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 technique adopted by many cosmetic dentists around the world tend towards macro-invasive protocols, and millions of healthy teeth are aggressively prepared each year for the last 20 years, and is 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 high-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 a major shift 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 like orthodontics, periodontics or paediatric dentistry. Cosmetic dentistry is synonymous with multidisciplinary dentistry, as its success and failure are related to the patient’s psychology, health, function and aesthetics. Ethical, high-standard cosmetic dentistry skill training of clinicians is essential for the increased global market of cosmetic dentistry and its promotion. 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, denture veneers, and invasive periodontal surgical procedures, 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, owing to 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 practicing clinicians 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 is 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. 

By D. Sushil Koirala, Nepal
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 (PFD factors), can be categorised as want or demand-based dental service. For example, a patient's request to replace old amalgam restorations with tooth-coloured restorative materials can be considered an aesthetic requirement or demand. The request of an old woman for pearly white teeth and the ideal smile design is far 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. Naturo-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 and aesthetics of the patient.

Aesthetic dentistry falls under need-based 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. Furthermore, science and art in dentistry have no meaning if practised by an unethical professional, 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.

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 centred: Clinicians with this kind of mindset generally have a do no harm dental practice (Fig. 1). Professional honesty and humanity are the fundamental principles of such a practice. Opera tors 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.

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. Dentist perceives 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 occupation-related stress. Stress has positive and negative sides; hence, if not applied properly, it may adversely affect the profession and may become a threat.

A study has found that 83% of dentists perceived dentistry as very stressful and nearly 60% 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 health and focus on professional happiness in daily practice.

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A clinician has full right to adopt the practice philosophy that he or she prefers. However, it is advisable to apply oneself to understanding, analysing and comparing this philosophy with others. I am very fortunate to have been brought up with the Vedic philosophy of the law of nature and the first, do no harm conscious-ness-based philosophy in my life at home, at school and in my society. The spiritual guidance and mentor- ing I received at an early age at home and school have helped me to become a professional with a firm philosophy of do no harm, hence is talanted practic- ing, consciousness-based dentistry early in my career. During my 23 years of practice, I have experi- enced happiness and joy with high patient satisfaction, which has given me complete confidence and faith in my practice philosophy and the MiCD treatment protocol that I apply in my practice. Since late 2009, I have been promoting my practice philosophy and clinical protocol in South Asia, and started the MiCD Global Academy in 2012 with the help of like-minded friends, who also practice a similar kind of holistic dentistry around the world. The MiCD Global Academy has a mission to share clinical knowledge and fundamental clinical skills free of charge with all clinicians who de- sire to practise do no harm cosmetic dentistry for better patient care and to enhance their happiness in their professional life.

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 profes- sional 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 hu manity, which is a total shift in mindset. 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. 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.

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mentioned below just by taking a deep breath and closing their eyes for a few minutes and analysing their answers (the true response that comes to mind) with professional honesty and humanity. A clinician's conscience responds positively to all the questions, then it is advisable for you to pro-
pose the treatment plan and take up the case if you give negative re-
sponses to the questions, then you should rethink your proposed treat-
ment options, consider your patient's long-term health, function and aesthetics using a more sensible and less destructive treatment ap-
proach.

The three-way test consists of three basic questions:
1. Would I use this treatment for a member of my own family in this situation?
2. Will the patient be happy with the biological, financial and time costs of the proposed treatment?
3. Have I been using this simple test since my early days of practice and enjoying every moment of my clinical practice without any mental stress and physical fatigue? Then, it is healthy and guilt-free. Moreover, I have found that the end-result of my case has always brought about an appreciation in me and to my entire supporting team with high patient satisfaction. During all my MiCD clinical techniques, training workshops and seminars, I always en-
courage my trainees and audience to enhance the quality of their operator factors (knowledge, skills, honesty and humanity) because it is the pillar of successful MiCD. It is my personal belief that a clinician adopts a habit of testing his or her treatment plan with the three-way test before pro-
posing it to the patient. It certainly helps him or her to promote overall happiness in his or her practice with high patient satisfaction.

Extension: Invasive dentistry

If we look carefully at the history of restorative dentistry, the word “exten-
sion” or “invasive” has always been a point of focus among clinicians.14 The concept of “extension for prevention and retention” was pronounced by Dr G.V. Black 100 years ago and it was developed to give the best solution to the restorative materials available at that time. However, with the development of porcelain-fused-to-metal technol-
ogy in the late 1960s, the concept of “extension for functional aesthetics” was advocated, which is still very pop-
ular in clinical practice. In the early 1980s, the concept of the “Hollywood smile” was introduced, which estab-
lished the concept of “extension for cosmetics” in dentistry.

