

Digital Smile Design

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Abstract: *Smile design refers to the many scientific and artistic principles that considered collectively can create a beautiful smile. These principles are established through data collected from patients, diagnostic models, dental research, scientific measurements, and basic artistic concepts of beauty. Digital smile design is a multipurpose digital tool with clinically relevant advantages. DSD can make diagnosis more effective and treatment planning more consistent so the effort required to implement it is worthwhile and will make the treatment sequence more logical and straightforward, saving time and materials and reducing the cost of treatment.*

Keywords: DSD, Smile, Design, Digital

1. Introduction

Smile design refers to the many scientific and artistic principles that considered collectively can create a beautiful smile. These principles are established through data collected from patients, diagnostic models, dental research, scientific measurements, and basic artistic concepts of beauty. From the patient's perspective, beauty measures that individual's perception of beauty as noted in the saying: "Beauty is in the eye of the beholder." That perception of beauty may also be influenced by cultural, ethnic, or racial concepts of beauty and may vary from the standards established in the North American dental community [1].

When planning treatment for esthetic cases, smile design cannot be isolated from a comprehensive approach to patient care. Achieving a successful, healthy, and functional result requires an understanding of the interrelationship among all the supporting oral structures, including the muscles, bones, joints, gingival tissues, and occlusion. Gaining this understanding requires collecting all the data necessary to properly evaluate all the structures of the oral complex [1].

A comprehensive dental examination should include dental radiographs, mounted diagnostic models, photographic records, and a thorough clinical examination and patient interview. The clinical examination should include a smile analysis and the evaluation of the teeth, temporomandibular joints, occlusion, existing restorations, periodontal tissues, and other soft tissues of the oral cavity [1].

In addition to the esthetics, the function component of the anterior teeth must be considered in treatment planning. Anterior guidance in harmony with healthy joint positions is key in establishing a stable occlusal scheme [1].

Digital smile design is a multipurpose digital tool with clinically relevant advantages. It can strengthen esthetic diagnostic abilities, improve communication among team members, create predictable systems throughout the treatment phases, enhance patients education and motivation through visualization. And increase the effectiveness of case presentation [2].

Because using DSD can make diagnosis more effective and treatment planning more consistent, the effort required to

implement it is worthwhile and will make the treatment sequence more logical and straightforward, saving time and materials and reducing the cost of treatment [2].

Esthetic dentistry: the skills and techniques used to improve the art and symmetry of the teeth and face to enhance the appearance as well as the function of the teeth, oral cavity, and face [3].

Cosmetic dentistry: is generally used to refer to any dental work that improves the appearance (though not necessarily the functionality) of teeth, gums and/or bite. It primarily focuses on improvement dental aesthetics in color, position, shape, size, alignment and overall smile appearance [4].

Smile design: means designing any changes that you would like to make to your smile, the effect of which would be to improve your self-confidence and lifestyle [5].

2. Clinically relevant advantages

The advantages of using DSD are as follows :

- 1) Esthetic diagnosis.
- 2) Treatment planning and communication.
- 3) Feedback.
- 4) Patient care.
- 5) Case presentation.
- 6) Education [2].

3. Goals of digital smile design

The goal of an esthetic makeover is to develop a peaceful and stable masticatory system, where the teeth, tissues, muscles, skeletal structures and joints all function in harmony . It is very important that when planning treatment for esthetics cases, smile design cannot be isolated from a comprehensive approach to patient care. Achieving a successful, healthy and functional result requires an understanding of the interrelationship among all the supporting oral structures, including the muscles, bones, joints, gingival tissues and occlusion [6].

4. Components of an esthetic smile

The principles of smile design require an integration of esthetic concepts that harmonize facial esthetics with the dental facial composition and the dental composition.

The dental facial composition includes: The lips and the smile as they relate to the face.

The dental composition: relates more specifically to the size, shape, and positions of the teeth and their relationship to the alveolar bone and gingival tissues.

Therefore, smile design includes an evaluation and analysis of both the hard and soft tissues of the face and smile [7]. Only basic facial esthetics are reviewed as a guideline for facial analysis. Analyzing, evaluating, and treating patients for the purpose of smile design often involve a multidiscipline approach to treatment. Specialty treatment for achieving an ideal smile can include orthodontics; orthognathic surgery; periodontaltherapy, including soft tissue repositioning and bone recontouring; cosmetic dentistry; and plastic surgery. This esthetic approach to patient care produces the best dental and dental-facial beauty [7].

5. Vital Elements of Smile Designing (Dental Composition)

The vital elements of smile designing include the following :

- 1) Tooth components[8]:
 - a) Dental midline.
 - b) Incisal lengths.
 - c) Tooth dimensions.
 - d) Zenith points.
 - e) Axial inclinations.
 - f) Interdental contact area (ICA) and point (ICP).
 - g) Incisal embrasure.
 - h) Sex, personality and age.
 - i) Symmetry and balance.
- 2) Soft tissue components[8]:
 - a) Gingival health.
 - b) Gingival levels and harmony.
 - c) Interdental embrasure.
 - d) Smile line.

