MiCD: Do no harm cosmetic dentistry

By Dr Sushil Koirala, Nepal

The demand for cosmetic dentistry is a growing trend globally. Increased media coverage, the availability of free online information and the improved economic status of the general public has led to a dramatic increase in patients’ aesthetic expectations, desires and demands. Today, a glowing, healthy and vibrant smile is no longer the exclusive domain of the rich and famous; hence, many general practitioners are now being forced to incorporate various aesthetic and cosmetic dental treatment modalities into their daily practices to meet the growing demand of patients.

Cosmetic dentistry is a science-based art guided by the desire of the patient. Many young clinicians who plan to incorporate it into their practice are confused about what they and their patients actually wish to achieve. It is to be noted that the treatment modalities of any health care service should be aimed at the establishment of health and the conservation of the human body with its natural function and aesthetics. However, it is worrying to note that the treatment philosophy and techniques adopted by many cosmetic dentists around the world tend towards macro-invasive protocols, and millions of healthy teeth are aggressively prepared every year for the sake of creating beautiful smiles.

The practice philosophy adopted by the clinic and the professional team members generally guides the overall output of the practice. Minimal invasive cosmetic dentistry (MiCD), a do no harm practice philosophy, has four fundamental components: level of care, quality of operator (dentist), protocol adopted and technology selected, which must all be respected in daily clinical practice. Adopting this holistic medical science practice philosophy is not an easy task, as it requires a change in the mindset of professionals.

In Parts I and II, I explain MiCD, do no harm cosmetic dentistry, based on my Vedic Smile concept, which I have been practising successfully in Nepal for the last 20 years, and advocating globally since 2009 as the MiCD Global Mission. It is to be noted that both parts are based on fundamental science, truth and available evidence, clinical experience and the common sense required in holistic dentistry.

Cosmetic dentistry, a global trend

The prevalence and severity of dental decay have been declining over the last decades in many developed countries and this trend is shifting towards developing countries as well. With increased media coverage, the availability of free online information, public awareness has fuelled the demand for cosmetic dentistry globally. Now, a glowing, healthy and vibrant smile is no longer the exclusive domain of the rich and famous. The population of beauty- and oral health-conscious people is increasing every year and data from various sources shows that the coming generations of children, especially from the middle- to higher-income population, will have fewer decayed teeth and will need less complex restorative dental care as they age. These changing patterns of dental care needs will bring about major shifts in the nature of dental services from traditional restorative care to cosmetic and preventive services.

The increased market demand for smile aesthetics among patients is forcing general practitioners of today to incorporate the art and science of cosmetic dentistry into their practice. Cosmetic dentistry is not yet recognised as a separate clinical specialty, but is included under orthodontics, periodontics or prosthodontics. However, the success and failure of cosmetic dentistry are viewed as synonyms by many cosmetic dentists. However, it is widely seen that the treatment modalities of contemporary cosmetic dentistry are tending towards more-invasive procedures with an over-utilisation of full crowns, bridges, dental veneers, and invasive periodontal aesthetic surgery, while neglecting long-term oral health, actual aesthetic needs and the characteristics of the patient. These aggressive treatment modalities are indirectly degrading social trust in dentistry, thereby threatening the trend of fulfilling the cosmetic demands of patients without ethical consideration and sufficient scientific background and promoting the “the more you replace, the more you earn” or “more is more” mindset in dentistry.

Changing the professional mindset of the practitioners has become an urgent task. In order to practise healthy dentistry, one must be groomed, and this must start from dental school education, with moral values, a high ethical standard, a positive attitude and a patient-centred practice philosophy. A student reflects the mindset of his or her teachers, and a teacher or mentor with comprehensive knowledge, clinical skills, honesty and humanity is difficult to find in today’s business-oriented dental education. I believe that knowledge should be free and skill training must be useful and easily affordable to our young practicing clinicians around the world. Compromised university dental education and expensive private skill training with biased monitoring have been promoting health-compromising treatment protocols and costly diagnostic, preventive and treatment technologies. This highly business-oriented trend will promote a change in the mindset of practising clinicians to adopt more-aggressive and invasive dental treatment modalities, leading to the practice of unhealthy dentistry in the long term.

