# CHAPTER NAME – CURRENT CONCEPTS OF DIGITAL SMILE DESIGNING

**AUTHORS – DR K SATHYA NARAYANAN, DR ANJANA ALEYS MATHEW, DR TINI TREESA BENNY**

**ORGANIZATION NAME – SATHYABAMA DENTAL COLLEGE AND HOSPITAL, CHENNAI**

**CHAPTER CONTENTS –**

## INTRODUCTION

When a patient wants to have a flawless smile but is reluctant to get treatment because they are unable to see their treatment outcome, a dental practitioner may employ the Digital Smile Designing (DSD) tool. By simulating and pre-visualizing, the eventual outcome of the recommended treatment, digital smile design is a digital mode that aids in the creation and projection of the new smile design. (1) The natural smile of an individual is made up of a lot of factors. These include the incisal edge location, buccal corridor, labiodental relationship, upper lip curvature, smile line, smile arc, and smile design. Additionally, the position of the gingival zenith, symmetry, gingival display, and dental-facial midline all have a significant impact on how attractive a smile appears. When creating the smile makeover, each of these elements must be considered. (5) A digitally created design involves patient involvement in the design process of their own smile, which permits customization of the smile in accordance to individual requirements and preferences that complement the patient's morpho psychological characteristics, connecting with the patient on a psychological level, boosting their trust in the procedure and enhancing their authorization of their scheduled treatment. (1)

## DIGITAL SMILE DESIGN (DSD)

A versatile conceptual tool called the Digital Smile Design (DSD) may enhance diagnostic insight, facilitate interactions, and improve accuracy during treatment. DSD helps to thoroughly inspect the facial and dental features of the patient as well as any significant information that clinical, photographic, or diagnostic cast-based examination techniques that might have missed. Presentation software like Keynote (iWork, Apple) or Microsoft PowerPoint (Microsoft Office) can be used to create DSD illustrations. (2)

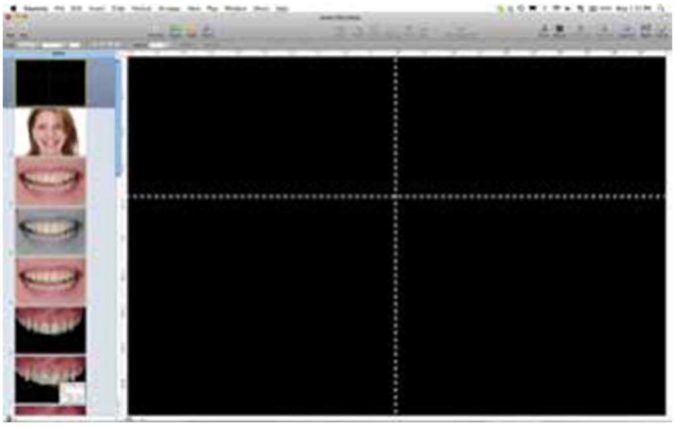


Fig 1: Keynote presentation software

## EVOLUTION OF DIGITAL SMILE DESIGNING:

Smile designing has gradually progressed over the past 20 years from physical analogue to digital designing and from 2D to the latest version, 3D. Beginning with older times, when hand drawings were utilised to communicate with and explain to patients what the outcome would look like on printed representations of the patient, it has advanced to comprehensive digital drawing on DSD software on the computer. To reach the final design that matches patients' functional and aesthetic needs, this is straightforward for modification and may be done at any time.

Christian Coachman proposed this evolution in 6 generations in 2017: (3)

- **Generation 1. Analogue drawings over photos and no connection to the analogue model.** Previously handmade sketches using pens were made on printed images to visualise the results of treatments, but these drawings could not be accurately matched to the patient's study model.
- **Generation 2. Digital 2D drawings and visual connection to the analogue model.** With the development of the digital age, familiarity with certain programs like PowerPoint that allowed for digital drawings increased. Although confined to two-dimensional drawings and not unique to dentistry, it was more precise and quicker than hand drawing. Visual connections between the drawing and the study model were possible, but no physical connections were made.
- **Generation 3. Digital 2D drawings and analogue connection to the model.** The connection between digital and analogue started at this point. The first digital dentistry-specific drawing program was made available, linking 3D wax-up and 2D digital smile

design. At this point, facial integration into smile design was also implemented, but there was no connection to the 3D digital environment.

- **Generation 4. Digital 2D drawings and digital connection to the 3D model.** Now was the moment when analysis in digital dentistry moved from 2D to 3D. A face integration and preset dental aesthetic parameters could be used in a 3D digital wax-up.
- **Generation 5. Complete 3D workflow.**
- **Generation 6. The 4D concept.** Adding various motions to the designing process allowing for a complete view from all axes.

## ADVANTAGES OF DIGITAL TECHNOLOGY:

1. Esthetic diagnosis - When a dentist first assesses a new patient with aesthetic concerns, several important aspects could be missed. A dental professional can visualise and analyse problems that they might not have noticed clinically thanks to a digital photography and analysis technique. Using presentation software, reference lines and shapes can be added to intraoral and extraoral digital photos.
2. Communication –
    - Dental technicians have always been in charge of designing smiles. The technician follows the guidelines provided by the dentist while doing the aesthetic wax-up, designing the tooth contour, and placing the dental prosthetics.
    - To improve predictability and satisfy patient expectations in respect to aesthetics, four key factors must be managed: the horizontal reference plane, facial midline, smile design (tooth form and arrangement), and colour.
    - The dental technician can create a three-dimensional wax-up more successfully, concentrating on the development of anatomical features within the given constraints, such as the reference planes, facial and dental midlines, suggested incisal edge position, lip dynamics, fundamental tooth arrangement, and incisal plane. Through a mock-up or temporary restoration, this information is conveyed from the wax-up to the try-in phase.
    - To direct the treatment procedure, the final aesthetic restoration design should be created and tested as soon as possible.

