SMILE ANALYSIS: — Photoshop smile design technique

Introduction: Smile analysis and esthetic design

Dental facial esthetics can be defined in three ways:

Traditionally, dental and facial esthetics have been defined in terms of macro- and micro-elements. Macro-esthetics encompasses the interrelationships between the face, lips, gingiva, and teeth and the perception that these relationships are pleasing. Micro-esthetics involves the esthetics of an individual tooth and the perception that the color and form are pleasing.

Historically, accepted smile design concepts and smile parameters have helped to design esthetic treatments. These specific measurements of form, color, and tooth/esthetic elements aid in transferring smile design information between the dentist, ceramist, and patient. Esthetics in dentistry can encompass a broad area—known as the esthetic zone.1

Rufenacht delineated smile analysis into facial esthetics, dentofacial esthetics, and dental esthetics, encompassing the macro- and micro-elements described in the first definition above.3 Further classification identifies five levels of esthetics: facial, orofacial, oral, dentogingival, and dental (Table 1).1, 5

Initiating smile analysis: Evaluating facial and orofacial esthetics

The smile analysis/design process begins at the macrolevel, examining the patient’s face first, progressing to an evaluation of the individual teeth, and finally moving to material selection considerations. Multiple photographic views (e.g., facial and sagittal) facilitate this analysis.

At the macrolevel, facial elements are evaluated for form and balance, with an emphasis on how they may be affected by dental treatment.4 During the macro-analysis, the balance of the facial thirds is examined (Fig. 1). If something appears unbalanced in any one of those zones, the face and/or smile will appear unesthetic.

Such evaluations help determine the extent and type of treatment necessary to affect the esthetic changes desired. Depending on the complexity and uniqueness of a given case, orthodontics could be considered when restorative treatment alone would not produce the desired results (Fig. 2), such as when facial height is an issue and the lower third is affected. In other cases—but not all—restorative treatment could alter the vertical dimension of occlusion to open the bite and enhance esthetics when a patient presents with relatively even facial thirds (Fig. 3).

Evaluating oral esthetics

The dentolabial gingival relationship, which is considered oral esthetics, has traditionally been the starting point for treatment planning. This process begins by determining the ideal maxillary incisal edge placement (Fig. 4). This is accomplished by understanding the incisal edge position relative to several different landmarks. The following questions can be used to determine the ideal incisal edge position:

Where in the face should the maxillary incisal edges be placed?

What is the proper tooth display, both statically and dynamically?

What is the proper intra- and inter-tooth relationship (e.g., length and size of teeth, arch form)?

Can the ideal position be achieved with restorative dentistry alone, or is orthodontics needed?

In order to facilitate smile evaluation based on these landmarks, the rule of 4.2.2—which refers to the amount of maxillary central display when the lips are at rest, the amount of gingival tissue re-

Table 1: Components of smile analysis and esthetic design.

<table>
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<tr>
<th>Facial esthetics</th>
<th>Total facial form and balance</th>
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<tr>
<td>Orofacial esthetics</td>
<td>Maxillomandibular relationship to the face and the dental midline relationship to the face pertaining to the teeth, mouth and gingiva</td>
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<tr>
<td>Oral esthetics</td>
<td>Labial, dental, gingival; the relationships of the lips to the arches, gingiva, and teeth</td>
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<tr>
<td>Dentogingival esthetics</td>
<td>Relationship of the gingiva to the teeth collectively and individually</td>
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<td>Dental esthetics</td>
<td>Macro- and micro-esthetics, both inter- and intra-tooth</td>
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revealed, and the proximity of the incisal line to the lower lip—is helpful (Fig. 5). At a time when patients perceive fuller and brighter smiles as most esthetic, 4 mm of maxillary central incisor display while the lips are at rest may be ideal. In an esthetic smile, seeing no more than 2 mm of ginviva when the patient is fully smiling is ideal. Finally, the incisal line should come very close to and almost touch the lower lip, being no more than 2 mm away. These guidelines are somewhat subjective and should be used as a starting point for determining proper incisal edge position.