Aesthetic versus cosmetic dentistry

The words “aesthetics” and “cosmetic” are viewed as synonyms by many cosmetic dentists. However, it is necessary to understand the core difference in meaning. The Oxford dictionary defines “aesthetics” as “the branch of philosophy which deals with...”
with questions of beauty and artistic "taste" and "cosmetic" as "improving only the appearance of something."

In dentistry, "aesthetics" explains the fundamental taste of a person concerning beauty, whereas "cosmetic" deals with the superficial or external enhancement of beauty. Therefore, aesthetic dentistry falls under need-based dental service, and is generally guided by the sex, race and age (SRA factors) of the patient. However, cosmetic dentistry, which is influenced by perception, personality and desires (PPD factors), can be categorised as want- or demand-based dental service. For example, a patient’s request to replace old amalgam restorations with tooth-colored restorative materials can be considered an aesthetic requirement or demand. The request of an old woman for a 'pearly white teeth and the ideal smile design' is for more than an aesthetic requirement, and must be considered a cosmetic demand or requirement.

In my clinical practice, I divide aesthetic and cosmetic clinical cases into three different categories:

1. Preventive, or support based: treatment prevents or intercepts the diseases, defects, habits and other factors that may adversely affect the existing or the future smile aesthetics of the patient.
2. Non-mimetic, or need based, treatment is carried out to restore or mimic the natural aesthetics, bearing the SRA factors of the patient in mind, and the treatment generally enhances the health and function of the oral tissue.
3. Cosmetic, or desire based, treatment is performed to enhance or supplement the aesthetic components of the smile; hence, the treatment outcome of cosmetic treatment may not be in harmony with the patient's SRA factors as in nature mimetic dentistry, and cosmetic treatment may not necessarily be beneficial to the health and function of the oral tissue.

**Practice philosophy in dentistry: The mindset**

The majority of dental schools around the world focus on teaching knowledge and skills in dental medicine that are based on contemporary dental science and art. Dental education does not give due consideration to healthy dental practice philosophy owing to various factors, such as the need to choose one's practice philosophy and the domination of business rather than service-oriented dental practice in the global market. However, quality and healthy clinical practice is always a dream of a good clinician, and establishing such practice requires an unbiased vision, learning and serving attitudes, and dedication from the dentist. Wernant understands that science and art in dentistry have no meaning if practised by an unethical operator, who does not respect the overall health of the patient. Any scientific advancement in technology has positive and negative sides; hence, if not applied properly, it may adversely affect the profession and may become a threat.

1. I believe that a clinic or treatment centre must establish its practice philosophy according to its objectives. What a clinician wants and the kind of services he or she wants to deliver to his or her patients guides the clinic. Practically, the practice philosophy in dentistry can be classified into two different categories, depending on the mindset of the operator.

**Patient centered**

Clinicians with this kind of mindset generally have a no harm dental practice (Fig. 1). Professional honesty and humanity are the fundamental principles of such a practice. Operato rs with this mindset enjoy sharing their clinical knowledge and skills with their professional friends and junior colleagues to promote patient-centred clinical practice in society. This group of clinicians firmly believes in the word-of-mouth approach to practice marketing and always thinks of the patient's long-term health, function and aesthetics. Clinicians practicing do no harm dentistry are generally cheerful, happy and healthy in their professional life.

**Financially focused**

Clinicians with this kind of mindset practice a financially focused dentistry and adopt various kinds of direct marketing approaches to sell their dentistry like a commodity in the market rather than a health care service. Practitioners in this group generally achieve a secure financial position quickly; however, it is frequently seen that they develop chronic stress, burn out syndrome, depression, frustration and professional guilt, leading to compromised health and happiness in their professional life.

**Dentistry and professional stress**

Dentistry has long been considered a stressful occupation. Dentists perceive dentistry as being more stressful than other occupations. Dentists have to deal with many significant stressors in their personal and professional lives. There is some evidence to suggest that dentists suffer a high level of occupational related stress. A study has found that 83 per cent of dentists perceived dentistry as very stressful and nearly 60 per cent perceived dentistry as more stressful than other professions. Stress can elicit varying physiological and psychological responses in a person. Professional burn-out is one of the possible consequences of ongoing professional stress. The effect of burn-out, although work related, often will have a negative impact on people's personal relationships and well being. Hence, dentists need to take care of their staff's health and focus on professional happiness in daily practice.