3. **Feedback** - The DSD enables accurate evaluation of the outcomes from each stage of treatment. On the slides, the order of the treatments is organised with images, movies, comments, graphics, and sketches. To monitor and evaluate the care given, team members can always view the PowerPoint presentation. Pre- and post-treatment photos can be easily compared using the digital ruler, sketches, and reference lines. In order to facilitate any necessary adjustments, the lab technician also receives comments concerning tooth form, arrangement, and colour.
4. **Patient management** - The clinician can discuss the prognosis, introduce treatment plans, convey the gravity of the condition, and offer case management suggestions. By assisting patients in visualising and comprehending previous and upcoming treatments, DSD also promotes patient acceptance. The DSD is also used as a promotional strategy to entice the patient, as an educational instrument for clarifying treatment-related concerns, and as an evaluation tool by contrasting before-and-after photographs.
5. **Education** - By including slides from realistic clinical situations in a presentation, DSD might enhance its visual impact. Both the presenter and the audience will be able to comprehend the ideas being addressed more clearly. (2)
6. **User-friendliness** - giving restorative dentists a simple form of communication with the dental lab which fabricates the restorations. (4)

## PHOTOGRAPHY PROTOCOL –

**BASIC ARMAMENTARIUM -**

1. Digital camera: (11,12)
   a. Compact point-and-shoot cameras
   b. Digital single-lens reflex –
      - More the pixels, the greater the detail of the image.
      - In dental photography, 10 Mega Pixels is required.
   c. Intraoral cameras
2. Camera accessories:
   a. Lens –
      - Macro lens with fixed focal length of 85–105 mm.
   b. Light and electronic flash systems –

- Ring flash
- Point flash
- Twin flash

c. Memory card –

- For storage of data

d. Filter –

- Lens protection
- Changing the lighting conditions if required

e. Batteries

3. Clinical accessories:

a. Cheek retractors

b. Black background/contrasters

c. Intraoral mirrors

**PHOTOGRAPHIC VIEWS -**

Six basic photographic views are necessary: (2)

1. Facial frontal smile with teeth apart
2. Facial frontal retracted with teeth apart
3. Facial profile at rest
4. Facial profile smile
5. Occlusal with mirror or from the model
6. 12 o'clock view smile

Fig 2: Six photographs

The clinicians should also record a brief video is also recommended where the patient is clarifying his or her treatment concerns and expectations in their own words. The film ought to record every achievable dental and smiling posture concurrently, including 45° view and a profile view.

## VIDEOGRAPHY PROTOCOL –

According to Coachman, when recording a video, the best frame, zoom, and exposure settings should be used to focus the lips and the mouth. (6)

1. A facial frontal video with a retractor and without a retractor smiling,
2. A facial profile video with lips at rest and a wide smile,
3. A 12 O'clock video above the head at the most coronal angle that still allows visualization of the incisal edge
4. An anterior occlusal video to record maxillary teeth from second premolar to second premolar with the palatine raphe as a straight line.

Other videos should also be taken to access speech and function. These photographs and videos are inserted into the applications used for designing.

## DIGITAL WORKFLOW SOFTWARE

A pre-case-acceptance phase (planning) and a post-case-acceptance phase (execution) can be distinguished in the timeline for the digital workflow. Similarly, the dental software platforms are divided into pre-case-acceptance software (pre-software) and post-case acceptance software (post-software) which show the ideal features according to the phase in which they will be used. (4)

### PRE-CASE ACCEPTANCE SOFTWARE

The pre-software needs to have two main characteristics:

- Treatment planning guided by the face
- Interdisciplinary integration.

The software should be used for diagnosing, creating the first ideal smile, and modelling various other treatment options for these reasons. In order to determine the appropriate combination of treatments for each patient, it should be able to execute all interdisciplinary simulations in the same programme and enable facial analysis and ideal smile design elements.

Main goals of pre-case acceptance software:

(a) Data acquisition

(b) Improve the process of identifying the patient's issues and diagnoses

(c) Simulate, compare the options, and promote a team brainstorm of the solutions

(d) Improve the decision-making process and risk assessment present

e) Explain treatment options to the patient, having the patient participate in the decision-making process with pre-software as a 3D visual communication tool. (4)

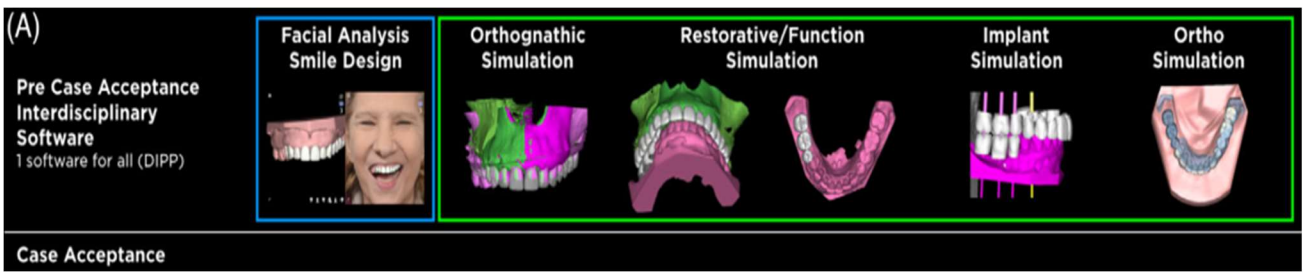



Fig 3: Pre-case acceptance software

**POST-CASE ACCEPTANCE SOFTWARE**

The dental practitioner can export the files from the pre-software and import them into numerous post-software after the treatment is arranged and the patient conforms to the plan. The primary objective of the post-software, which is the area-specific software, is to meticulously organise a particular disciplinary procedure while constructing any devices required to carry out the clinical procedure.