Dentogingival esthetics
Gingival margin placement and the scalloped shape, in particular, are well discussed in the literature. As gingival heights are measured, heights relative to the central incisor, lateral incisor, and canine in an up/down/up relationship are considered esthetic (Fig. 6). However, this may create a false perception that the lateral gingival line is incisal to the central incisor. Rather, in most esthetic tooth relationships, the gingival line of the four incisors is approximately the same line (Fig. 6), with the lateral incisor perhaps being slightly incisal. The gingival line should be relatively parallel to the horizon for the central incisors and the lateral incisors and symmetric on each side of the midline. The gingival contours (i.e., gingival scallop) should follow a radiating arch similar to the incisal line. The gingival scallop shapes the teeth and should be between 4 mm and 5 mm (Fig. 7). Related to normal gingival form is midline placement. Although usually the first issue addressed in smile design, it is not as significant as tooth form, gingival form, tooth shape, or smile line. Several rules can be applied when considering modifying the midline to create an esthetic smile design:
The midline only should be moved to establish an esthetic intra- and inter-tooth relationship, with the two central incisors being most important.

The midline only should be moved restoratively up to the root of the adjacent tooth.

The midline should be vertical when the head is in the postural rest position.

Evaluating dental esthetics

Part of evaluating dental esthetics for smile design is choosing tooth shapes for patients based on their facial characteristics (e.g., long and dolichocephalic, or squarish and brachycephalic). When patients present with a longer face, a more rectangular tooth within the esthetic range is appropriate. For someone with a square face, a tooth with an 80% width-to-length ratio would be more appropriate. The width-to-length ratio most often discussed in the literature is between 75% and 80%, but esthetic smiles could demonstrate ratios between 70% and 75% or between 80% and 85%.

The length of teeth also affects esthetics. Maxillary central incisors average between 10mm and 11mm in length. According to Magne, the average length of an unworn maxillary central to the cementoenamel junction is slightly over 11mm. The esthetic zone for central incisor length, according to the authors, is between 10.5mm and 12mm, with 11mm being a good starting point. Lateral incisors are between 1mm and a maximum of 2mm shorter than the central incisors, with the canines slightly shorter than the central incisors by between 0.5mm and 1mm.

The inter-tooth relationship, or arch form, involves the golden proportion and position of tooth width. Although it is a good beginning, it does not reflect natural tooth proportions. Natural portions demonstrate a lateral incisor between 60% and 70% of the width of the central incisor, and this is larger than the golden proportion. However, a rule guiding proportions is that the canine and all teeth distal should be perceived to occupy less visual space.

If feasible, the contact areas can be restoratively moved up to the root of the adjacent tooth.

Creating a digital smile designed in Photoshop

Although there are digital smile design services available to dentists for a fee, it is possible to use Photoshop CS5 software (Adobe Systems) to create and demonstrate for patients the proposed smile design treatments. It starts by creating tooth grids—predesigned tooth templates in different width-to-length ratios (e.g., 75% central, 80% central) that can be incorporated into a custom smile design based on patient characteristics. You can create as many different tooth grids as you like with different tooth proportions in the esthetic zone. Once completed, you will not have to do this step again, since you will save the created tooth grids and use them to create a new desired outline form for the desired teeth. Follow these recommended steps:
Photoshop provides an effective and inexpensive way to design a digital smile with proper patient input. To start creating custom tooth grids, open an image of an attractive smile in Photoshop and create a separate transparent layer.

The polygonal lasso tool is an effective way to select the teeth. To begin tracing the tooth grid, activate a selection tool, move to the tool palette, and select either the polygonal lasso tool or the magnetic lasso tool. In the authors’ opinion, the polygonal works best. Once activated, zoom in (Fig. 16) and trace the teeth with the lasso tool.

To create a pencil outline of the tooth, with the transparent layer active, click on the edit menu in the menu bar; in the edit drop-down menu, select “stroke”; choose black for color, and select a two-pixel stroke pencil line (Fig. 17), which will create a perfect tracing of your selection. Click “OK” to stroke the selection. Select (trace with the lasso selection tool) one tooth at a time and then stroke it (Fig. 18). Select and stroke (trace) the teeth up to the second premolar (the first molar is acceptable; Fig. 19).

The image should be sized now for easy future use in a smile design. In the authors’ experience, it is best to adjust the size of the image to a height of 720 pixels (Fig. 20) by opening up the image size menu and selecting 720 pixels for the height. The width will adjust proportionately.