**Three-way test: Questions for your conscience**

Cosmetic dentists can make errors in practice in two ways, first owing to a lack of the required professional knowledge and skills, and second owing to a lack of professional honesty and humanity. The first one can be eliminated with good education and proper training, but the second one demands a total shift in mindset, with a high level of consciousness in professional ethics, attitudes and respect towards the patient’s long-term health, function and natural beauty.

I apply a simple yet very powerful test to keep myself stress- and guilt-free and within the boundaries of professional ethics, honesty and humanity when planning the dental treatment plan to my patient. Clinicians can apply the three-way test

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**Table 1:** Treatment options, treatment procedures and biological cost in cosmetic dentistry.

<table>
<thead>
<tr>
<th>Treatment options</th>
<th>Treatment procedures</th>
<th>Biological cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-invasive treatment: when hard and soft tissue not prepared at a micro-level during similar enhancement procedures</td>
<td>• Smile surgery</td>
<td>None</td>
</tr>
<tr>
<td>• Bonding of white spots</td>
<td>• Oral Hygiene and home treatment</td>
<td></td>
</tr>
<tr>
<td>• Veneer</td>
<td>• Gingival reshaping</td>
<td></td>
</tr>
<tr>
<td>Micro-invasive treatment: when hard and soft tissue is prepared at a macro-level during similar enhancement procedures</td>
<td>• Cosmetic chemical treatment, such as bleaching and laser treatments</td>
<td>Very low</td>
</tr>
<tr>
<td>• Recontouring with minimal tooth preparation</td>
<td>• Gingival grafts</td>
<td></td>
</tr>
<tr>
<td>Minimal invasive treatment: when hard and soft tissue is prepared at a superficial level during similar enhancement procedures</td>
<td>• Cosmetic contouring with and/or gingival grafts</td>
<td>Low</td>
</tr>
<tr>
<td>• Cosmetic reconstruction with minimal tooth preparation, such as the veneers</td>
<td>• Soft tissue grafts</td>
<td></td>
</tr>
<tr>
<td>• Bonding</td>
<td>• Porcelain veneers and inlays</td>
<td></td>
</tr>
<tr>
<td>Stream treatment: when hard and soft tissue is prepared at a deeper-level during similar enhancement procedures</td>
<td>• Tooth preparation for crowns, bridge abutments and inlay</td>
<td>High</td>
</tr>
<tr>
<td>• Orthodontics treatment with tooth extraction</td>
<td>• Restorative treatment</td>
<td></td>
</tr>
<tr>
<td>• Prosthodontic treatment</td>
<td>• Periodontal and orthodontic and surgical treatments</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2:** Smile Design Wheel approach.

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Aesthetic treatment</th>
<th>Cognitive treatment</th>
<th>Psychological treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be a better</td>
<td>Follow early diagnosis, prevention and intervention approach.</td>
<td>Understand psychology, establish health, restore function and enhance aesthetics (PHFA—sequences of Smile Design Wheel).</td>
<td>Undertake psychological and cognitive treatments.</td>
</tr>
<tr>
<td>Preventive</td>
<td>Understand psychology, establish health, restore function and enhance aesthetics (PHFA—sequences of Smile Design Wheel).</td>
<td>Understand psychology, establish health, restore function and enhance aesthetics (PHFA—sequences of Smile Design Wheel).</td>
<td>Undertake psychological and cognitive treatments.</td>
</tr>
<tr>
<td>Need-based</td>
<td>Understand psychology, establish health, restore function and enhance aesthetics (PHFA—sequences of Smile Design Wheel).</td>
<td>Understand psychology, establish health, restore function and enhance aesthetics (PHFA—sequences of Smile Design Wheel).</td>
<td>Undertake psychological and cognitive treatments.</td>
</tr>
</tbody>
</table>

**Table 3:** MiCD core principles.
Extensive: Invasive dentistry

If we look carefully at the history of restorative dentistry, the word "extensive" (or "invasive") has always been a point of focus among clinicians. The concept of "extension for prevention and retention" was pronounced by Dr. G.V. Black. He recognized that the surface of dental restorations is subject to wear and tear, and that the restoration materials available at the time were not able to withstand the wear and tear. Therefore, the clinician had to be able to provide good preparation for the restoration to be successful. This led to the development of extensive (or invasive) dentistry.