Main goals of post-case acceptance software:

(a) Import files from pre-software: import the ideal design and initial speciality simulation suggestion

(b) Precisely merge files from pre-software with working files to perform disciplinary tasks

(c) Design the devices needed to perform specific procedures

(d) Connect to manufacturing systems such as milling and 3D printing machines. (4)

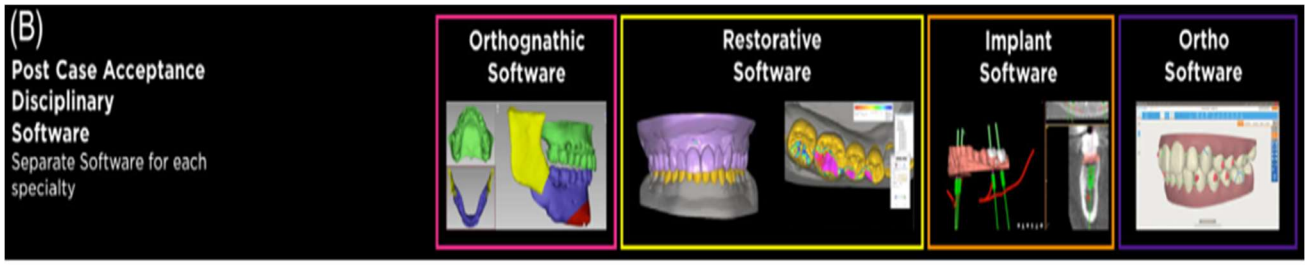



Fig 4: Post-case acceptance software

## COMMONLY USED DSD PROGRAMS:

1) Photoshop CS6 (Adobe Systems Incorporated)
2) DSD App by Coachman (DSDApp LLC)
3) Microsoft PowerPoint (Microsoft Office, Microsoft, Redmond, Washington, USA)
4) Cerec SW 4.2 (Sirona Dental Systems Inc.)
5) Planmeca Romexis Smile Design (PRSD) (Planmeca Romexis®)
6) VisagiSMile (Web Motion LTD)
7) Keynote (iWork, Apple, Cupertino, California, USA)
8) Guided Positioning System (GPS)
9) Exocad DentalCAD 2.3
10) Aesthetic Digital Smile Design (ADSD - Dr Valerio Bini)
11) DSS (EGSolution)

12) Smile Designer Pro (SDP) (Tasty Tech Ltd)

13) NemoDSD (3D) (1)

While not designed with DSD in mind, dentists and other dental professionals have utilised Photoshop CS6 and Keynote as DSD programs. Regarding their suitability for usage in the area of cosmetic dentistry, they are discussed in a number of literature reviews. As specialised digital design tools for the dental cosmetic industry, SDP and ADSD are marketed. Cerec SW 4.2 and PRSD are CAD/CAM programs are commonly used to build anterior restorations. Ceramic restorations need to be designed using frontal photographs and intra-oral digital impressions. The DSD App and VisagiSMile both embrace the visagism theory, which asserts that temperament can be used as a design component for smiles. Coachman, who has previously published various studies on the use of Keynote for digital smile design, also created the DSD App. The scope of these programs designed for non-dental reasons is expected to be more expansive due to their wider array of functions and adaptability. (7,8)

Fig 5: The Cerec software

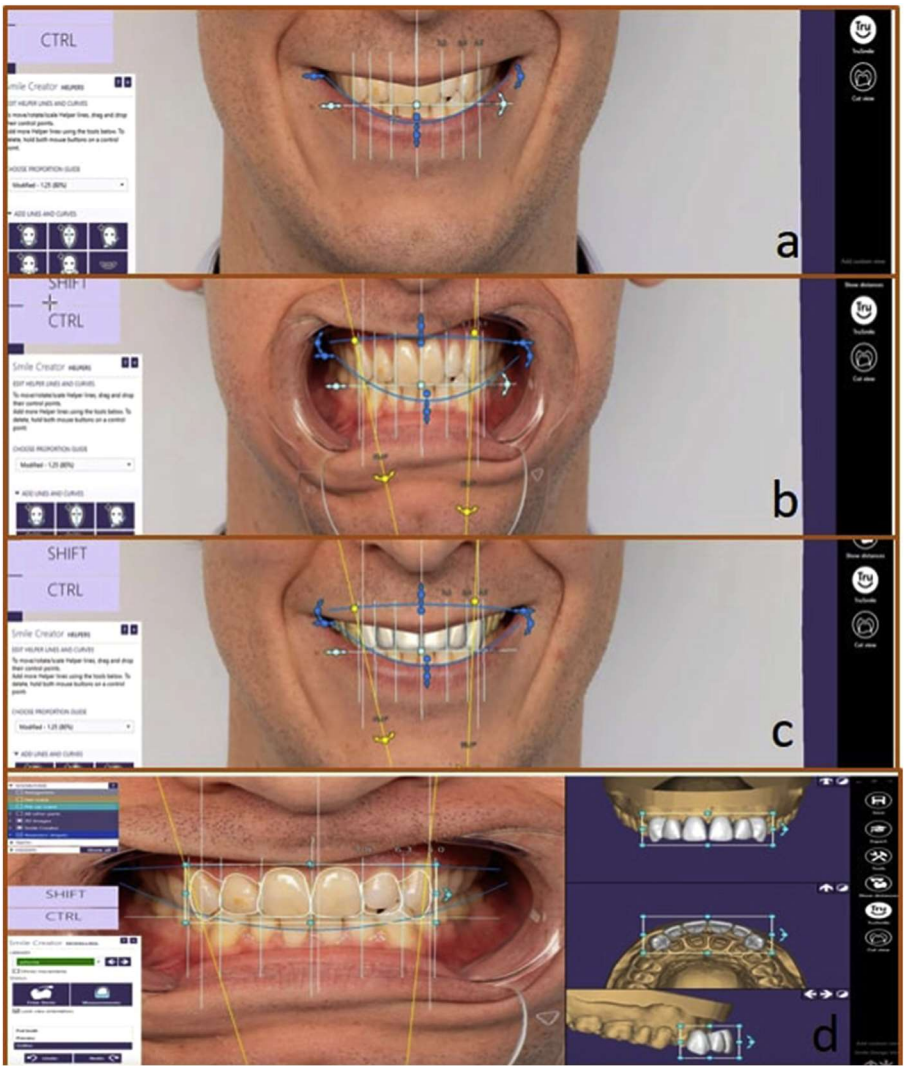



Fig 6: Exocad 3D software

## THE PHOTOSHOP SMILE DESIGN TECHNIQUE

Converting of the actual tooth length and width into the software is the first stage in the PSD approach. Next, the recommended new length and proportion of the teeth are determined digitally. (10)

### DETERMINING DIGITAL TOOTH SIZE

a. A conversion factor is determined by dividing the expected length by the existing length of the tooth
b. Open the full-arch cheek-retracted view in Photoshop software, and zoom in on the central incisor.