In 2002, the FDI World Dental Federation endorsed the approach of non-invasive dentistry, which has basically focused on the conservative management of carious lesions, applying the concept of “minimal intervention dentistry” or “minimal cavity decay re-
move”. History clearly shows that, since Dr G.V. Black era to the present

day, we have been applying the concept of “extension in dentistry” in the name of prevention, retention, func-
tion, aesthetic need and cosmetic de-
sire, and caries removal. It is a clinical fact that this concept will remain the focus because each clinical situation is different, as its treatment modalities are guided by multifactorial issues such as patient factors (mind, body and human factors), patient factors (the truth, evidence, experience and common sense), technology factors (health, reliability, affordability and simplicity). The use of science and technology requires consciousness in operators and awareness in patients, hence, the operator must use his or her professional knowledge and skills with honesty and humanity to tailor the least invasive protocol, procedure and technology in treatment, so that extension in dentistry is always mini-
mal, safe and healthy.

The invasiveness of procedures as-
lected in cosmetic dentistry depends on the level of smile defect, type of smile design, proposed treatment and the patient's aesthetic desire and treatment complexity. MiCD uses the most conservative smile enhancement procedure possi-
ble. The level of invasiveness in cos-
metic dentistry can be classified into four types, namely non-invasive, mi-
cro-invasive, minimally invasive and invasive, and the treatment options vary from non-invasive to invasive. The clinician's biocost for each case are pre-
presented in Table 1. There is only one principle in selecting treatment mo-
dalities in MiCD: always select the least invasive procedure as the choice of the treatment. Treatment proce-
dures mentioned under non-invasive, micro-invasive and invasive are used selectively in MiCD.

MiCD treatment protocol and clinical technique

Minimally invasive dentistry was developed over a decade ago by restorative experts and founded on sound evidence-based principles.15–19 In dentistry, it has focused mainly on prevention, remineralisation and minimal dental intervention in caries management and not given sufficient attention to other oral health prob-
lems. For this reason, I developed the MiCD concept and its treatment pro-

tocol in 2002, which 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 “Minimally invasive aesthetic dentistry—Concept and treatment protocol” published in the current issue of the Journal of the Vedic Institute.

MiCD clinical technique: Rejuvenation, restoration, rehabilitation, remodeling, repair and reconstruction. The MiCD clinical technique focuses on the aesthetic pyramid

<table>
<thead>
<tr>
<th>Aesthetic components</th>
<th>MiCD treatment protocol and clinical technique</th>
</tr>
</thead>
</table>
| Macro-aesthetics:  | - Contour: 
| Facial midline | - Aesthetic diagnosis 
| Nasolabial angle | - Aesthetic diagnosis 
| Rickett’s E-plane | - Aesthetic diagnosis |
| Micro-aesthetics:  | - Contour: 
| Peri-incisal smile | - Aesthetic diagnosis 
| Peri-incisal distance | - Aesthetic diagnosis |
| Macro-restoration:  | - Contour: 
| Maxillary central incisors (tooth size ratio) | - Aesthetic diagnosis 
| Smile index | - Aesthetic diagnosis |
| Micro-restoration:  | - Contour: 
| Shade progression | - Aesthetic diagnosis 
| Contact point progression | - Aesthetic diagnosis |
| Micro-moisture: | - Contour: 
| Micro-erosion | - Aesthetic diagnosis 
| Micro-abrasion | - Aesthetic diagnosis |
| Micro-contouring | - Aesthetic diagnosis 
| Micro-alignment | - Aesthetic diagnosis |

Conclusion

In order to practice no harm cos-
metic dentistry, a clinician requires the desire, passion, dedication and will power to become an honest, professional and humanity because honesty and humanity are the pillars of no harm cosmetic dentistry, since the mind controls all other practice factors. The clinician must understand that the concept of honesty and humanity is 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 simply related to the level of a person’s consciousness, which are generally expressed as habits and attitudes. Therefore, we need to train these qual-
ities at school and from the profession and society.

Self-evaluation and the realisation of the level of inner happiness that you obtain through your daily profes-
sional work are vital in understanding and beginning to practise no harm cosmetic dentistry in your practice.

Editorial note: A complete list of references is available from the publisher.

Table II: Aesthetic components and smile design parameters.

