Review

An Overview of Digital Smile and its Use in Aesthetic Dentistry

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Abstract

The idea of beautiful aesthetic smile dates back into history and has evolved further over the recent decades. The transition of smile design from 2-dimension approach to three dimensions approach was introduced in the last two decades and in recent times has shifted completely to computer aided digital smile design. The use of digital smile design helps the patient to visualize the outcome of treatment prior to the initiation thus yielding better satisfaction. The purpose of this research is to review the available information about digital smile and its use in aesthetic dentistry. Patients concerned with improving their smile are taking keen interest in the field aesthetic dentistry. Various digital smile design software is available and used in clinical practice. Digital smile design involves patients in the process of designing their smile formats, which leads to customizing smile based on individual needs and desires. It may be necessary to better encourage patients to recognize the aesthetic aspects and improve their knowledge of the smile design to obtain additional results. The digital smile design opens many opportunities for teaching, learning, and practice. Literature reveals that application of digital smile in aesthetic dentistry results in effective patient outcomes as it not only aids the patient in visualizing his treatment but is also helpful tool for dentist in treatment planning and management however, more clinical studies in future are needed to highlight the impact of digital smile design in the field of aesthetic dentistry.

Keywords: *digital, smile, design, dentist, aesthetic*

Introduction

Smile is a person's ability to communicate a variety of emotions through the form and movement of their teeth and lips is often a determining factor in how effectively they can participate in society. Moreover, the value of a beautiful smile in a society is not new and this pursuit of beauty can be traced back to the dawn of civilization. The goal of an aesthetic makeover is to create a calm and stable masticatory system in which the teeth, tissues, muscles, skeletal structures, and joints all work together in perfect harmony. When planning therapy for aesthetics issues, it is critical to remember that smile design cannot be separated from a comprehensive approach to patient care. Both facial and dental components are an integral part of the smile design (1). Smile design has progressed from physical analogue to digital design, which has advanced from 2-dimension to 3-dimension, over the last two decades. From the days when hand drawing on printed images of the patient was utilized to communicate and show how the eventual result will look, it has now moved to complete digital drawing on computer using digital smile design software. This can be readily modified and undone at any moment to get the final design that balances the aesthetic and functional needs of the patient (2).

A dentist can utilize the digital smile designing tool when a patient wants to get that smile but is hesitant to undergo treatment because he or she cannot picture the treatment outcome. The digital smile design concept is to assist clinicians by improving the aesthetic visualization of the patient's concern, providing comprehension of the potential remedy, and educating and motivating them about the treatment's benefits, so increasing case acceptance. Digital smile design refers to a digital model that allows us to design and project a new smile by simulating and previsualizing the final result of the suggested treatment. A digitally created design involves patients in the designing process of their own self-smile design, resulting in customization of smile design based on individual needs and desires that complement the patient's morpho psychological characteristics, relating to the emotional level of the patient, increasing their confidence in the process, and better affirmation of the anticipated treatment (3).

Digital smile design is based on the use of high-quality digital tools, with the ability to practice both static and dynamically, resulting in a more effective and personalized treatment plan. Digital planning increases documentation and communication, both interdisciplinary and between the professional and the patient, allowing for the construction of a treatment plan that includes a smile that fits the patient's functional, aesthetic, and emotional needs (4). In the field of dentistry, aesthetics refers to the harmony of the smile. In addition to characteristics connected to the teeth, gingival factors such as colour, symmetry of the gingival contour, the greatest point of the marginal gingiva, and the triangle papillary are considered in the principles of the aesthetic smile. The relation between the length and width of the teeth, as well as their position, the form of the arch, and smile configuration is a significant aspect in the appearance of the smile. Changes in the width or height ratio of the teeth might even revitalize the appearance. Before evaluating the dental proportion, it's also vital to get a good gingival shape. The digital smile design allows for a more comprehensive treatment plan that focuses on the development of anatomical features within the parameters set. It allows to see the patient's results, which show the severity of the case, treatment plans, prognosis, and recommendations, making acceptance or change easier (5). The purpose of this research is to review the available information about digital smile and its use in aesthetic dentistry.

Methodology

This study is based on a comprehensive literature search conducted on June 1, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about the digital smile and its use in aesthetic dentistry. There were no restrictions on date, language, participant age, or type of publication.