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MiCD treatment protocol and clinical technique

Minimal invasive dentistry was developed over a decade ago by restorative experts and founded on sound evidence-based principles. In dentistry, it has focused mainly on prevention, remineralization and minimal dental intervention in caries management and non-given sufficient attention to other oral health problems. For this reason, I developed the MiCD concept and its treatment protocol in 2002. The protocol integrates the evidence-based minimally invasive philosophy into aesthetic dentistry in the hope that it will help practitioners achieve optimum results in terms of health, function, and aesthetics with minimum treatment intervention and optimum patient satisfaction. The MiCD concept and treatment protocol are explained in an article titled "Minimal invasive aesthetic dentistry—Concept and treatment protocol" (Fig. 1). The current article discusses the MiCD concept and treatment protocol in more detail.

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The MiCD treatment protocol focuses on the aesthetic pyramid of the Smile Design Wheel (Fig. 3). Aesthetic components in dentistry are divided into three broad groups:

1. macro-aesthetics,
2. mini-aesthetics, and
3. micro-aesthetics.

Each aesthetic group deals with different aesthetic components (Tab. III) and each component must be harmonized at the end of treatment.

Rejuvenation: to rejuvenate in MiCD to enhance smile aesthetics with minor modifications in tooth position, colour and form, also known as the MiCD ARC principle, namely align, brighten and contour (Fig. 4–9).

Micro asymmetries between the facial and dental midlines are acceptable in many instances. However, a canted midline would be more obvious and therefore less acceptable in cosmetic dentistry. Similarly, the disharmony in natural progression of axial inclination or the degree of tipping of anterior teeth affects the aesthetic outcome of any smile. The correction to the midline and axial inclination progression can be carried out using cosmetic orthodontic procedures, fixed or removable appliances. Once the anterior teeth are in an aesthetically acceptable position, the aesthetic concern of the patient generally focuses towards the colour enhancement of the dentition. It is to be noted that a well-aligned tooth generally requires no or less tooth preparation during tooth contour (shape and size) modification. This helps the clinician to arrive at aesthetic smiles with micro- or minimally invasive procedures with a very low biological cost. Brightening: tooth bleaching or colour modification in MiCD is carried out once teeth are in acceptable alignment but the tooth form is modified. The level of tooth colour modification depends on the quality of the remaining colour of the dentition and the patient’s desire. Home and office bleaching are popular methods for modifying tooth colour. However, in some cases, procedures such as remineralization, micro-abrasion, walking bleach and thin enamel veneers are used.

Conclusion

In order to practice cosmetic dentistry, a clinician requires the desire, passion, dedication and will power to become an honest professional with humanity because honesty and humanity are the pillars of do no harm cosmetic dentistry, since the mind controls all other practice factors. The clinician must understand that honesty and humanity are not scientific like knowledge and skills, which can be learned, copied and applied immediately in the practice. Honesty and humanity are inner qualities of a person and are deeply related to the level of a person’s consciousness, which are generally expressed as habits and attitudes. Therefore, we need to understand these qualities at the level of the school and from the profession and society.

Self-evaluation and the realization of the level of inner happiness that you obtain through your daily professional work is vital for understanding and beginning to practice no harm cosmetic dentistry in your practice.
Introduction: Smile analysis and aesthetic design

Dental facial aesthetics can be defined in three ways. Traditionally, dental and facial aesthetics have been defined in terms of macro- and micro-elements. Macro-aesthetics encompasses the interrelationships between the face, lips, gingiva, and teeth and the perception that the colour and form are pleasing. Micro-aesthetics involves the aesthetics of an individual tooth and the perception that the colour, form, and translucency are harmonious. The aesthetic zone is defined as the area from the gingival margin to the incisal edge of the tooth.

Gingival symmetry in relation to the central incisors, lateral incisors, and canines is essential to aesthetics. Optimal aesthetics is achieved when the gingival line is relatively horizontal and symmetrical on both sides of the midline in relation to the central incisors and lateral incisors. Drawing a line along the glabella, subnasale, and pogonion enables a quick evaluation of aesthetics without the need for radiographs to determine alignment of ideal facial elements. According to the 2.2 rule, this patient's smile is deficient in aesthetic elements, having only 1 mm of tooth display at rest (left), minus 3 mm of gingival display, and 4 mm of space between the incisal edge and the lower lip (right).