Fig 7: Open an image of an attractive smile in Photoshop in a separate transparent layer.

c. Select the eyedropper palette. A new menu will appear. Select the ruler tool

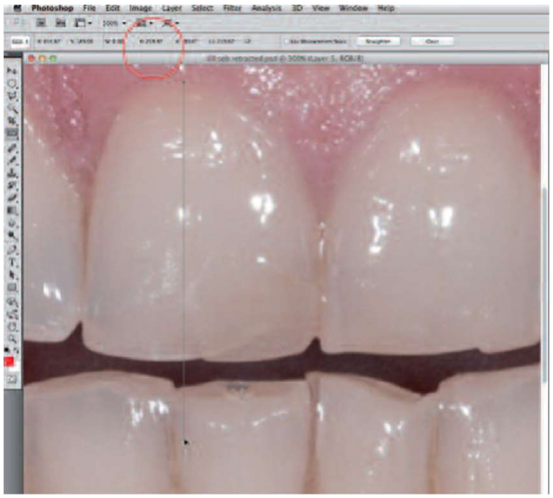


Fig 8: Measure the digital length of the central incisor using the ruler tool.

d. Use the ruler tool to generate a vertical number from the top to the bottom of the tooth. Multiply the number of pixels by the conversion factor earlier determined and calculate the digital tooth width using the same formula.

e. Create a new layer, leave it transparent, and mark the measurement with the pencil tool (10)

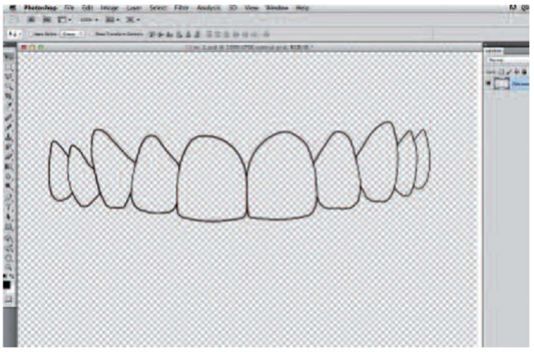


Fig 9: A two-pixel stroke black line used to trace tooth selection.

**APPLYING A NEW PROPOSED TOOTH FORM**

a. 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.

Fig 10: Image of the ideal teeth traced up to the second premolar to create a tooth grid.

b. Open the image of the chosen tooth grid in Photoshop and drag the grid onto the image of teeth to be smile-designed.
c. Depending on the original image size, the tooth grid may be proportionally too big or too small. To enlarge or shrink the tooth grid created (with the layer activated), press command (or control) and “t” to bring up the free transform function. While holding the shift key (holding the shift key allows you to transform the object proportionally), click and drag a corner left or right to expand or contract the custom tooth grid.

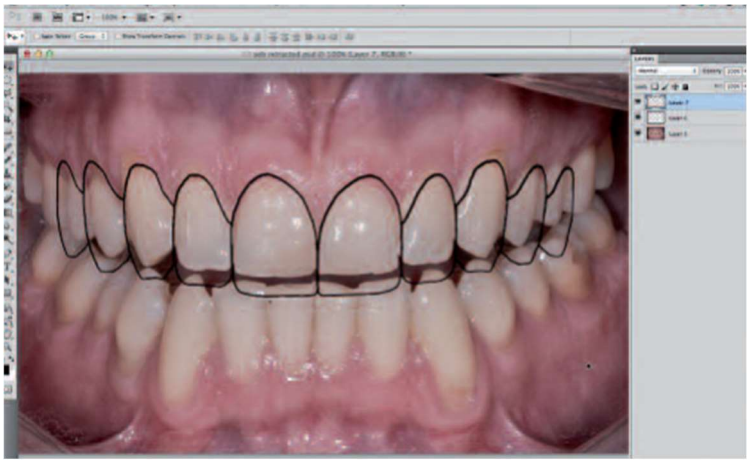


Fig 11: Adjust the grid as required while maintaining proper proportions

d. 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.

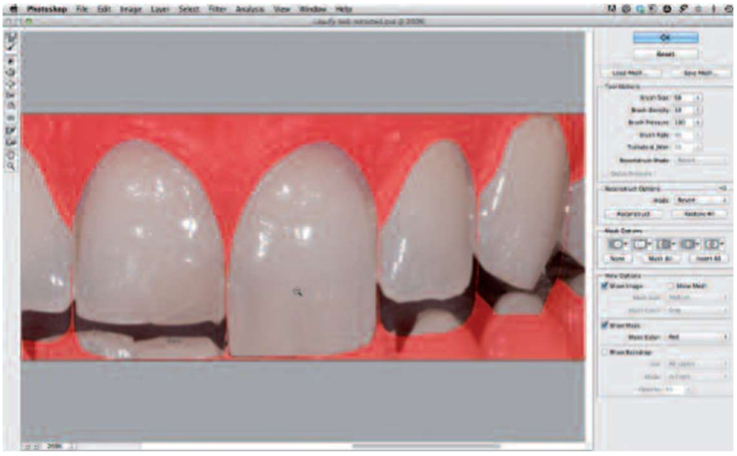


Fig 12: Shape one tooth at a time using the Wand tool

e. Areas of the grid can be individually altered using the liquify tool. (10)

**DIGITALLY CREATING NEW AESTHETIC TEETH**

a. 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.
b. Expand the selection by two pixels in the expanded menu; click “select > modify > expand”. Activate the layer of the teeth (cheek-retracted view) by clicking on it.
c. Activate the liquify filter (you will see a red mask around the shapes of the proposed teeth). The mask creates a digital limit that the teeth cannot be altered beyond. This is similar to creating a mask with tape for painting a shape.

Fig 13: Once all of the teeth have been shaped, use the liquify tool.

d. Use the forward warp tool by clicking on an area of the existing tooth and dragging it to mould/shape the tooth into the shape of the new proposed outline form.
e. Repeat this for each tooth.
f. Select the dodge tool to brighten the teeth. (10)

Fig 14: Teeth whitened using the dodge tool.

## COACHMAN'S DSD APP

The DSD workflow by Coachman proceeds as follows: (2)

a. **The cross:** Two lines forming a cross should be placed in the middle of the slide. A facial image with distinct teeth should be placed behind these lines.

