, the degree of mesial tipping should progressively increase. (Color version of figure is available online.)



Figure 3. The incisal edges of the maxillary anterior teeth should follow a convex curvature that coincides with the curvature of the lower lip. (Color version of figure is available online.)

As one ages, the plane of the incisal edges of the maxillary anterior teeth is often flattened or even inverted. This may be due to tooth wear or other dental pathology, poor restorative dentistry, or altered tooth eruption patterns. This noncoincidence of harmony and parallelism between the teeth and lower lip leads to a loss of uniformity in the dentofacial perspective. This can classically be seen in patients wearing old complete dentures, with worn anterior acrylic teeth. Prosthodontic treatment in this situation should aim to produce a new denture tooth setup that restores the smile line and achieves optimal positioning of the teeth in relation to the lower lip, both for esthetic and functional reasons.

The plane of the incisal edges of the maxillary anterior teeth should also be related to the facial and dental midlines. An incisal plane that is perpendicular to the facial and dental midlines produces harmony and gives a sense of symmetry.

Dental Midline

The dental midline should coincide with the facial midline; however, in reality, the maxillary dental midline coincides with the facial midline in only 70% of the population. Fortunately, the dental literature suggests that of all esthetic parameters, dental midline abnormalities are the least noticed. Maxillary dental midline discrepancies of ≤ 2 mm go largely unnoticed.⁹

What is more noticeable is when the axial incisor angulation is incorrect. If the visual junc-

tion of the maxillary central incisors is at an angle to the facial midline, termed a canted plane, it can have a significantly negative impact on the overall esthetic result in the natural or restored dentition. Angulations of $>6^\circ$ were found to be unacceptable when judged by orthodontists, and those of $>10^\circ$ were found to be unacceptable when judged by lay people.¹⁰

From an orthodontic perspective, although the alignment of the maxillary and mandibular dental midlines is desirable (Fig. 2), the mandibular midline is less significant from an esthetic point of view. The maxillary and mandibular midlines fail to coincide in almost three-quarters of the population.¹¹ The relatively smaller width and uniformity of the mandibular incisors make visualization of the midline more difficult, and it is often masked, particularly when seen in relation to the lips and other soft-tissue structures.

Buccal Corridor

The term buccal corridor (also called the “negative space”) was initially added to dental terminology by specialists in removable prosthodontics in the late 1950s.¹² When arranging denture teeth on removable prostheses, clinicians aimed to recreate a natural appearance, by incorporating buccal corridors. The buccal corridor is defined as the space created between the buccal surfaces of the posterior teeth and the commissures of the mouth when smiling. In an ideal smile, bilateral negative spaces should be evident, separating the teeth from the corners of the mouth.

Gingival Tissues

The gingival tissues form the soft-tissue framework around every tooth. Healthy gingival soft tissues have the free gingiva that extends from the free gingival margin coronally to the gingival groove apically, and it is keratinized and has a coral pink dull surface. The attached gingiva extends from the free gingival groove coronally to the mucogingival junction and has a coral pink color and firm texture. The attached gingiva is keratinized and can be highly stippled or smooth. The alveolar mucosa is apical to the mucogingival junction, with a loose and dark-red appearance.

Although the primary aim of periodontal therapy is to maintain the health of the attach-

ment tissues, from an esthetic perspective, this is often not sufficient. An irregular arrangement of the gingival tissues, despite being healthy, may well significantly diminish the outcome of all other treatment, resulting in a less than optimal esthetic outcome. It is most important that the gingival perspective is fully assessed at the outset of any esthetic treatment planning, and it may become desirable to establish a certain balance and symmetry of the gingival tissues to achieve a healthy and predictable final esthetic result. Assessment of gingival esthetics is of critical importance in patients with high lip lines, where the gingival margins are clearly visible, as well as for patients with high esthetic demands.

Treatment methods for developing gingival harmony may involve periodontal plastic surgery or orthodontics. Periodontal surgery may involve additive or resection gingival techniques, and orthodontics may involve extrusion or intrusion techniques. The various procedures and the treatment provided will ultimately depend on the underlying concern. Excess gingiva can be corrected using resection periodontal surgery techniques, such as the gingivectomy or crown-lengthening surgery involving osseous recontouring of one or more teeth. Gingival recession can be corrected using additive periodontal surgery techniques, such as tissue grafts or guided tissue regeneration, or nonsurgically using orthodontic extrusion techniques.