Discussion

One of the main goals of dentistry is to imitate teeth and design a smile in a natural and aesthetic way, based on the individual and the specific needs of the patient. The potential for achieving the goal has greatly improved over the past decade through the use of new and more advanced therapies, improved and more advanced dentistry, and new techniques and technologies. Among the most significant developments over the past decade are the establishment of international aesthetic principles and guidelines based on the examination of the boundaries of natural beauty, anatomy, and physiognomy; the development of dental whitening and

advanced rehabilitation and implants and methods, which support the early detection of dental adhesions; significant advances in orthodontics and periodontal and oral and maxillofacial surgery; and, more recently, the introduction of digital technology into 3-dimensional programming and the realization of a truly natural, personal, and beautiful smile. In the future, the ingenuity of the design and learning of the machine will likely lead to aesthetic testing, smile design, and treatment planning procedures (6).

Evolution of digital smile designing

The evolution of digital smile design can be explained in course of following generations

- First generation: Drawing with a pen on a printed copy of a photograph to visualize the treatment result was common at the time, but it couldn't be linked to the research model. During this time, digital dentistry was not introduced.
- Second generation: With the introduction of the digital age, certain software such as PowerPoint became more widely known, allowing for digital drawing. Although not unique to dentistry and limited to two-dimensional drawing, it was more precise and time efficient than manual drawing. The drawing was visually related to the study model, but there was no real connection.
- Third generation: This was the first time a digital-analogue connection was made. The first digital dentistry-specific drawing program was released, which coupled 2-dimension digital smile design to 3-dimension wax-up. At this point, facial integration for smile design was also developed, but there was no connection to the 3-dimension digital environment.
- Fourth generation: Digital dentistry had moved from 2-dimension to 3-dimension analysis at this point. Facial integration and pre-set dental aesthetic factors could be used in a 3-dimension digital wax-up.
- Fifth generation: Workflow in complete 3-dimension setup.
- Sixth generation: Motion also being introduced and added to the smile design process, the concept of 4-dimension approach (2).

Evidence from Literature

Zanardi reported a case in 2016 of a 37-year-old female who presented with two chief complaints, the tooth form and colour anomalies. The appropriate actions for a harmonic smile modification could be reliably computed

using the digital smile design method. The master cast was waxed up and replicated in acrylic resin right in the mouth after the initial diagnosis. Temporary restoration technique was used as a guide for the periodontal surgery and the final pressed ceramic crown repair. Satisfactory aesthetic effect can be achieved by the implementation of digital smile design concept. (7). Santos reported another case of a 16-year-old female in 2017 who underwent gingival recontouring surgery using a digital smile design and mock-up. The incisal plane was compared to the horizontal face plane of reference to assess the link between facial and dental parameters. The dental contour sketch was placed once the relative dental height into breadth was measured. The gingival zenith, as well as the gingival and incisal battlement connecting lines, are drawn as complementary lines. According to the known established digital smile pattern, the periodontal aesthetic was improved. These findings highlight the relevance of surgical methods, which are well-received by patients and simple to conduct for professionals. They meet the required expectations when correctly planned. Surgical techniques related with the building of a digital smile make it easier for the patient and the expert to communicate (5).

Results from an observational study in 2016 revealed that respondents rated both the previsualization of digital smile design (64.3%) and the milling mock-up test (85.7%) very effective. The new 3-dimension digital editing system is a highly predictable and non-disruptive process that allows for easy diagnostics, enhances patient interaction, and helps reduce time and errors associated with traditional prosthodontic manual steps (8). Findings of a survey in 2020 depicted that both dental experts and laypeople alike found that digital smile design is a popular way of previewing and interacting with patients. Furthermore, laypeople appreciated brighter colours higher, and substantial differences were discovered between the two studied groups. It appears that using digital previews for dentists and laypeople in the improvement of previewing and communication methods is feasible. It may be necessary to better motivate patients to recognize aesthetic elements and improve their knowledge of the need of achieving more mimetic aesthetic results. Digital smile design opens up a lot of possibilities in terms of teaching, learning, and habitual practice (9).