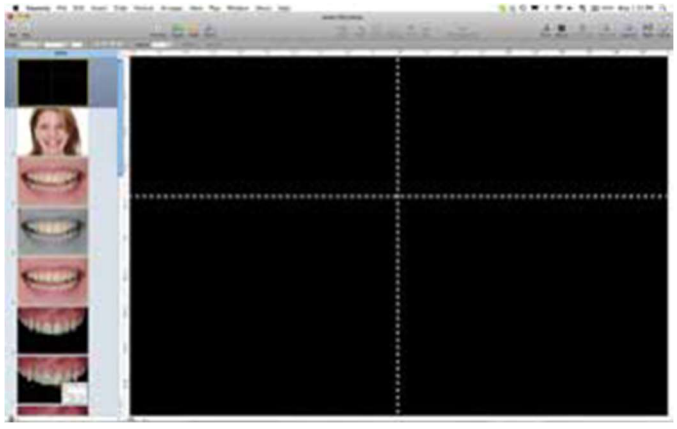


Fig 15: Cross lines placed in the middle of the slide

b. **Digital facebow:** The most crucial phase of smile design is aligning the full-face smile image with the horizontal reference line. Although it shouldn't be the only reference line used to define the horizontal plane, the interpupillary line should be the first. Before choosing the ideal horizontal reference to produce harmony, the face must be examined. The facial midline is defined in accordance with face features like the glabella, nose, and chin after the horizontal reference line has been established.

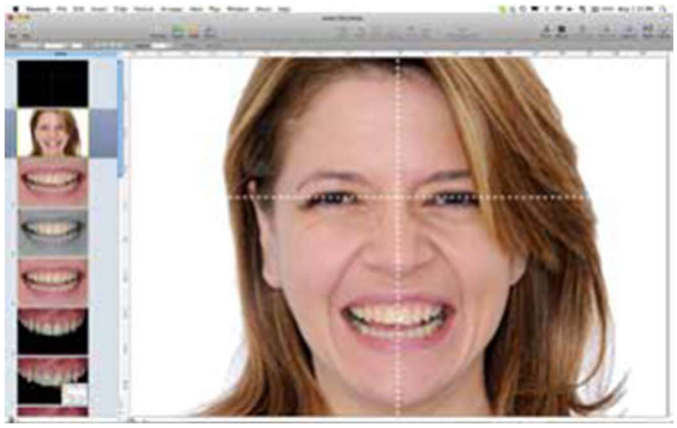
c. 

Fig 16: The facial photograph is moved behind the cross to determine the ideal horizontal plane and vertical midline

c. **Smile analysis:** The relationship between the facial lines and the smile can be initially assessed by dragging the horizontal line over the mouth. The clinician can zoom in on the image while maintaining the connection between the lines and the facial shots by grouping the lines and the photos. It is simple to identify midline and occlusal plane displacement and canting.

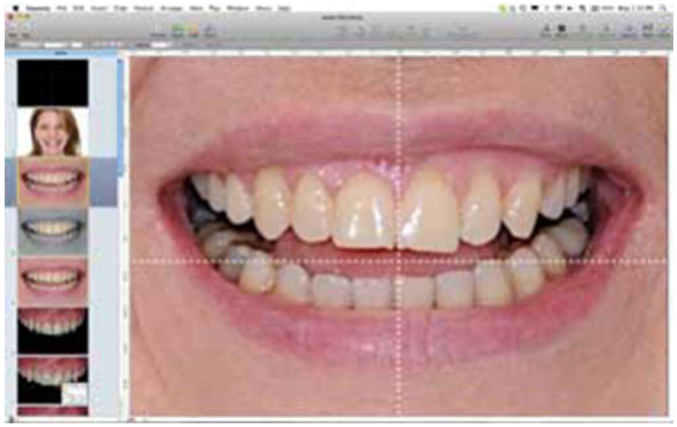


Fig 17: Transferring the cross to the smile

d. **Smile simulation:** Simulations can be performed to capture incisal edge position, inclination, tooth proportions and soft tissue contours.

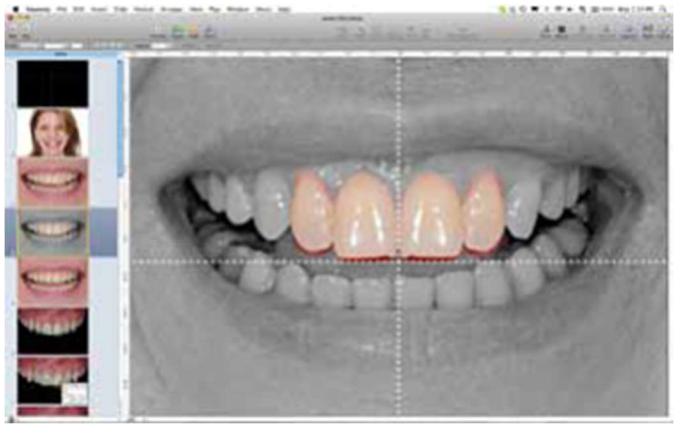


Fig 18: Simulation performed by cropping the images of the teeth and placing them over the smile photograph

e. **Transferring the cross to the intraoral images:** The cross must be transferred to the retraction view using three transferring lines drawn over the grin view in the manner shown below in order to analyse the intraoral pictures in accordance with the facial references:
    - The first line extends from the tip of one canine to the tip of the contralateral canine.
    - The second line extends from the middle of the incisal edge of one central incisor to the middle of the incisal edge of the contralateral central incisor.
    - The third line extends from the tip of the midline interdental papillae to the incisal embrasure over the dental midline.

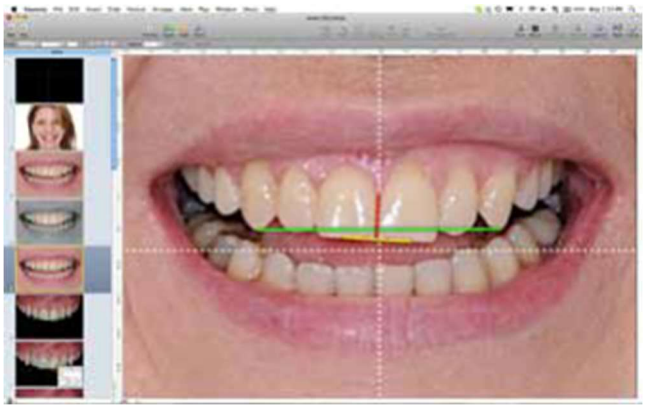


Fig 19: The three reference lines

f. **Measuring tooth proportion:** The first step in determining how to remodel the grin is to measure the width/length proportion of the central incisors. After that, a rectangle is put over the fronts of the two central incisors. The central incisors of the patient's mouth can be compared to the recommended proportions mentioned in the literature.