Table III: Treatment procedure Rating

<table>
<thead>
<tr>
<th>Rating</th>
<th>Complex</th>
<th>Moderate</th>
<th>Simple</th>
<th>Minimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment procedure</td>
<td>Complex</td>
<td>Moderate</td>
<td>Simple</td>
<td>Minimal</td>
</tr>
<tr>
<td>1. Smile self-evaluation</td>
<td>Satisfactory</td>
<td>Compromised</td>
<td>Good</td>
<td>Compromised</td>
</tr>
<tr>
<td>2. Aesthetic category</td>
<td>Macro</td>
<td>Mini</td>
<td>Micro</td>
<td>Macro</td>
</tr>
<tr>
<td>3. Aesthetic category</td>
<td>Micro</td>
<td>Mini</td>
<td>Macro</td>
<td>Macro</td>
</tr>
<tr>
<td>4. Treatment complexity</td>
<td>Complex</td>
<td>Moderate</td>
<td>Simple</td>
<td>Minimal</td>
</tr>
<tr>
<td>5. Proposed treatment</td>
<td>Modified</td>
<td>Accepted</td>
<td>Changed</td>
<td>Modified</td>
</tr>
<tr>
<td>6. Smile self-evaluation</td>
<td>Improved</td>
<td>No change</td>
<td>Unchanged</td>
<td>Improved</td>
</tr>
<tr>
<td>7. Enhancement category</td>
<td>Cosmetic</td>
<td>Preventive</td>
<td>Naturo-mimetic</td>
<td>Cosmetic</td>
</tr>
<tr>
<td>8. Biological cost</td>
<td>High</td>
<td>Low</td>
<td>Very low</td>
<td>None</td>
</tr>
<tr>
<td>9. Extrovert</td>
<td>Satisfactory</td>
<td>Compromised</td>
<td>Good</td>
<td>Compromised</td>
</tr>
<tr>
<td>10. Intraoral</td>
<td>Simple</td>
<td>Moderate</td>
<td>Complex</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

Table IV: Treatment protocol and clinical technique.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Clinical technique</th>
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</table>
| 1. Macro-aesthetics | - Contour: 
| 2. Micro-aesthetics | - Contour: 
| 3. Macro-restoration | - Contour: 
| 4. Micro-restoration | - Contour: 
| 5. Micro-moisture | - Contour: |

Table V: The MiCD treatment summary.

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| 4. Micro-restoration: - Contour: 
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Smile analysis and photoshop smile design technique

Prof. Edward A. McLaren & Lee Culp, USA

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 and form are pleasing.

Historically, accepted smile design concepts and smile parameters have helped to design aesthetic treatments. These 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.

Rufenacht 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. I).

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. Multiple 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 (Fig. 3). If something appears unbalanced in any one of these zones, the face and/or smile will appear unesthetic.

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 (Fig. 3), 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. 3).

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>taining 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-</td>
</tr>
<tr>
<td></td>
<td>and intra-tooth</td>
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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.—Fig. 7: The aesthetic ideal from the gingival scallop to the tip of the papilla is 4–5 mm.—Fig. 8: Acceptable width-to-length ratios fall between 70% and 85%, with the ideal range between 80% and 85%.—Fig. 9: An acceptable starting point for central incisors is 1 mm in length, with lateral incisors 1–2 mm shorter than the central incisors, and canines 0.5–1 mm shorter than the central incisors, for an aesthetic smile display.—Fig. 10: The canines and other teeth distally located are usually perceived as occupying less space in an aesthetically pleasing smile.—Fig. 11: A general rule for achieving proportionate smile design is that lateral incisors should measure two-thirds of the central incisors and canines four-fifths of the lateral incisors.—Fig. 12: If feasible, the contact area can be retracted up to the root of the adjacent tooth.—Fig. 13: Photoshop provides an effective and noninvasive 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.—Fig. 14: The polygonal lasso tool is an effective way to select the teeth.—Fig. 15: Click “select” 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 re- lationship, which is considered oral aesthetics, has traditionally been the starting point for treatment plan- ning. This process begins by deter- mining the ideal maxillary incisal edge placement (Fig. 4). This is ac- complished by understanding the incisal edge position relative to sev- eral different landmarks. The follow- ing questions can be used to deter- mine the ideal incisal edge position:

• Where in the face should the maxil- 
  lary 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)?

The ideal position should be achieved with restorative dentistry alone, or orthodontics needed.