The results of a 2-year follow-up study in 2016 showed that gingival alterations, home tooth bleaching, and restorative performance with small porcelain laminate veneers using lithium disilicate glass-ceramic laminates

4 to 13 improve the quality of a smile. After two years of follow-up, the proposed method demonstrated acceptable clinical performance. Digital smile design can be utilized to improve professional and patient communication also predictability in the aesthetic rehabilitation of a smile (10). Omar stated that patients who want to improve their smile are increasingly concerned about cosmetic dentistry. Before beginning aesthetic treatment, a thorough and systematic dentofacial examination is required. Several computer software tools for digital smile design have been developed to aid dentists in this process, While comparing digital smile design software including Photoshop CS6, Keynote, Planmeca Romexis Smile Design, Cerec SW 4.2, Aesthetic Digital Smile Design, Smile Designer Pro, Digital smile design App, and VisagiSMile the most aesthetic analysis parameters were found in Photoshop, Keynote, and Aesthetic Digital Smile Design. The capacity to examine facial aesthetic characteristics was lacking in other design software programs studied, although they did contain full dentogingival and dental aesthetic functions. 3-dimension analysis was possible using the digital smile design App, Planmeca Romexis Smile Design, and Cerec SW 4.2; additionally, Cerec SW 4.2 and Planmeca Romexis Smile Design may be utilized together with computer aided design technology. Digital smile design App and Smile Designer Pro are available in the mobile phone versions also. Despite the fact that they were not created expressly for dental diagnosis, Photoshop CS6 and Keynote provide a more thorough smile analysis than other dedicated digital smile design tools. Other program features should be addressed as well when determining whether digital smile design program is appropriate for specific clinical situations (11).

Cervino concluded in his study that both dentist and patient receive essential information from the digital smile technology. Patients can see their rehabilitation before they begin, which can serve crucial medico-legal purposes. These digital approaches have undergone a significant favourable evolution in recent years. Other approaches, such as engineering finite element analysis, have also been of tremendous assistance to the biomedical profession, allowing for the simulation of structures even before they are tested on patients, thereby boosting the quality of rehabilitations and their predictability. In terms of planning, digital devices that are properly interfaced with other digital files such as radiography and dental laboratory machines allow for more predictable rehabilitations. Indeed, technology has advanced in this field in recent years, and major upgrades on digital smile design will continue to be made. Facial scans, on the other hand, would be able to forecast bone growth in children, arrange orthodontic rehabilitations, and then drive appropriate jaw growth (12).

It is critical to emphasize that devoting more time to diagnosis and planning improves treatment predictability and execution efficacy. Improved predictability will aid in the early detection of complimentary treatments such orthodontic movement and clinic crown expansion. Furthermore, it reduces clinical errors and irritation by obstructing patient-clinician dialogue. Every professional seeks to improve planning and predictability support for clinical therapy with the goal of gaining aesthetic and functional rehabilitation. When combined with the traditional mock-up technique, the use of digital tools such as digital smile design gives dentists a new perspective, resulting in a higher success rate in terms of final results. The use of digital smile design and mock-up techniques together allows for greater aesthetic manipulation and, as a result, a more predictable model to back up the treatment plan. In addition to improving the presentation of the current state of his dental health, digital imaging allows patients to envision the projected final result (13). Sathya reported certain limitations of the use of digital smile design technology in his study that since the diagnosis and treatment plan are totally dependent on photographic and video documentation, even slight inadequacies can lead to inaccurate diagnosis and treatment planning, it requires expensive hardware and software. Handling and training for a small number of software applications is time consuming and costly (14). Although the use of digital smile design technology in the field of aesthetic dentistry is well-established over the recent years limited studies are available in literature. More clinical studies are required to provide evidence-based results of advantages and application of digital smile design in aesthetic dentistry and also add on to the existing literature.

Conclusion

The aesthetics of a patient's problem can be effectively visualized by the digital smile design concept. It not only aids patients in visualizing their treatment outcomes, but it also aids clinicians in diagnosing and planning treatment. However, in future more clinical studies are needed to establish evidence-based link between digital smile design and aesthetic dentistry.

Disclosure

Statement

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Ethical consideration

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Data availability

Data that support the findings of this study are embedded within the manuscript.

Authors' contribution

All authors contributed equally to the drafting, writing, sourcing, article screening and final proofreading of the manuscript.

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