



Current Concepts and Perspectives of Digital Smile Designing: A Review

Dr. Disha Prabhu¹, Dr. Nayana Prabhu², Dr. Veena Hegde³, Dr. Pradeep S⁴, Dr. Mukesh Kumar Goyal⁵, Dr. Shelly Goyal⁶

¹Tutor, Department of Conservative Dentistry and Endodontics, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India

²Associate Professor, Department of Prosthodontics and Crown and Bridge, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India (Corresponding Author)

³Professor, Department of Prosthodontics and Crown and Bridge, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India

⁴Professor and Head, Department of Prosthodontics and Crown and Bridge, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India

⁵Professor and Head, Department of Prosthodontics and Crown and Bridge, Inderprastha Dental College and Hospital, Ghaziabad, Uttar Pradesh, India

⁶Professor, Dental Department, Varun Arjun Medical College and Rohilkhand Hospital, Banthra, Shahjahanpur, Uttar Pradesh, India

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ABSTRACT:

Literature has well evidenced about the significance of aesthetics and its role in patients overall satisfaction. Aesthetic dentistry has different aspects and characteristics including the digital smile design (DSD) which has been used to improve obviousness of rehabilitation procedures such as direct restorative techniques. All these are an important low-cost option to receiving dental aesthetics in a short clinical duration. A structured and systematic approach is needed to assess, diagnose and address aesthetic problems predictably. It is of primary importance that success of the restoration is not only dependent on the looks. Instead as clinicians, our ultimate aim is to create a pleasing composition in the smile by making an arrangement of different aesthetic components. Via Digital Smile Designing (DSD) technique, a patient constantly doubting the end result of the operation, which is an irreversible procedure, can be inspired and trained. DSD is a technological tool used to digitally design and change patients' smiles and allow them to imagine them in advance by developing and showing a digital mockup of their current smile design before physically beginning the procedure. It helps to visually communicate and engage patients in their own phase of smile design, thereby ensuring consistent outcomes of care and increasing acceptance of cases. This review paper is an attempt to highlight and focus on the various aspects of digital smile design and its evolution relating to its application, benefits, restrictions and potential prospects in aesthetic dental practise.

Introduction

Aesthetics is defined as a branch of Philosophy dealing with the nature of and with judgments concerning beauty. For dentistry, the concept of aesthetics was narrowed by Scmarer as aesthetics include the morphological aspects only, but Stein (1978) extended it by including cosmetics, e.g. colour related aspects into the science of aesthetics. In the overall appraisal of aesthetics, we utilize the principles of Proportion,

Balance, Rhythm & Empathy.¹ The aim of an aesthetic makeover is to create a healthy system of mastication, teeth, tissues, structures of the skeleton, muscles and joints that operate in harmony. The assessment and analysis of both facial and dental structure should always involve a smile template. Perfect smile design goes a long way in restoring a patient's lost faith, and in this area of dentistry, the prosthodontist will play a pivotal and critical role.² Beauty is that entity which



gives the highest degree of pleasure to the senses or to the mind and suggests that the object of delight approximates one's conception of an ideal. Smile is the ability of person to express a range of emotions with the structure and movement of the teeth and lips.³

Types of Smile

While there are millions of different smiles, nearly as many as there are people, it is possible to recognise three simple smile patterns. The following neuromuscular smile trends have usually been established by plastic surgeons tasked with rehabilitating smiles.³ The most common pattern, seen in about 67 percent of the population, is the commissure smile. The corners of the mouth are first pulled up and outward in this smile, traditionally thought of as a Cupid's bow, followed by the upper lip contracting to reveal the upper teeth. The central incisors are the lowest incisional edge of the maxillary teeth in this classic smile pattern. From this point, with the maxillary first molar being 1 to 3 mm higher than the central incisal edge. The overall movement of the commissure from 7 to 22 mm results in a spontaneous smile. Similarly, the commissure's average direction of movement is 40 degrees from the horizontal plane. The cupid smile is found in 31% of the population.⁴ The lip shape is typically visualised as a diamond. The superiority of the levator labi-superioris defines this smile pattern. They first contract, revealing the cupid teeth, then contract the corners of the mouth to draw the lips upward and outward. Ackerman et al. divided the smile into two basic types 1) Reproducible, voluntary social smile / posed smile. The section of the lips due to mild muscular contraction of the muscles of the lip elevator, and the teeth and often the gingival scaffold are shown. (fig.1) 2) enjoyment smile/unposed smile/Duchenne smile, is an involuntary smile and is elicited by laughter or great pleasure and causing full expansion of the lips, gingival show, and maximum anterior tooth display.^{5,6} (fig.2) Tjan classified smile into 1) High smile where complete length of incisors is exhibited along with some amount of gingival display 2) Average smile, 75–100% of upper incisors and interdental papilla is displayed.