Initiating smile analysis: Evaluating facial and orofacial aesthetics

The smile analysis/design process begins at the macro level, examining the patient's face first, progressing to an evaluation of the individual teeth, and finally moving to material selection considerations. Multi-photographic views (e.g., facial, and sagittal) facilitate this analysis. At the macro level, facial elements are evaluated for form and balance, with an emphasis on how they may be affected by dental treatment. During the macro-analysis, the balance of the facial thirds is examined. If something appears unbalanced in any one of those zones, the face and/or smile will appear unaesthetic. Such evaluations help determine the extent and type of treatment necessary to affect the aesthetic 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, 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 aesthetics when a patient presents with relatively even facial thirds.

Historically, accepted smile design concepts and smile parameters have helped design aesthetic treatments. Specific measurements of form, colour, and tooth/aesthetic elements aid in transferring smile design information between the dentist, ceramist, and patient. Aesthetics in dentistry can encompass a broad area—known as the aesthetic zone. Rufener described delineated smile analysis into facial aesthetics, dentofacial aesthetics, and dental aesthetics, encompassing the macro- and micro-elements described in the first definition above. Further classification identifies five levels of aesthetics: facial, orofacial, oral, dentogingival, and dental (Tab. II).

Table 1: Components of smile analysis and aesthetic design

<table>
<thead>
<tr>
<th>Facial aesthetics</th>
<th>Total facial form and balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orofacial aesthetics</td>
<td>Maxillomandibular relationship to the face and the dental midline relationship to the face per-</td>
</tr>
<tr>
<td>Oral aesthetics</td>
<td>to the teeth, mouth and gingiva</td>
</tr>
<tr>
<td>Dentogingival aesthetics</td>
<td>Relationship of the gingiva to the teeth collectively and individually</td>
</tr>
<tr>
<td>Dental aesthetics</td>
<td>Macro- and micro-aesthetics, both inter- and intra-tooth</td>
</tr>
</tbody>
</table>

The aesthetic ideal from the gingival scallop to the tip of the papilla is 4–5 mm. According to the 4.2.2 rule, this patient’s smile is deficient in aesthetic elements, having only 1 mm of tooth display at rest (left), minus 3 mm of gingival display, and 4 mm of space between the incisal edge and the lower lip (right).

The smile analysis/design process begins at the macro level, examining the patient’s face first, progressing to an evaluation of the individual teeth, and finally moving to material selection considerations. Multi-photographic views (e.g., facial, and sagittal) facilitate this analysis. At the macro level, facial elements are evaluated for form and balance, with an emphasis on how they may be affected by dental treatment. During the macro-analysis, the balance of the facial thirds is examined. If something appears unbalanced in any one of those zones, the face and/or smile will appear unaesthetic. Such evaluations help determine the extent and type of treatment necessary to affect the aesthetic 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, 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 aesthetics when a patient presents with relatively even facial thirds.

Fig. 6: Gingival symmetry in relation to the central incisors, lateral incisors, and canines is essential to aesthetics. Optimal aesthetics is achieved when the gingival line is relatively horizontal and symmetrical on both sides of the midline in relation to the central incisors and lateral incisors. The aesthetic ideal from the gingival scallop to the tip of the papilla is 4–5 mm. Acceptable width-to-length ratios fall between 70% and 85%, with the ideal range between 80% and 85%.

Fig. 7: If feasible, the contact areas can be repositioned up to the root of the adjacent tooth. 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. Click “edit > stroke,” then use a two-pixel stroke line (with colour set to black) to trace your selection. Make sure the transparent layer is the active working layer.
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Evaluating oral aesthetics

The dentolabial gingival relationship, which is considered oral aesthetics, has traditionally been the starting point for treatment planning. This process begins by determining the ideal maxillary incisal edge position. The following questions can be used to determine the ideal incisal edge position:

1. Where in the smile should the maxillary incisors lie?

2. What is the proper tooth display, both stastically and dynamically?

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

4. 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—-which refers to the amount of maxillary central digital display when the lips are at rest, the amount of gingival tissue revealed, and the proximity of the incisal line to the lower lip—is helpful (Fig. 8). At a time when patients perceive fuller and brighter smiles as most aesthetic, 4 mm of maxillary central incisor display while the lips are at rest may be ideal. In an aesthetic smile, seeing no more than 2 mm of gingiva 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 aesthetics

Gingival margin placement and the scalloped shape, in particular, are well discussed in the literature. As gingival heights are measured from the marginal gingiva to the incisal edge, and canines in an up/down/up relationship are considered to be most aesthetic (Fig. 6). However, this may create a false perception that the gingival line is incisal to the central incisors. Either, in most aesthetic 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 4.5 mm and 5.5 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 aesthetic smile design:

1. The midline only should be moved to establish an aesthetic intra- and inter-tooth relationship, with the two central incisors being most important.