In order to facilitate smile evalua- 
tion based on these landmarks, the rule of 4.2.1—which refers to the amount of maxillary central display when the lips are at rest, the amount of gingival tissue, and the proximity of the incisal line to the lower lip—is helpful (Fig. 3). At any 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.1 In an aesthetic smile, seeing 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.2 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, gingival contours (e.g., gingival scallop) should follow a radiating arch simi- lar 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 gingival display. Although usu- ally 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:

• The midline only should be moved to establish an aesthetic intra- and inter-tooth relationship, with the two central incisors being most im- portant.
• The midline only should be moved restoratively up to the root of the adjacent tooth if the midline is within 4 mm of the center of the face, it will be aesthetically pleasing.
• The midline should be vertical when the head is in the postural rest 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, square and brachycephalic). When patients present with a longer face, a more rectan- 
gular tooth with an aesthetic height is more appropriate. For someone with a square face, a tooth with an 85% width-to-length ratio would be more appropriate. The tooth's width-to-length ratio mostly discussed in the liter- ature is between 75% and 80%, but aesthetic smiles could demonstrate ratios between 70% and 75% or be- tween 80% and 85% (Fig. 8-10).

The length of teeth also affects aes- thetics. Maxillary central incisors aver- age between 10 mm and 11 mm in length. According to Magne, the aver- age length of an unworn maxillary central to the cemento-enamel junc- tion is slightly over 11 mm.3 The aes- thetic zone for central incisor length, according to the authors, is between 10.5 mm and 12 mm, with 11 mm be- ing a good starting point. Lateral incisors are between 11 mm and a maxi- mum of 2 mm shorter than the cen- tral incisors, with the canines slightly shorter than the central incisors by between 0.5 mm and 1 mm (Fig. 11).

The inter-tooth relationship, arch form, involves the golden pro- portion and position of tooth width. Although it is a good beginning, it does not reflect natural tooth propor- tions. Natural proportions demonstrate a lateral incisor between 60% and 70% of the width of the central inci- sor, and this is larger than the golden proportion.4 However, a rule guiding proportions is that the canine and all teeth distal should be perceived to occupy less visual space (Fig. 12). An- other rule to help maintain propor- tions throughout the arch is 3:2:3:4:5. 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 (Fig. 13). Finally, contact areas can be moved restoratively up to the root of the ad- jacent tooth. Beyond that, orthodon- 
tics is required (Fig. 14).

Creating a digitalsmile designed in Photoshop

Although there are digital smile design services available to dentists for a fee, it is possible to use Photo- shop CS6 software (Adobe Systems) to create and demonstrate for pa- tients 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 pa- tient characteristics. You can create as many different tooth grids as you like with different tooth proportions in the aesthetic zone. Once com- pleted, 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:

• To begin creating a tooth grid, use a cheek retracted image of an attrac- tive smile as a basis (e.g., one with a 75% width-to-length ratio). Open the image in Photoshop and create a new clear transparent layer on top of the teeth (Fig. 16). This transparent layer will enable the image to be outlined without the work being embedded into the image.
• 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.
• To begin tracing the tooth grid, ac- tivate a selection tool, move to the tool palette, and select either the polygonal lasso tool or the mag- netic lasso tool. In the authors’ opinion, the polygonal works best.

To determine the digital tooth size, a conversion factor is created by dividing the proposed tooth length by the existing length of the tooth—Fig. 23. Select the ruler tool in Photoshop—Fig. 24. Measure the digital length of the central incisor using the ruler tool—Fig. 25. Measure the new digital length using the conversion factor created earlier—Fig. 26. Create a new transparent layer and mark the new proposed length with the pencil tool—Fig. 27. Open the image of the chosen tooth grid in Photoshop and drag the grid on to the image of teeth to be smile designed. This will create a new layer in the image to be smile designed.
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 activated, 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 pencilline (Fig. 17) which will create a perfect tracing of your selection. Click "OK" to stroke the selection. Trace with the lasso, select tool one tooth at a time and then stroked (Fig. 18). Select and stroke (trace) each tooth 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 double-click on the layer size of the image to a height of 720 pixels (Fig. 19) 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. Double-clicking on the desired 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 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 demonstrates how to perform the technique on the cheek-retracted view.

The first step in the PSD technique is to create a digital conversion of the actual tooth length and width, and 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).

• 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 x 1.29 = 219 pixels; 219 pixels is digitally equivalent to 1 mm (Fig. 25). Determine the digital width teeth 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 80/75/95). 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. 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.

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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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