Gingival esthetics relies on achieving a balance of gingival levels from the central incisors to the canines. The gingival architecture of the central incisor teeth should mirror one another. The gingival contour of the lateral incisors should lie more coronal to the central incisors and canines and be bilaterally symmetrical. This ideal scenario represents the Class 1 gingival height.¹³ Variations in the positioning of the gingival margin of the lateral incisors can occur; in Class 2 gingival height, the gingival contour of the lateral incisors lies apical to that of the central incisors and canines. The canines, in turn, should ideally have the level of the free gingival margin at the same height as the central incisor teeth and matching one another (Fig. 2).

When evaluating the free gingival margin, the maxillary lateral incisors and the mandibular incisors should display a semicircular shape. The maxillary central incisors and canines display a more elliptical gingival shape, with the most api-



Figure 4. This patient has periodontal disease, which has resulted in the so-called “black triangles.” (Color version of figure is available online.)

cal point of the gingival outline positioned distal to the longitudinal axis of the tooth; this is termed the gingival zenith.¹⁴ The gingival zenith of the maxillary lateral incisors and mandibular incisors is usually centered along the tooth axis. The position of the gingival zenith around individual teeth is primarily related to tooth morphology and corresponds to the area of maximum convexity of the tooth at the free gingival margin.

In a healthy periodontium, the interdental papilla should fill the space below the contact area of adjacent teeth. After periodontal disease, tooth loss, or poor restorative dentistry, the interdental papilla may be lost, resulting in what is termed “dark triangles.” The presence of black triangles will result in gingival disharmony and an overall compromised esthetic outcome (Fig. 4). The presence of the interdental papilla is primarily dependent on the existence of the teeth, the underlying periodontal support, and the gingival biotype. However the relationship of the contact points of the maxillary teeth with the alveolar crest also has a significant influence on the interdental papilla. When the distance from the contact point to the interproximal osseous crest is ≤ 5 mm, there is complete papillary fill of the gingival embrasures. As this distance increases for every 1 mm > 5 mm, the chances of achieving complete fill is progressively reduced by 50%.¹⁵ The clinician should be aware of the negative esthetic impact that the lack of interdental papilla can have on dental esthetics, particularly in a patient with a high smile line. Numerous techniques can be used to optimize this aspect of “pink esthetics,” through the use of esthetic periodontal surgery, orthodontics, or fixed prosthodontics, alone or in combination.

Dentition

Optimal smile esthetics can only be achieved if the clinician has knowledge and understanding of tooth form; arrangement, color, and texture of natural teeth; and how they relate to other facial structures.¹⁶

Tooth Shape

The shape of the maxillary anterior teeth is genetically determined and varies between individuals. The shape of a tooth requiring restoration can be determined from adjacent teeth, previous study casts, and photos. If the aim of restorative treatment is to alter tooth shape, it is imperative that the final result is pretested in the form of a diagnostic wax-up, intraoral mock-up, and good-quality restorations. What constitutes an esthetic smile can be subjective, and the patients' assessment of the esthetic improvement may differ from that of the clinician. Following the sequence suggested provides the clinician with controls and allows the patient to assess the esthetic changes to the teeth, allowing for a more predictable and desirable final outcome.

In geometric terms, tooth shape can essentially be divided into square, ovoid, or triangular forms. Square teeth are characterized by straight mesial and distal outlines and parallel transitional line angles and lobes (Fig. 5). These teeth have a large cervical area, and the incisal edges are generally straight. Ovoid teeth are characterized by curved mesial and distal outlines with smooth transition line angles. Incisal to cervical convergence results in a narrow cervical area and more rounded incisal edges (Fig. 6). Triangular teeth are characterized by a straight outline, with marked transition line angles and lobes. There is a more prominent convergence

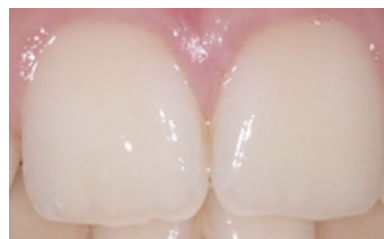


Figure 5. An example of square-shaped teeth. (Color version of figure is available online.)



Figure 6. An example of ovoid-shaped teeth. (Color version of figure is available online.)

from incisal to cervical, especially on the distal outline, which is clearly inclined, defining a narrow cervical area (Fig. 7). The incisal edges tend to be slightly curved.¹¹

Numerous prosthodontic articles describe the shape of the anterior teeth. Williams¹⁷ suggested that the basic shape of the anterior teeth was the inverted frontal view of the face. Frush and Fisher have suggested that the sex, age, and personality of the individual should also be considered in relating the shape of the anterior dental segment.¹⁸

In general, younger patients have incisors with sharper unworn incisal edges, whereas incisors in older patients show greater incisal edge wear. For female patients, a softer more rounded tooth form may be preferable for prosthodontic restoration, whereas in male patients, restorations can be fabricated, with more clearly defined line angles. The character of an individual may also be taken into account when deciding on tooth shape.