2. The midline only should be moved restoratively up to the root of the adjacent tooth that the midline is within 2 mm of the center of the face, it will be aesthetically pleasing.

3. The midline should be vertical when the head is in the postaural position.

Evaluating dental aesthetics

Part of evaluating dental aesthetics for smile design is choosing tooth shapes for patients based on their facial characteristics (e.g., long and dolichocephalic, or short and brachycephalic). When patients present with a square face, a tooth with an 80% length ratio would be most aesthetic. Although it is a good beginning, it does not reflect natural tooth proportions. Natural proportions 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 ruling proportion is that the canine and all teeth distal should be perceived to occupy less visual space (Fig. 12). Another rule to help maintain proportions throughout the arch is 2:3:4:3:4:5:6:7:8:9:10. The lateral incisor is two-thirds of the central incisor, and the canine is four-fifths of the lateral incisor, with some latitude within those spaces. Finally, contact areas can be moved restoratively up to the root of the adjacent tooth. Beyond that, orthodontics is required (Fig. 14).

Creating a digitally designed in Photoshop

Although there are digital smile designs 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., 7.5, 7% 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 aesthetic zone. Once completed, you will not have to do this step again, you will save the created tooth grids and use them to create a new desired outline form for the desired tooth.

Follow these recommended steps:

1. To begin creating a tooth grid, use a cheek-retracted image of an attractive smile as a basis (e.g., one with a 7.5% width-to-length ratio). Open the image in Photoshop and create a new clear transparent layer on top of the teeth (Fig. 10). This transparent layer will enable the image to be outlined without the work being embedded into the image.

2. Name the layer appropriately, and when prompted to identify your choice of fill, choose “no fill,” since the layer will be transparent, except for the tracing of the tooth grid.

3. To begin tracing the tooth grid, activate a selection tool, move to the tool palette, and select either the polygonal lasso tool or the magic 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 colour, and select a two-pixel stroke pencilleisen (Fig. 17) which will create a perfect tracing of your selection. Click “OK” to stroke the selected trace (or trace with the lasso selection tool) one tooth at a time and then stroked (Fig. 18). Select and stroke (trace) the teeth on the second premolar (the first molar is acceptable) (Fig. 19).

The image should be sized now for ease of future use in a smile design. In the author’s experience, it is best to size 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. Additionally naming “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. 20). 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% S/W 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 view.

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 teeth 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 aesthetic smile, divide it by 8.5. The conversion factor equals 1.29; a 29% digital increase length-wise.
- 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).
- Drag and click 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 x 1.29 = 219 pixels; 219 pixels is digitally equivalent to 1 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., 90/70 or 80/65). Open the image of the chosen tooth grid in Photoshop and drag the grid onto the image of the teeth to be smile designed (Fig. 27).
- If the shape or length is deemed inappropriate, press the command button (control button for PC) 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 “z” to bring up the free transform function. While holding the shift key (holding the shift key allows you to transform the object proportionately), 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 aesthetic 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 select menu, click “select” and “expand” (Fig. 30).

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. 31).
- Next, select 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. 31).

- 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).

Adjusting tooth brightness

The following steps are recommended next:

- Select the whitening tool (dodge tool) to brighten the teeth. In the dodge tool palette, click on “mid tones” and set the exposure to approximately 50%. Click on the area of the tooth you want brightened (Figs. 36 & 37).

- Alternatively, with the teeth selected, you can use the brightness adjustment in the brightness/contrast menu, click “image” adjustments > brightness/contrast.

Performing the changes on only one side of the mouth allows the patient to compare the new smile design to his/her original teeth before agreeing to treatment.

Create a copy

To save the information you have created for presentation to the patient, follow these steps:

- Go to “file” and select “save as”.
- When the menu appears, click on the “copy” box.
- Name the file at that step.
- Save it as a JPEG file type.
- Save in a digital file type where you want it saved.
- Click “save”.

A file of the current state of the image will be created in the designated area. You can now continue working on the image and save again at any point you want.

Conclusion

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