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Digital Smile Design - A New Era of Smile Design

K.P .Dhinesh Kumar, *PG student, Department of Prosthodontics and crown and Bridge, KarpagaVinayaga Institute of Dental Sciences, Madhuranthagam, Chengalpattu district, Tamil nadu, India.*
R. Kamalakannan, *Professor and Head, Department of Prosthodontics and crown and Bridge,* KarpagaVinayaga *Institute of Dental Sciences, Madhuranthagam, and Chengalpattu district, Tamil nadu, India.*
C. Nagappan, *professor, Department of Prosthodontics and crown and Bridge, KarpagaVinayaga Institute of Dental Sciences, Madhuranthagam, Chengalpattu district, Tamil nadu, India.*
J. Raghunathan, *associate professor,Department of Prosthodontics and crown and Bridge, KarpagaVinayaga Institute of Dental Sciences, Madhuranthagam, Chengalpattu district, Tamil nadu, India.*
N. C. Arun Prasad, *Senior Lecturer, Department of Prosthodontics and crown and Bridge, KarpagaVinayaga Institute of Dental Sciences, Madhuranthagam, Chengalpattu district, Tamil nadu, India.*
S. Vinoth Kumar, *Senior Lecturer, Department of Prosthodontics and crown and Bridge, KarpagaVinayaga Institute of Dental Sciences, Madhuranthagam, Chengalpattu district, Tamil nadu, India.*
Corresponding author: K.P.DHINESH KUMAR

ABSTRACT:
BACKGROUND:
The evolution of dentistry which started from pain has now more alleviated into aesthetics. The basics of dental treatment nowadays are more concerned with the aesthetic choice of treatment. And the most promising part of aesthetic treatment is the satisfaction and meeting the expectation of the patient regarding their confidence in smile. The most difficult part in aesthetic smile designing is the unknown outcome of the treatment result irrespective of what is explained by the clinician. Here comes the tool that plays a major role to overcome the uncertainty regarding the outcome of the treatment. Digital Smile Design not only helps the clinician better to communicate but also it increases the confidence about the outcome of the smile. It shows the patient promising results through the software, thus making the patient more comfortable and acceptable for the treatment. Here in this article we are going to share knowledge about the DSD (Digital Smile Design)
Keyword: *digital smile design, smile design*

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I. Introduction:

Smile is a person's ability to express a range of emotions with the structural and co-ordinated movement of the teeth, lips and facial muscles. Smile can often determine how well a person can function in society.[1, 2]

DSD are multi-use conceptual tools that can improve diagnostic vision, strengthen communication, and enhance treatment predictability, by allowing careful analysis of the patient's facial and dental characteristics that may have been overlooked by clinical, photographic or diagnostic cast based evaluation procedures.

The digital smile design (DSD) is a digital planning tool for aesthetic dentistry, in which the evaluation of the aesthetic relationship among the teeth, gingival, smile, and face is obtained through lines and digital drawings that are placed on the facial and intraoral photographs of the patient.[3,4]

EVOLUTION OF DIGITAL SMILE DESIGN:

The importance given towards beautiful smile is not a new concept. They can be traced from our earliest civilization. The Phoenicians (app 800 BC) and Etruscians (app 900 BC) carefully carved animal tusks to simulate the shape, form and hue of natural teeth.[4, 5]

It was not until the 18th century that dentistry was recognized as a separate discipline and its various branches were established. Pierre Fauchard (1678– 1761) of France, the leader of the movement, together with several colleagues modernized and promoted dentistry and also advocated aesthetic practices.[6]