6. Classification of smile

Depending on the nature of labial mucous membrane:

- 1) Papilla smile
- 2) Gingival smile
- 3) Mucosa smile

Depending on the lip component:

- 1) Straight smile
- 2) Convex smile
- 3) Concave smile^[9]

7. Principles of Smile Design

Facial Analysis

The facial analysis involves an assessment of the face as a whole. Facial analysis in the frontal plane, relating the facial midline with the midline of the central incisors. Facial analysis in the frontal plane, showing horizontal parameters relating the inter- pupillary line to the incisal edge position. A full-facial analysis using lines to assess parallelism and hence synergy in the various components of the face as related to the smile [10]. The Ricketts E-plane connects the tip of the nose to the chin prominence. Average distance from the upper lip is 4 mm; and from the lower lip, 2 mm. The nasio-labial angle is determined by the base of the nose and the upper lip. The average angle for males is 90 to 95 degrees; for females, 100 to 105 degrees [10].

Smile and dental analysis:

Smile Design Sequence:

Step 1: Establish the Incisal edge position using the inter-pupillary line, phonetics, and the lip line as guides. The use of phonetics and the “M” sound help to determine the position of the lips at rest. The amount of tooth visible in this position is important as a baseline for designing the smile. The more tooth visible, the younger the look. Establish the incisal edge position use of phonetics to evaluate the location of the incisal edge position. The incisal edges of the maxillary anterior teeth should fall on the vermilion or wet/dry border of the lower lip [11].

Step 2: Develop midline symmetry and align the dental midline to that of the face. This line should be perpendicular to that of the incisal edge position [11].

Step 3: Establish the gingival margin based on the space available, calculate the length of the teeth using the width: length ratio of 78%. Once the gingival zenith of the central incisors has been plotted, design the gingival esthetic line based upon the esthetic parameters [11].

Step 4: Create silhouette form of the central incisors. The position of the central incisors is determined using the facial midline as a guide. The size depends on the space analyses and the tooth proportions of 78%.In order to create midline symmetry, the central incisors should be mirror images of each other [12].

Step 5: Develop relative proportions of lateral incisors and canines. The size of the lateral incisors and canines are determined so as to maintain relative proportions to each other and the centrals. We can use principles of tooth proportions, the “golden proportion,” and the various other proportion tools defined for the anterior segment. The aim is to create radiating lateral harmony [12].

Step 6: Extend the smile into the corners. Buccal corridor encroached upon by the teeth, leaving no contrast in color between the teeth, tissues, and space. Extend the smile into the corners prominent anterior segment with depressed posteriors gives the impression of an empty, “hollow” smile [12]. Axial inclinations of the teeth should be medially directed for a more esthetic and pleasing appearance. Extend

the smile into the corners eliminate the dark corridors of the smile, paying attention to the vertical parallelism and medial axial inclinations [13].

Step 7: Design the shape & texture of individual teeth. Characterization of the teeth is now developed. Embrasure spaces, contact points and contact areas, color, and translucency are all finalized to complete the smile [13].

8. Digital dental photography

Dental photography has become an important adjunct to dental records, informed patient treatment planning, and communications with dental laboratories and dental insurance companies. But perhaps its most important use is in the field of esthetic dentistry [14].

9. Uses of dental photography

Quality control

Dental photography can be an effective quality control measure. An image resolution of twelve megapixels or larger will allow sufficient magnification of the dental image to highlight imperfections that the clinician may be unable to see without magnification [14].

Patient records

Digital photographs are an effective treatment-planning adjunct. With a thorough medical history, intraoral charting, study casts, radiographs and intra- and extraoral photographs, treatment planning may be accomplished almost as if the patient were present. In addition, attaching a photographic image to the patient's chart or digital record facilitates instant recall of that patient by all staff members [14].

Case presentation

Digital photographs of the patient's preoperative clinical situation enhance the patient's understanding and acceptance of a proposed treatment plan, especially when accompanied by a portfolio of "before" and "after" images of similar successfully treated patient. Digital photographs combined with computer imaging software can be used to predict clinical results [14].

Treatment documentation

Before and after digital photographs provide accurate and instant visual documentation of treatment [15].

Laboratory communication

A color image of the restorative case facilitates communication with the dental laboratory. Sending digital images to the dental laboratory is simple and instantaneous. Images of the shade tab positioned over the prepared tooth to show the shades of the adjacent teeth increases the chance of esthetic success [15].

Dental specialist communication

High-quality digital images can be sent to other clinicians, thus facilitating the "team" approach to comprehensive dental care. Images of oral or perioral pathology can be captured and forwarded to an oral pathologist or oral surgeon for macroscopic review [15].