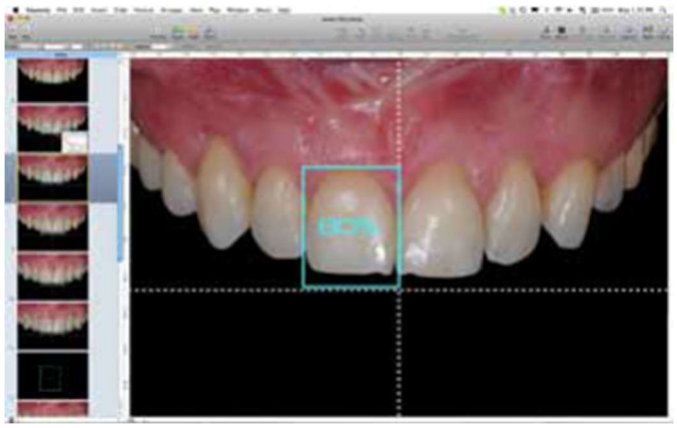


Fig 20: Box with ideal length and width proportion is placed over the central incisor

g. **Tooth outline:** All the markings can be made depending on what needs to be visualized or conveyed in each particular case. For example, the dentist can draw outlines of teeth on top of the photo or copy and paste ready-made outlines of teeth. The choice of tooth shape depends on various factors such as the patient's wishes, aesthetic expectations and what matches with their facial features.

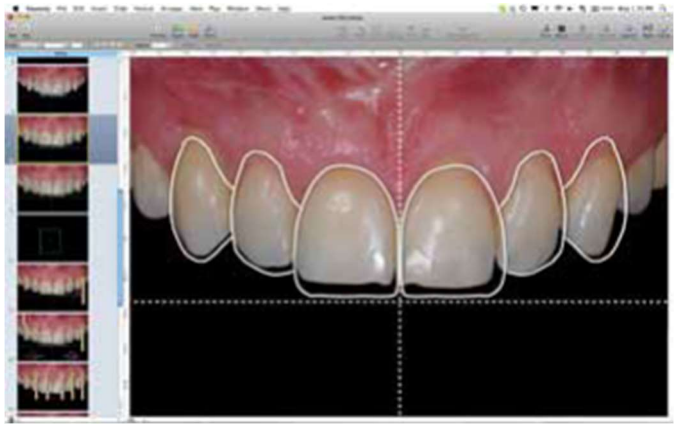
h. 

Fig 21: Final teeth outline showing the preoperative situation and the ideal design.

i. **White and pink esthetic evaluation:** The clinician should have a thorough understanding of the aesthetic issues pertaining to the patient's maxillary arch after all

reference lines and drawings have been provided. These issues include tooth proportions, interdental relationship, the relationship between teeth and smile line, the discrepancy between facial and dental midlines, midline and occlusal plane canting, soft tissue disharmony, relationship between the soft tissues and teeth, papillae heights, gingival margin levels, incisal edge design, and tooth axis.

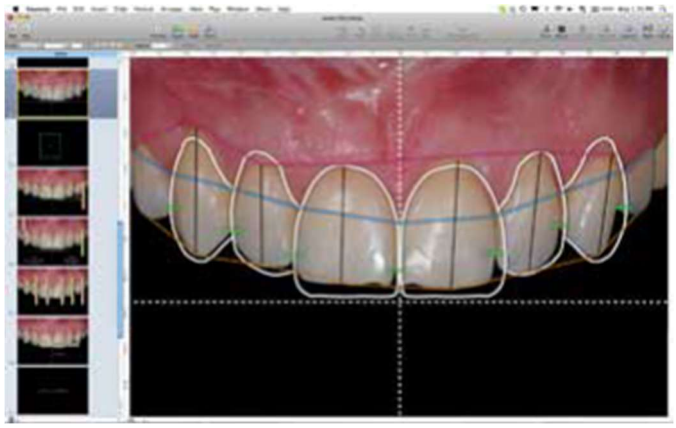


Fig 22: Other drawings and lines added to help visualize the aesthetic issues

j. **Digital ruler calibration:** By measuring one of the central incisors on the cast and entering the measurement into the computer, the digital ruler can be calibrated over the intraoral image. The doctor can take any measurements necessary over the anterior region of the image once the digital ruler has been calibrated.


Fig 23: Measuring the length of the cast and calibrating the digital ruler on the slide

k. **Transferring the cross to the cast**: First, the gingival margin of the six anterior teeth should be moved above the horizontal line that spans the intraoral photograph. Using the digital ruler, the distance between each tooth's gingival margin and horizontal line

is measured. These measurements are then recorded on the slide. A calliper is then used to transfer the measurements to the cast. The vertical midline transfer comes next. Only one point is required to pinpoint the location of the vertical line because it must be perpendicular to the horizontal line. On the computer, the distance between the dental and facial midlines is measured at the incisal edge, and the measurement is then transferred with a calliper to the cast. (2)

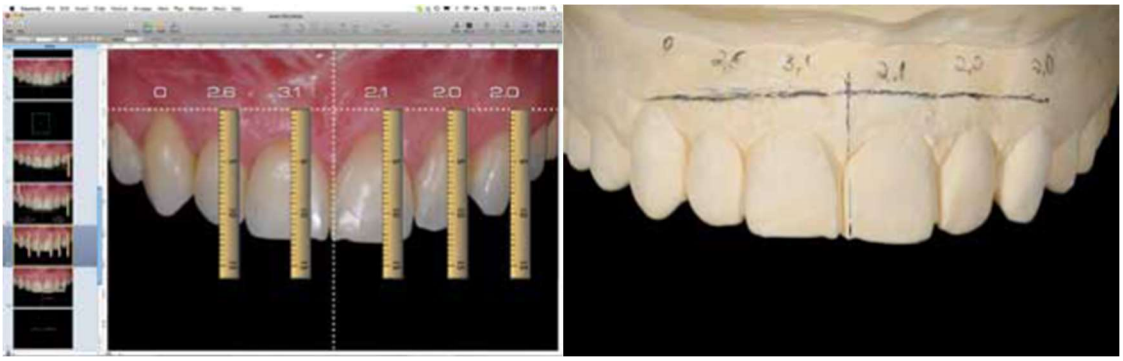



Fig 24: These digital measurements are transferred to the cast

k. **Evaluate the precision:** A clinical try-in is the next crucial step in validating the accuracy of the DSD technique and the wax-up. Depending on the complexity of the situation, either a direct mock-up or a tentative restoration can be used for the clinical try-in. (2)