Christian Coachman in 2017 has proposed this evolution in generations as:
Generation 1: Analogue drawings over photos and no connection to the analogue model. During this period drawing with pen on printed photocopy of patient was done to visualize the treatment result. But this drawing is not accurate and not able to correlate with the study model.
Generation 2: Digital 2D drawings and visual connection to the analogue model. It was during this digital world started budding. Certain software like PowerPoint where introduced, which allowed digital drawing. This two dimensional drawing was more accurate and less time consuming when compared to hand drawing.
Though it is accurate and able to visually connect to the study model the main disadvantage of its physical connection with the patient is lacking.
Generation 3: Digital 2D drawings and analogue connection .In to the model. This was the period during which the digital-analogue connection was established.
The very first digital drawing software specific to dentistry was introduced during this generation.
The software was able to link the 2D digital smile design to 3D wax up. Facial integration to smile design was also introduced at this stage, but connection to 3D digital world was missing.
Generation 4: Digital 2D drawings and digital connection to the 3D model. Now was the time when digital dentistry progressed from 2D to 3D analysis.
3D digital wax-up could be done involving facial integration and predetermined dental aesthetic parameters.
Generation 5: Complete 3D workflow.
Generation 6: The 4D concept .Adding motion and live movements' to the smile design process.[7]

GOALS OF SMILE DESIGN:
Now the main goal of digital smile design is to produce ideal smile using digital software to satisfy the patient's expectation, so that patient can express a range of emotion without any hurdles and can perform well in society.[8]
The main goals of digital smile design are:

- aesthetic diagnosis
- communication
- feedback
- patient management
- education

Requirements for DSD:
DSD techniques are done by digital equipments in already prevailing current dental practices with help of a computer, one of the DSD software, a digital SLR camera or even a smart phone.[9]
A digital intraoral scanner for digital impression, a 3D printer and CAD/CAM are also accessory tools for complete digital 3D work flow.
Photography protocol
Poor photography misrepresents the reference image and may lead to an improper diagnosis and planning.
The following photographic views in fixed head position are necessary:
1. Three frontal views:
• Full face with a wide smile and the teeth apart,
• Full face at rest,
• Retracted view of the full maxillary and mandibular arch with teeth apart.
2. Two profile views:
• Side Profile at Rest
• Side Profile with a full Smile
3. A 12 O, clock view with a wide smile and incisal edge of maxillary teeth visible and resting on lower lip.
4. An intra occlusal view of maxillary arch from second premolar to second premolar.

Videography protocol
According to Coachman during videography best framing and zoom should be adjusted with suitable exposure and focus adjusted to mouth.
For ideal development of the facially guided smile frame, four videos from specific angles should be taken:
1. A facial frontal video with retractor and without retractor smiling,
2. A facial profile video with lips at rest and wide-E 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.

PROCEDURE FOR DIGITAL SMILE DESIGN:

There are many different types of software's to carry out digital smile design effectively as discussed earlier. Basically three basic photographic views are necessary: full face with a wide smile and the teeth apart, full face at rest, and retracted view of the full maxillary arch with teeth apart.[10]

The DSD workflow then proceeds as follows:

1. The cross:

Two lines must be placed on the centre of the slide, forming a cross. The facial photograph with the teeth apart should be positioned behind these lines.

2. Digital face bow:

Relating the full-face smile image to the horizontal reference line is the most important step in the smile design process. The interpupillary line should be the first reference line to establish the horizontal plane, but it should not be the only one.

The face as a whole must be analyzed before determining the best horizontal reference to achieve harmony. After determining the horizontal reference line, the facial midline is outlined according to facial features such as the glabella, nose, and chin.

3. Smile analysis:

Dragging the horizontal line over the mouth will allow for initial evaluation of the relationship of the facial lines with the smile.

Grouping the lines and the facial photographs will allow the clinician to zoom in on the image without losing the reference between the lines and photograph. (figure.1).Midline and occlusal plane shifting and canting can be easily detected.

Smile simulation:

Simulations can be performed to fix the incisal edge position, canting, shifting, tooth proportions, and soft tissue outline.

4. Transferring the cross to the intraoral images:

To analyze the intraoral photographs in accordance with the facial references, the cross must be transferred to the retracted view using three transferring lines drawn over the smile view as follows:

a) Line 1: from the tip of one canine to the tip of the contra lateral canine.

b) Line 2: from the middle of the incisal edge of one central incisor to the middle of the incisal edge of the contra lateral central incisor.

c) Line 3: over the dental midline, from the tip of the midline interdental papillae to the incisal embrasure. It is necessary to calibrate four features on the photograph: size, canting, incisal edge position, and midline position.

Line 1 will guide the two first aspects (size and canting), line 2 will guide the incisal edge position, and line 3 will guide the midline position. (Figure .2)

Measuring tooth proportion:

Measuring the width/ length proportion of the central incisors is the first step toward understanding how to best redesign the smile.