Tooth Size and Proportion

A symmetrical tooth arrangement that displays appropriate dominance of certain teeth and also provides a sense of proportionality is important in establishing an esthetic smile. The height and width-to-length ratio of the individual teeth are criteria that need to be considered in creating a beautiful smile.

Tooth size and proportion is subject to great individual variation and, even in the same person, will alter throughout life owing to physiological or pathological tooth wear. In assessing or attempting to modify tooth shape and proportion, the profession has become obsessed with applying “magic formulas” to define appropriate tooth dimension. Although tempting, simply using a concept of “one formula to fit all”

provides a rather mundane approach to esthetic dentistry. For a successful outcome in any given patient, subtle variations should be introduced to match the age, race, and personality as well as taking into account the wishes of the individual patient. Nevertheless, some general guidelines are required as a baseline starting point for creating a beautiful tooth arrangement.

The findings of Sterrett et al¹⁹ provide useful information to determine the final size and proportion of a tooth. Their study revealed that, in general, the size of male teeth was greater than female teeth. One other significant finding from the study was that the crown height-to-width ratio of a tooth is a more suitable reference rather than simply using the dimensions of a tooth. This ratio shows minimal variation between gender and individual teeth.

As stated by Lombardi,²⁰ “just as unity is the prime requisite of a good composition, dominance is the prime requisite to provide unity.” The maxillary central incisor should be the dominant tooth of any smile. The results of the study by Sterrett et al revealed that the ideal maxillary central incisor should have a width-to-length ratio of approximately 0.75-0.85. A ratio <0.6 would create a long narrow tooth, and a ratio >0.85 would result in a short wide tooth. On average, the central incisor may be between 9.5 and 10.2 mm in length and 8.1 and 8.6 mm in width.

Further guidelines for developing an esthetic maxillary anterior tooth arrangement include

- The crown width-to-length ratios of the canines and incisors should be similar to each other and should have a range of 77%-86%.
- On average, the lateral incisor should be between 7.8 and 8.7 mm in length and 6.1 and



Figure 7. An example of triangular-shaped teeth. (Color version of figure is available online.)

6.6 mm in width. Central incisors should be wider than lateral incisors by 2-3 mm.

- On average, the canines should be between 8.9 and 10.1 mm in length and 7.1 and 7.6 mm in width. Central incisors should be wider than canines by 1-1.5 mm.
- The maxillary central incisors and canines should have similar crown heights and, on average, should be 1-1.5 mm longer than the maxillary lateral incisors.

Once the shape and the size of the maxillary anterior teeth have been determined, emphasis should be placed on the relationship of the incisors with the canines, in particular their relative proportions, when viewed directly from the anterior.

The dental literature describes the use of mathematical models such as the "golden proportion," to determine the ideal mesiodistal widths of the central and lateral incisor and the mesial aspect of the canine.²¹ As defined by the golden proportion, a ratio of 1 is given to the lateral incisor with regard to mesiodistal width. The central incisors will then have a 1.616 ratio and the canines will have a 0.618 ratio when compared with the lateral incisors.

Although objects such as buildings and paintings as well as living organisms displaying such golden proportion are perceived to be beautiful, its relevance to the dentition is less clear. Studies have demonstrated that the actual measurements of most people's anterior teeth do not conform to it.²² Strict adherence to and application of the golden proportion to every case would result in unnecessary narrowing of the maxillary arch. In reality, subtle variations in sizes and proportions are acceptable. Of greater importance is achieving balance and symmetry between the teeth, to provide an overall harmonious final result.

Axial Inclination

The long axis of the maxillary anterior teeth should follow a progression from the midline distally. When the long axis of a tooth tips toward the midline from apical to coronal margin, the tooth is described as medially tilted. If the long axis of the tooth tips away from the dental centerline, the tooth is said to be distally inclined. When the axial inclinations of the maxillary anterior teeth are mesially inclined toward

the midline, a more pleasing esthetic result is achieved. Within an esthetic smile, the degree of axial inclination will vary for different tooth combinations. The maxillary central incisors should be bilaterally symmetrical and dominate the smile to some degree. From the central incisors, moving away from the midline, the degree of mesial tipping should progressively increase (Fig. 2).

Shade Progression

It is beyond the scope of this article to give a detailed account of tooth shade and color; however, certain basic aspects are worthy of mention. In the authors' experience during initial treatment planning stages, great emphasis was placed on the final tooth shade, by the patient, often at the expense of more fundamental esthetic considerations.