Figure 2: Enjoyment smile/unposed smile/Duchenne smile

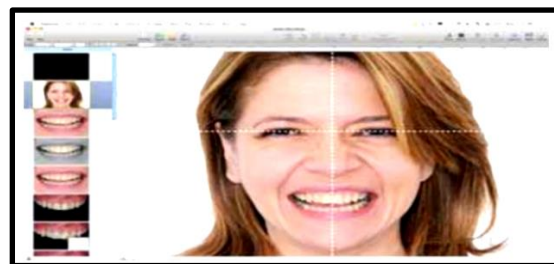


Figure 3: Positioning two lines at the middle of the slide and creating a cross

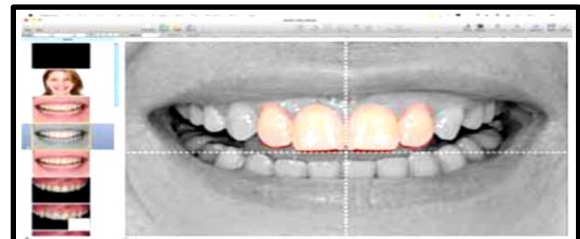


Figure 4: Transferring the cross to the intraoral images

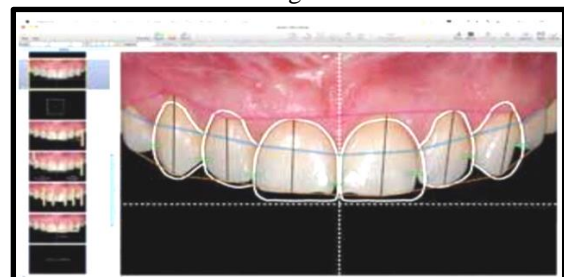


Figure 5: Visualization of the aesthetic problems and enhancement of the efficacy



Figure 1: Reproducible, voluntary social smile / posed smile



Figure 6: Measuring the discrepancy between the facial midline and dental midline



Figure 7: Measurements are transferred to the cast, and the cross is drawn

Evolution of Digital Smile Designing

Smile design has been discussed and conceptualized by several researchers in the recent past. It has progressively advanced over the last two decades, from physical analogue to digital design, and moved from 2D to 3D. It has now advanced to full digital drawing on DSD software on the computer.⁷ This can be quickly edited and can be done and undone at any time to satisfy the final design balance of aesthetic and functional needs of patients. This evolution in generations was suggested by Christian Coachman in 2017 as⁸ Generation 1. Analog drawings over photos and no connection to the analogue model. Generation 2. Digital 2d drawings and visual connection to the analogue model. With the advent of the digital world, some software such as PowerPoint, which allowed digital drawing, became familiar. It was more detailed and less time-consuming than hand drawing. Generation 3. Digital 2D drawings and analogue connection to the model. Generation 4. Digital 2D drawings and digital connection to the 3D model. Generation 5. Complete 3D workflow. Generation 6. The 4D concept. Adding motion to the smile design process.

Requirements for DSD

In modern day's dental practise, DSD expertise is operated by digital apparatus like a computer with one of the DSD applications, a digital SLR camera or even a mobile phone.⁹ Supplementary tools for full digital 3D workflow are a digital intra-oral scanner for digital printing, a 3D printer and CAD / CAM. A precise photographic documentation is important since complete facial and dental analysis is based on preliminary photographs on which modifications and design are formulated, a video documentation is required while smiling, laughing and talking for dynamic analysis of teeth, gingiva, lips and face in order to incorporate facially driven concepts into the smile design.¹⁰ The clinician may follow any of the software like Photoshop CS6 (Adobe Systems Incorporated), Microsoft PowerPoint (Microsoft Office, Microsoft, Redmond, Washington, USA), Smile Designer Pro (SDP) (Tasty Tech Ltd), Aesthetic Digital Smile Design (ADSD - Dr. Valerio Bini), Cerec

SW 4.2 (Sirona Dental Systems Inc.), Planmeca Romexis Smile Design (PRSD) (Planmeca Romexis®), VisagiSMile (Web Motion LTD). The decision of the consumer may be influenced by factors such as dentofacial aesthetic criteria, ease of use, case documentation capability, cost, time performance, systematic digital workflow and organisation, and programme compatibility with CAD / CAM or other digital systems [11]. Clinicians have experienced several significant aesthetic parameters, such as the midline, height, and the curve of the smile and intra- and interdental proportion, that guide smile evaluation and design.¹¹⁻¹⁵