Insurance

Submitting color images as part of dental insurance claims may increase the chances of treatment plan acceptance [15].

Education

Digital photographs can be used when lecturing at dental meetings, study clubs, or in table clinics [15].

Community service

Presentations to local organizations raise the dental health consciousness of the community, improve the image of the profession and expand the dentist's future patient base by creating a greater awareness of advances and available services [16].

Marketing

The effective use of digital photographs can be a tremendous asset to a dental practice wishing to market its services. The photographs can be used for both internal and external marketing [16].

Bleaching

Monitoring the progress of bleaching by recording photographs of shade tabs against the teeth is possible and gives a record of pre-bleaching tooth color [16].

Medicolegal concerns

Any and every form of record keeping is vital for the historical preservation of patient consultation and treatment, particularly if needed for defense litigation [16].

10. Basic principles of dental photography

Reproduction ratio

Different reproduction ratios are used in dental photography; however, intraoral photography needs somewhere between 1: 1 and 1: 3. Lenses capable of producing these reproduction ratios are known as macro lenses [17].

Depth of field

The depth of field of a photograph is the distance in front and behind an object that the camera has been focused on (focal plane) that appears to be in focus. In general, approximately 50% of the depth of field is in front of the focal plane and 50% behind the focal plane. The depth of field is dependent upon the size of the aperture or metal diaphragm inside the lens, which is usually referred to as an f-stop. A good depth of field is determined by a large f-stop. The problem with a small aperture, however, is that this limits the amount of light getting to the film or sensor in your camera and therefore affects the exposure of the object [17].

Exposure

Exposure relates to whether the image is too light or too dark [17].

Illumination

Intra-oral photographs should be carried out using a ring flash or twin flash that gives an even illumination of the teeth. The unit should allow modification of its output by TTL metering. The main reported disadvantage with ring flashes is that they can produce multiple reflections from the

surface of the tooth with a flattening effect as they eliminate shadow [17].

Other photographic equipment:

Cheek retractors

Cheek retractors are important for keeping the soft tissues away from the teeth and allowing easy camera viewing of the dentition [17].

Contrasters

These are used to give a 'blacked out' background to the anterior teeth and remove the distraction of the tongue or other soft tissues [17].

Photographic mirrors

Two main types of mirrors are needed: occlusal mirrors or lateral mirrors. They can be either metal or glass [17].

11. General photographic technique

It is often easier to recline your patient in the dental chair to take intra-oral photographs. You should ask your patient to move their head towards you to allow you to take your photographs without having to lean over the dental chair. The dental light can be used to allow you to visualize the teeth for framing and focusing the view. The camera should be held with the body of the camera in your right hand and the lens supported by your left hand. Your arms should be held against your chest to give a stable support. Angulation is crucially important, as we are evaluating smile elements such as canting and parallelism in relation to the true horizon. Thus, most views should be obtained with the camera held at 90° to the subject (or in the case of occlusal views, the camera held at 90° to a mirror held at 45° to the occlusal plane) [17].

Where the maxillary canines seem longer than the centrals. It follows that angling the camera from above the subject will exaggerate the curve of the smile. Note that a photograph angled from below can be useful for shade assessment, as the angulation will prevent the flash from drowning out the shade tabs. The reproduction ratio should be set on the lens according to the standard view you are taking. Focusing is best carried out by setting the camera to manual focusing rather than automatic focusing and then moving the camera backwards and forwards to bring the object into focus. The reason for this approach is to ensure reproducibility of images taken on different occasions. You may need to make minor changes to the focusing to give an ideal coverage for the standard view [17].

12. Interaction between clinician and dental technician

Communication between clinicians and technicians has relied on photographs for some time, but never before has there been such great opportunity for accurate communication without the dental technician actually seeing the patient. It is now possible to obtain images with accurate colors.

To achieve this it is necessary to have the appropriate camera equipment, a professionally calibrated monitor, and a section of the office where the lighting is always consistent. The clinician should wear a neutral gray apron, and the patient should wear a neutral gray napkin. Using the Nikon Capture NX, it is possible to download data to a computer, take pictures of the patient, enter the photos on the computer, manipulate the images with the program until the colors match what is in the patient's mouth, and then record the data. The laboratory technician can recreate the exact same parameters in the dental lab for precise color matching. It is important to avoid making changes in the room, in the wall color, in the lighting, in the color of the lab coat, and so on [18].

13. Conclusion

DSD is a practical multi-use tool with clinically relevant advantages. It can strengthen esthetic diagnostic abilities, improve communication among team members, create predictable systems throughout the treatment phase, enhance patients education and motivation, and increase the effectiveness of case presentation. The drawing of reference lines and shapes over the patients photograph, following a predetermined sequence, allows the team to better evaluate the esthetic relation among the teeth, the gingiva, the smile, and the face.

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