5. Tooth outline:

From this step on, all drawings may be performed depending on what needs to be visualized or communicated for each specific case. For example, tooth outlines can be drawn over the photograph, or premade tooth outlines can be copied and pasted. (figure.3)

White and pink aesthetic evaluation:

After all reference lines and drawings have been provided, the clinician should have a clear understanding of the aesthetic issues involved in the patient's maxillary arch, including :

- Tooth proportions,
- Interdental relationship,
- Relationship between the teeth and smile line,
- 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,
- Tooth axis.(figure .4)

Digital ruler calibration:

The digital ruler can be calibrated over the intraoral photograph by measuring the length of one of the central incisors on the cast and transferring this measurement to the computer.

6. Transferring the cross to the cast:

First, the horizontal line over the intraoral photograph should be moved above the gingival margin of the six anterior teeth. The distance between the horizontal line and the gingival margin of each tooth is measured using the digital ruler, and these measurements are written down on the slide.

The measurements are then transferred to the cast with the aid of a calliper. Pencil marks are made on the cast at the same distances above the gingival margins as shown on the digital images. Those dots are then connected, creating a horizontal line above the teeth. The next step is to transfer the vertical midline.

Because the vertical line must be perpendicular to the horizontal line, only one point is necessary to determine its location. The distance between the dental midline and the facial midline at the incisal edge is measured on the computer, and the distance is then transferred to the cast with the calliper. Subsequently, the line can be drawn perpendicular to the horizontal line passing over this reference point.[11]

After drawing the cross on the cast, it is possible to transfer any necessary information, such as gingival margins, root coverage, crown lengthening, incisal edge reduction, and tooth width. At this stage, all information the technician will need to develop a precise wax-up is available on both the slides and cast.[12]

The next important step to evaluate the precision of the DSD protocol and the wax-up is to perform a clinical try-in. The clinical try-in can be carried out using a direct mock-up or a provisional restoration depending on the complexity of the case. If all of these steps are carried out properly and carefully, the final result will likely exceed the patient's expectations.

Limitations:

1. As the diagnosis and treatment plan depends on photographic and video documentation, inadequacy in them may distort the reference image and may result in an incorrect diagnosis and planning.
2. For complete 3D digital work flow, 3D software's with updates, intraoral scanner, 3D printer and CAD/CAM are required which makes it economically expensive.
3. Training and handling for certain software are necessary which further increases time and cost.

II. Conclusion

Aesthetic dentistry is part of any clinical specialty area and has seen tremendous progress over the last 100 years, especially with the application of digital tools and workflows that facilitate a customized 3D interdisciplinary approach to smile design and treatment execution.[15]

Smile design is a relatively new discipline in the area of cosmetic dentistry, and it involves several areas of evaluation and treatment planning, which simply means that cosmetic dentistry has to be a multispecialty branch. . The Digital Smile Design is a multi-use tool that can assist the restorative team throughout treatment, improving the dental team's understanding of the aesthetic issues and increasing patient acceptance of the final result.

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FIGURE LEGENDS:

FIGURE 1- THE CROSS

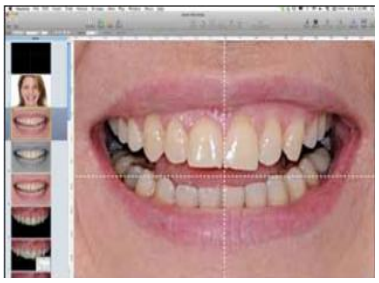

FIGURE 2- TRANSFERING THE CROSS TO THE INTRAORAL IMAGE

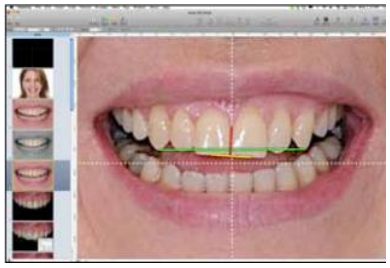

FIGURE 3- TOOTH OUTLINE

FIGURE 4-WHITE AND PINK AESTHETICS EVALUATION

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