At this time, the tooth grid tracing can be saved, without the image of the teeth, by double-clicking on the layer of the tooth image. A dialog box reading “new layer” will appear; click “OK.” This process unlocks the layer of the teeth so it can be removed. Drag the layer of the teeth to the trash, leaving only the layer with the tracing of the teeth (Fig. 21). In the file menu, click “save as” and choose “.png” or “.psd” (Photoshop) as the file type. This will preserve the transparency. You do not want to save it as a JPEG, since this would create a white background around the tracing. Name the file appropriately (e.g., 75% W/L central).

By tracing several patients’ teeth that have tooth size and proportion in the aesthetic zone and saving them, you can create a library of tooth grids to custom design new teeth for your patients who require smile designs.
The Photoshop smile design technique
The Photoshop smile design (PSD) technique can be done on any image, and images can be combined to show the full face or the lower third with lips on or lips off. This article (Part 1) demonstrates how to perform the technique on the cheek-retracted view. Part 2 of this article will review more possibilities using the technique.

The first step in the PSD technique is to create a digital conversion of the actual tooth length and width, and then digitally determine the proposed new length and proportion of the teeth.

Determining digital tooth size
To determine digital tooth size, follow these steps:

Create a conversion factor by dividing the proposed length (developed from the smile analysis) by the existing length of the tooth.

The patient’s tooth can be measured in the mouth or on the cast (Fig. 22). If the length measures 8.5 mm but needs to be at 11 mm for an esthetic smile, divide 11 by 8.5. The conversion factor equals 1.29, a 29% digital increase lengthwise.

Open the full-arch cheek-retracted view in Photoshop, and zoom in on the central incisor.

Select the eyedropper palette. A new menu will appear. Select the ruler tool (Fig. 23).

Click and drag the ruler tool from the top to the bottom of the tooth to generate a vertical number, in this case 170 pixels (Fig. 24). Multiply the number of pixels by the conversion factor. In this case, 170 × 1.29 = 219 pixels; 219 pixels is digitally equivalent to 11 mm (Fig. 25).

Determine the digital tooth width using the same formula.

Create a new layer, leave it transparent, and mark the measurement with the pencil tool (Fig. 26).

Applying a new proposed tooth form
Next, follow these steps:

After performing the smile analysis and digital measurements, choose a custom tooth grid appropriate for the patient. Select a tooth grid based on the width-to-length ratio of the planned teeth (e.g., 80/70/90 or 80/65/80). Open the image of the chosen tooth grid in Photoshop and drag the grid on to the image of teeth to be smile designed (Fig. 27).

If the shape or length is deemed inappropriate, press the command button (control button for PCs) and “z” to delete and select a suitable choice.

Depending on the original image size, the tooth grid may be proportionally too big or too small. To enlarge or shrink the tooth grid created (with the layer activated), press command (or control) and “t” to bring up the free transform function. While holding the shift key (holding the shift key allows you to transform the object proportionally), click and drag a corner left or right to expand or contract the custom tooth grid. Adjust the size of the grid so that the outlines of the central incisors have the new proposed length. Move the grid as necessary using the move tool so that the incisal edge of the tooth grid lines up with the new proposed length (Fig. 28).

Areas of the grid can be individually altered using the liquify tool (Fig. 29).
Digitally creating new esthetic teeth

Next, follow these suggested steps:

With the new tooth grid layer and the magic wand tool both activated, click on each tooth to select all of the teeth in the grid (Fig. 30).

Expand the selection by two pixels in the expand menu; click “select > modify > expand” (Fig. 31). Note that the selection better approximates the grid. You can expand the selection or contract as necessary using the same menu.

Activate the layer of the teeth (cheek-retracted view) by clicking on it (Fig. 32).

Next, activate the liquify filter (you will see a red mask around the shapes of the proposed teeth). The mask creates a digital limit that the teeth cannot be altered beyond. This is similar to creating a mask with tape for painting a shape (Fig. 33).

Use the forward warp tool by clicking on an area of the existing tooth and dragging to mold/shape the tooth into the shape of the new proposed outline form (Fig. 34).

Repeat this for each tooth. If you make a mistake or do not like something, click command (or control) and “z” to go back to the previous edit (Fig. 35).
Conclusion

Knowledge of smile design, coupled with new and innovative dental technologies, allows dentists to diagnose, plan, create, and deliver esthetically pleasing new smiles. Simultaneously, digital dentistry is enabling dentists to provide what patients demand: quick, comfortable, and predictable dental restorations that satisfy their esthetic needs.