Of the 3 components of color, the value or brightness is the most critical element, followed by the chroma (the intensity or saturation of the color).²³ The hue (the color itself) is of less critical importance owing to the low concentration of hues in tooth shades.

The shade and color of the maxillary anterior teeth follow a progression within the same tooth from cervical to incisal and also from tooth to tooth, based on the distance away from the midline. This reproduction of shade progression is an important element when attempting to create anterior natural-looking restorations in prosthodontics. The maxillary central incisor teeth are generally the lightest and brightest teeth in the smile, and this also helps to enhance the sense of central dominance of these teeth.²⁴ The maxillary lateral incisor teeth have a hue similar to that of the central incisors, but may have a slightly lower value. The canines have the greatest chroma saturation and are also lower in value than any of the other anterior teeth. The premolar teeth have a value similar to that of the lateral incisors and appear lighter than the canines.¹

As already mentioned, value is the most important component of the color and must be given the greatest consideration during tooth shade selection. The value or brightness also varies in different regions within the same tooth as well as from tooth to tooth. The middle third of the tooth is generally the brightest, followed

by the cervical third. The incisal third has the lowest value owing to the higher transparency and light absorption in this area.³

Connector Space and Contact Areas

The connector space is defined as the area in which adjacent anterior teeth appear to meet, whereas the contact area is the points where the teeth actually meet. The connector space is a larger broader area than the contact area, and in the ideal smile, a relationship exists between anterior teeth referred to as the 50-40-30 rule.²⁵ The ideal connector space between the central incisors is 50% of the length of the crowns, between the maxillary central incisor and the lateral incisor is 40% of the length of the crown of the central incisor, and between the lateral incisor and canine is 30% of the length of the central incisor. The actual contact points are generally smaller areas and are coronally placed between the central incisors and tend to progress apically from the incisors to the rest of the dentition.

Incisal Embrasure

The incisal embrasures are defined as the spaces that are developed between maxillary anterior teeth as a result of the separation and edges of the teeth. These spaces help to define the individual teeth and enhance esthetics. Foulger et al²⁶ have shown that the lack of embrasure spaces has a significant negative impact on perceived smile esthetics, when assessed by dentists, dental technicians, and patients. One further conclusion from their study was that an incisal embrasure space arrangement where the embrasure spaces increase in size and volume distally from the midline was deemed to be the most esthetic. The embrasure spaces are approximately the shape of an inverted "V," and the size and volume of the incisal embrasures between teeth should increase in progression distally from the central incisors to the posterior dentition (Fig. 8).

Individual Teeth

Each tooth in the arch has its own specific basic anatomy, and the dental technician should recreate this in the definitive restorations in prosthodontics. A failure to appreciate basic



Figure 8. The incisal embrasure spaces are approximately the shape of an inverted "V," and the size and volume of the incisal embrasures between teeth should increase in progression distally from the central incisors to the posterior dentition. (Color version of figure is available online.)

tooth shape and form will result in restorations that are not natural and will significantly compromise the final esthetic result.

Further enhancement of tooth esthetics can be achieved by paying specific attention to individual tooth characterization, such as surface texture and contour, incisal edge translucency and haloing, transitional line angle enhancement, and other specific surface characterizations.

Texture of the facial surface of a tooth plays an important role with respect to the reflective and deflective zones of a tooth. Light surface textures demarcate reflective and deflective zones and are often used to produce more mature-looking restorations in prosthodontics. Heavy surface textures will produce multiple variations of reflective and deflective zones and are often reserved for more youthful prosthodontic restorations or patients requesting a younger look.

Summary

Society, in general, now places great emphasis on looking and feeling younger and healthier, and esthetic considerations have become increasingly more relevant in dental treatment planning. Patients are becoming increasingly conscious of facial beauty and, in particular, the significance of a beautiful smile. Traditionally, restorative dentists have focused on restoring health and functional elements of the dentition. Contemporary smile design is a relatively new discipline, and techniques and philosophies are

constantly evolving. Clinicians must be able to evaluate what constitutes the basic features of the ideal smile. This goes beyond simply the teeth to a notion where complete dentofacial harmony is developed. This requires an understanding of the careful integration of the essential components of a smile: facial esthetics, gingival esthetics, and macro- and microesthetics of the teeth.

Providing a satisfactory functional and esthetic outcome requires careful assessment and treatment planning on the part of the restorative dentist. A clear vision of the final desired outcome should be understood and communicated at the outset to all clinicians and technicians involved in multidisciplinary care of patients.

Finally, a successful esthetic outcome can only be achieved if clinicians understand their patients and provide them with a smile that matches both their expectations and personalities.

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