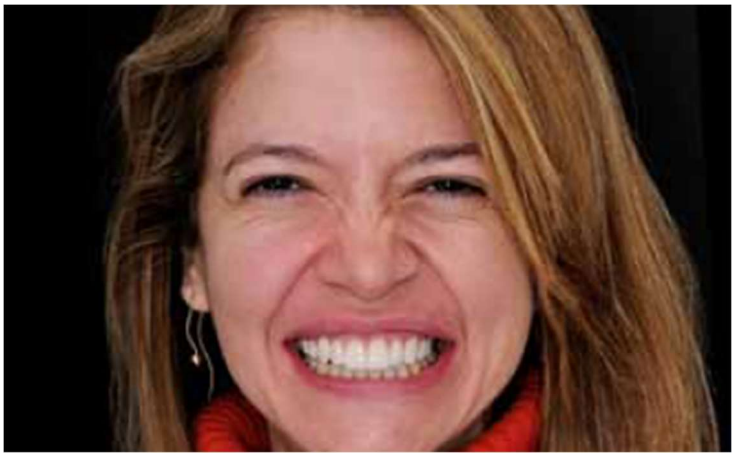


Fig 25: Temporization made using bis-acrylic resin

l. **Tooth preparation**: Once the patient is satisfied, tooth preparation should be very minimal, allowing just enough clearance to create proper space for ceramic restorations.

Fig 26: Tooth preparation guided by the silicone indexes.

m. **Fabrication of the final restorations.** (2)

Fig 27: Final ceramic veneers

## CEREC - SIRONA SMILE DESIGN TOOL

The "Smile Design" software programme was created by Sirona for the aesthetic inspection and evaluation of virtually designed restorations and is compatible with the Cerec and inLab software. (8)

a. The clinical status of the patient's dentition is initially scanned in three dimensions. The intraoral scanner can be used to obtain a direct optical impression for this, or a laboratory scanner can digitise cast models.
b. After designing the virtual model, the Smile Design process can be initiated.
c. This requires a photograph of the patient in portrait format. It is important to ensure that the patient’s teeth, and possibly also portions of the gingiva, are visible in the photograph.

d. The patient’s smile should be as natural as possible, and the lips open to an average degree.

Fig 28: The patient with the aesthetic problem.

e. The photograph is then selected using a file explorer and imported.
f. On the monitor, a photograph of the patient will be shown next to a virtual head.
g. 16 separate feature points must be recorded sequentially on the patient's photo at the locations where they appeared analogously on the avatar by the software in order to project the patient's image onto this head with the highest degree of fit correctness. These include the corners of the eyes, the tip of the nose, and the chin, which are distinguishing, conspicuous features of the face.
h. The actual distance between the two lateral corners of the eyes must be noted in the following stage. A calliper can then be used to measure this.
i. The computation of the head's actual size, onto which the results of the jaw scan are later superimposed, depends on this measurement.
j. A three-dimensional representation of the jaw that was created throughout the scanning process is now visible in the mouth.

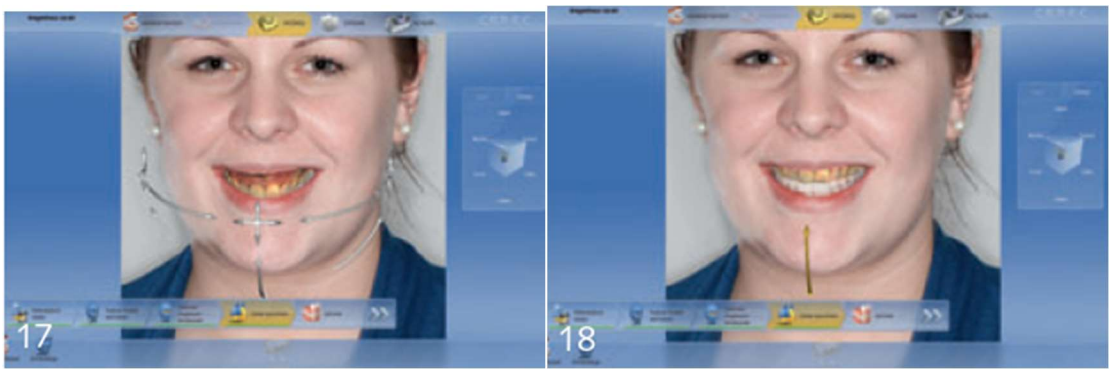



Fig 29: Characteristic feature points marked on the image.

k. An accurate fit upon insertion of the “dentition” in the avatar is presently the weak spot of the software.

l. In most cases, this needs subsequent manual adjustment. For this purpose, it is helpful to use the teeth of the scanned photograph (also displayed) as a guide.

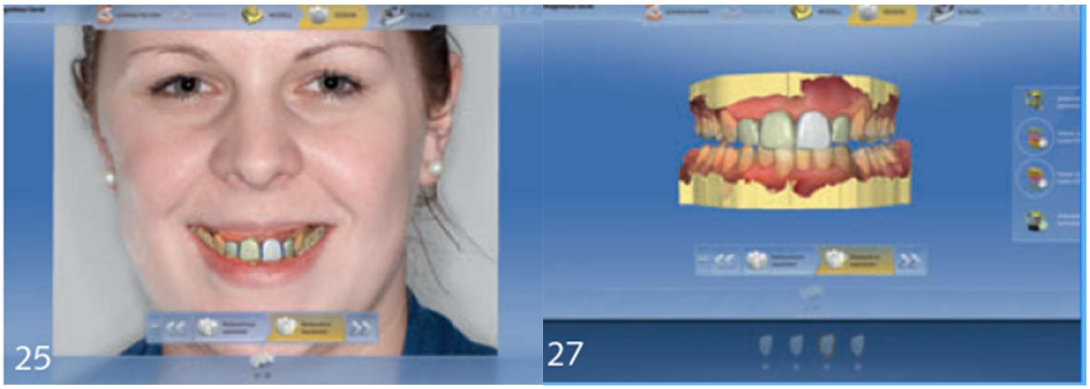



Fig 30: The completed trial restoration is given a final check in the virtual articulator.