DSD Work Flow

Using Keynote software (iWork), the authors execute the DSD protocol; however, related software such as Microsoft PowerPoint can be used with slight changes to the technique. Three simple photographic views are required: full face with a broad smile and separated teeth, full face at rest, and a retracted view of the full upper arch with separated teeth. The workflow for the DSD then continues as follows as Cross which is important to position two lines at the middle of the slide, creating a cross. The facial photograph should be placed behind these lines with the teeth apart. Digital Facebow which is the most important step in the smile design process is to connect the full-face smile picture to the horizontal reference line. Smile analysis which is the dragging the horizontal line over the mouth will allow the relationship of the facial lines with the smile to be initially evaluated. Transferring the cross to the smile: grouping the lines and zooming in to evaluate the relation between the gingiva, teeth, lips, and facial lines, with the facial photograph. Smile Simulations can be performed to determine the location of the incisal tip, canting, moving, tooth proportions and outline of soft tissue (Figure 3-7).

Digital Smile Designing

The Digital Smile Design (DSD) is a comprehensive multi-use device that can increase diagnostic vision, communication and increase predictability during treatment. The drawing of reference lines and shapes in a predetermined series over extra- and intraoral digital images will expand diagnostic interpretation and help the restorative team assess the shortcomings and risk factors of a given case, including asymmetries, disharmonies, and aesthetic principle violations.^{16,17,18}

Esthetic Diagnosis

When a new patient with aesthetic problems is first examined by the dentist, several important factors can be overlooked. A procedure for digital imaging and



digital analysis helps the dentist to visualise and examine conditions that he or she may not clinically notice.

Communication

Traditionally, smile design has been instituted by the dental technician. The technician conducts the restorative wax-up, produces the shapes and dental arrangements of the tooth, and follows the written or telephone directions and guidance given by the dentist. The outcomes are likely to be much superior when the treatment planner or any member of the restorative team has formed a personal relationship with the patient who takes responsibility for the smile design. This person has the potential to better express the personal interests and/or psychological characteristics of the patient to the technician, improving the excellence of the restoration from appropriate to exemplary.¹⁹⁻²¹

Feedback

The DSD allows the outcomes obtained in any treatment process to be correctly analysed. The treatment series is arranged with photos, images, notes, graphics, and sketches on the slides. Simple comparisons between pre- and post-procedure images can be made with the digital ruler, sketches, and reference lines. These comparisons help to assess whether the treatment was successfully implemented by the original plan or whether the actual result needs to be changed by other adjunctive procedures.²²⁻²⁴

Patient Management

By comparing before and after images, the DSD can be used as a marketing tool to empower the patient, an educational tool to better clarify problems relevant to treatment, and an evaluative tool. In addition, the library of slides from previous procedures can be used during patient consultation to illustrate treatment possibilities.

Education

It is also possible to share this personal library of clinical cases with patients and friends, and the most suitable cases can be turned into a slideshow for dental demonstrations and tutorials. By integrating the slides of clinical cases, DSD will improve the visual impact of a lecture. The audience can understand the ideas explored better, and the presenter can reduce the use of a laser pointer.

Advantages

It has several advantages which includes visualization of the desired final outcome before the procedure itself begins, it increases the procedure's predictability, it enhances the treatment strategy of clinicians by aesthetically visualising the issue of patients through

digital analysis of facial, gingival and dental parameters that examine the smile and face in an objective and systematic way. DSD did lead to smile design customization by increasing patient participation in their own smile design, resulting in a smile that is more aesthetically driven, humanistic, emotional and confident. It enhances the patient satisfaction and leaves no post-treatment scope of regret where the irreversible procedures once performed cannot be undone.

Limitations

Despite of the various advantages, it has certain disadvantages like the lack of adequacy in them because of photographic reliability.²⁵ 3D software with upgrades; intraoral scanner, 3D printer and CAD/CAM are required for the full 3D digital workflow, which makes it economically costly. Training and handling are required for such software, which further increases time and price.²⁶

Future Prospects

Complete 3D digital workflow is still not frequently used, and as more and more clinicians implement digital scanners, 3D printers, CAD/CAM, the need for time-consuming impressions, plaster and wax will become much less important in the future. In advanced cases where implants need to be positioned by superimposing the files coming from a CT scan or a Cone Beam, along with 3D files of an oral impression or a facial scan and a picture, it will be possible to resolve facial aesthetics with software improvements over the next few years. There is also a possibility of integrating the idea of 4D in which motion can be applied to the principle of smile design.²⁷

Conclusion

Within certain critical limitations, authors have proposed highly significant prospects about the Digital Smile Designing. They concluded that the principle or concept of digital smile design is a valuable tool for cosmetic visualisation of the patient's dilemma. It not only allows patients to imagine the results of their treatment, but also increases the diagnosis and treatment preparation of the clinician. Inferences of our study should be considered as indicative for assuming prognosis for similar clinical circumstances. However, authors expect few large scale studies to be conducted in these regards.

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