m. Once this process is completed, the Smile Design Tool is ready for use. It can be accessed via the menu item “Display Objects” at every stage of the digital design procedure.

n. The current state of the virtual process is then immediately displayed together with the patient’s face.

o. For this purpose, there are several applications,

1. **Planning and virtual wax-up/mock-up** - Digital picture from its beginning is collected. The patient can observe the procedure's outcomes on the monitor. The restoration can be made from a polymer block and fitted to the patient's teeth as a Snap-On. The patient will have a very realistic notion of the upcoming restoration as a result of this.
2. **Intermediate assessment and long-term provisional restoration** - After preparation, the anatomical situation is digitalized. It is also possible to mill the restoration from polymer blocks after digitally creating it. In conjunction with providing a realistic estimate of the potential outcome of treatment, the restoration that ensues from this is also ideal for use as a long-term temporary restoration.
3. **Verifying the results of designing the definitive restoration** - This is especially useful when determining the tooth length, sectioning, midline, and horizontal

plane alignment, for instance. (8)

Fig 31: After completion of the design calculations, the restoration can now be milled.

Omar et al in 2017 did a systematic review comparing some of the most popular DSD programmes in their capacity to evaluate and digitally alter parameters affecting the aesthetic appearance of the face, teeth, and the smile. A set of parameters for dentofacial esthetic evaluation was used. (7)

**Table 1** Facial analysis components found in computer programs used for DSD.

| Esthetic parameters | Photoshop CS6 | Keynote | ADSD | Cerec SW 4.2 | DSD App | SDP | Visagi-SMile | PRSD |
|---|---|---|---|---|---|---|---|---|
| Intercommissural line | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | X |
| Interpupillary line | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Facial midline | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ |
| Smile cant | ✓ | ✓ | ✓ | ✓ | ✓ | X | X | X |
| Dental midline deviation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mandibular midline | ✓ | ✓ | ✓ | X | X[c] | X[c] | ✓ | ✓ |
| Horizontal proportions | ✓ | ✓ | ✓ | X | X | X | ✓ | X |
| Vertical proportions | ✓ | ✓ | ✓ | X | X | X | X | X |
| Facial profile angle | ✓ | ✓ | ✓ | ✓[b] | X | X | X | X |
| Nasolabial angle | ✓ | ✓ | ✓[a] | ✓[b] | X | X | X | X |
| E-plane | ✓ | ✓ | X | X | X | X | X | X |
| H-plane | ✓ | ✓ | X | X | X | X | X | X |

**Table 2** Dento-gingival analysis components found in computer programs used for DSD.

| Esthetic parameters | Photoshop CS6 | Keynote | ADSD | Cerec SW 4.2 | DSD App | SDP | Visagi-SMile | PRSD |
|---|---|---|---|---|---|---|---|---|
| Gingival line | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Lower lip line | ✓ | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ |
| Buccal corridor | ✓ | ✓ | ✓ | X | X | X | X | X |

**Table 3** Dental analysis components found in computer programs used for DSD.

| Esthetic parameters | Photoshop CS6 | Keynote | ADSD | Cerec SW 4.2 | DSD App | SDP | Visagi-SMile | PRSD |
|---|---|---|---|---|---|---|---|---|
| Tooth dimension | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Tooth shape modification | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | ✓ |
| Tooth characterization | ✓ | X | ✓ | ✓ | X | X | ✓ | X |
| Tooth shade | ✓ | ✓ | ✓ | ✓[a] | ✓ | ✓ | ✓ | ✓ |
| Occlusal plane/Incisal curve | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | ✓ |

Fig 32: Comparison of DSD programs by Omar et al, 2017

## DRAWBACKS OF DIGITAL TECHNOLOGY:

1. **Startup Costs** - The price of purchasing digital dentistry equipment is still quite considerable. A platform with subscription-based licencing is used by many of the systems to operate. For instance, an annual subscription is necessary for various Digital Smile Design Apps. Similar to cloud-based data storage for backups, some intraoral scanners charge a monthly or annual fee.
2. **Lack of Standardized Work Flows** - There are no clearly defined, universal workflows for digital dentistry that can be easily included in any practice. Interoperability is a problem since various data-gathering devices from various manufacturers export various file types.
3. **Limited Access to Digital Partners** - Finding other dental team members who use digital technology is one of the main hurdles of going digital because many of the higher-end small-scale facilities are still not totally digital.
4. **Intraoral Scanners and Scanning** - When incorporating digital impressions, there are problems such as a learning curve and adjustment for scanning, scanning sequence, and digital workflow. There are three different digital impression systems:
    1. Stand-alone systems - include Cerec Primescan, Carestream CS, iMedit 500, iTero, and Trios. Each of these scanners makes a very high-quality digital impression, and all have specific features and benefits designed to enhance the user experience.
    2. Scan, design, and output to a third-party mill – include Trios by 3Shape used for scanning the patient, but also can add chair-side design software.
    3. All-in-One ecosystem – include Planmeca Emerald and Sirona Cerec. With the use of these devices, a dentist and their staff can digitally take a patient's imprint in the dental office, create the patient's restoration using internal design software, and mill the restoration using an integrated in-office mill. (9)

## CONCLUSION

The Digital Smile Design is a versatile tool that can assist the aesthetics team at each phase of the procedure, enhancing the dental professional's comprehension of the aesthetic concerns and boosting patient acceptance of the outcome. The placement of reference lines and other shapes over

extra- and intraoral photographic images helps the dentists assess a case's restrictions, risk factors, and aesthetic principles. This broadens their field of view for diagnostic purposes. All treatment phases will see enhanced outcomes as a result of these crucial facts. The Digital Smile Design protocol's use of dynamic smile documentation will improve diagnosis accuracy and consistency of treatment regimens. Additionally, it will offer more rational and uncomplicated therapy sequences, lowering dangers and enhancing ultimate outcomes.

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