



REVIEW ARTICLE

# The application of parameters for comprehensive smile esthetics by digital smile design programs: A review of literature



Doya Omar<sup>1</sup>, Carolina Duarte\*

RAK College of Dental Sciences, RAK Medical and Health Sciences University, Al Qusaidat, Ras Al Khaimah, United Arab Emirates

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**Abstract** Cosmetic dentistry is increasingly becoming an issue of concern to patients who hope to improve their smile. A systematic and comprehensive dentofacial analysis must be performed before commencing esthetic treatment. Several computer software programs have been developed for digital smile design (DSD) to assist clinicians in this process. This article compares DSD programs commonly used in cosmetic dentistry and their ability to assess esthetic parameters. A literature review was performed of current dentofacial aesthetic parameters and clinical applications of computer technology to assess facial, dentogingival and dental esthetics. Eight DSD programs (Photoshop CS6, Keynote, Planmeca Romexis Smile Design, Cerec SW 4.2, Aesthetic Digital Smile Design, Smile Designer Pro, DSD App and VisagiSMile) were compared. Photoshop, Keynote and Aesthetic Digital Smile Design included the largest number of esthetic analysis parameters. Other studied DSD programs presented deficiencies in their ability to analyze facial esthetic parameters but included comprehensive dentogingival and dental esthetic functions. The DSD App, Planmeca Romexis Smile Design, and Cerec SW 4.2 were able to perform 3D analysis; furthermore, Cerec SW 4.2 and PRSD could be used jointly with CAD/CAM. The DSD App and Smile Designer Pro are available as mobile phone applications. It can be concluded that despite the fact that they were not specifically designed for dental diagnosis, Photoshop CS6 and Keynote provide a more comprehensive smile analysis than most specialized DSD programs. However, other program

\* Corresponding author at: RAK College of Dental Sciences, RAK Medical and Health Sciences University, P.O. Box 12973, Al Qusaidat, Ras Al Khaimah, United Arab Emirates.

E-mail address: [caro.duarte1@gmail.com](mailto:caro.duarte1@gmail.com) (C. Duarte).

<sup>1</sup> RAK College of Dental Sciences, RAK Medical and Health Sciences University, P.O. Box 12973, Al Qusaidat, Ras Al Khaimah, United Arab Emirates.

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functions should also be considered when deciding which DSD program is applicable to individual clinical setups.

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## 1. Introduction

In modern practice of dentistry, more patients are demanding highly esthetic treatment outcomes. In order to improve smile attractiveness, clinicians need to carry out a comprehensive facial and dental assessment that will analyze the smile and the face in an objective and standardized manner that will address the patient's factors of dissatisfaction and concern. The fundamental criteria for esthetic analysis should include facial, dentogingival and dental esthetics (Magne and Belser, 2010; McLaren and Culp, 2013). In recent years, several computer software programs for digital smile design (DSD) have been introduced to clinical practice and research. They are multi-use conceptual tools that can strengthen diagnostic vision, improve communication, and enhance treatment predictability, by permitting careful analysis of the patient's facial and dental characteristics that may have been overlooked by clinical, photographic or diagnostic cast based evaluation procedures (Coachman and Calamita, 2012).

Facial analysis is performed using reference lines from which standardized parameters have been developed for frontal and profile views of the face. The horizontal reference lines used in frontal analysis include the interpupillary and intercommissural lines that provide an overall sense of harmony and horizontal perspective in the esthetically pleasing face (Chiche and Pinault, 2004; Cohen, 2007), while the vertical reference lines include the facial midline, dental midline and mandibular midline. These are crossed against each other to assess symmetry and cant (Naini, 2011). Symmetry can also be assessed by dividing the face into horizontal thirds and vertical fifths that measure facial proportions (Naini, 2011; Prendergast, 2012; Vaidya et al., 2014). The parameters used for profile analysis include the facial profile angle that can indicate the underlying skeletal pattern (Naini and Gill, 2008; Rifkin, 2000), as well as the Ricketts E-Plane, Holdaway H-Line and nasolabial angle to assess lip position (Calamia et al., 2011; Heasman, 2013; Patnaik et al., 2003). The facial analysis will not only provide information on facial esthetics but can also serve as a guideline to determine the shape and proportion of teeth, as suggested by Leon William's theory (Farias et al., 2010), Berry's biometric index (Naini, 2011) and H Pound's formulas (Vassantha Kumar et al., 2011).

The dentogingival analysis includes parameters of gingival health and morphology such as the status of the interdental papillae and formation of black triangles (Patel and Chapple, 2015; Prato et al., 2004), the position of the gingival zenith (Magne and Belser, 2010), gingival line (Pawar et al., 2011), gingival contour (Camare, 2010), smile line (Priya et al., 2013) and dimension of the buccal corridors (Nascimento et al., 2012). The Appropriate relationship of the teeth and its surrounding soft tissue will greatly determine the overall esthetic outcome of treatment.

The dental analysis will render the conclusive size, shape and color of the restored teeth. There have been several theories used to define adequate tooth dimension which include the golden proportion (Priya et al., 2013), width to length ratio (McLaren and Culp, 2013), pound's theory (Vassantha Kumar et al., 2011; Ward, 2015), recurring esthetic dental proportion (Ward, 2015), law of harmony (Farias et al., 2010), dentogenic theory (Farias et al., 2010; Pedrosa et al., 2011), and, more recently, visagism (Sharma et al., 2015). In considering tooth color there are four primary attributes (hue, value, chroma, and translucency) and characteristics such as texture and luster which can change the perception of the tooth shape and value (Culp et al., 2013). Also important is proper reproduction of shade progression that Approximates natural esthetics even when patients seek the very lightest shade (Morley and Eubank, 2001).

This article aims to compare some of the most commonly used DSD programs in their ability to assess and digitally modify facial, dento-gingival and dental smile esthetic parameters. The programs included in this observation are Photoshop CS6 (Adobe Systems Incorporated), Keynote (Apple Inc.), 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) and DSD App by Coachman (DSDApp LLC). Photoshop CS6 and Keynote were not created specifically for DSD but have been used by dentists and dental professionals as DSD programs and are presented in several literature reviews regarding their qualification to be used in the field of cosmetic dentistry. SDP and ADSD are marketed as specialized digital design programs to be used in the dental

cosmetic field. Cerec SW 4.2 and PRSD are CAD/CAM software that can be used for designing anterior restorations and may require frontal photographs and intra-oral digital impressions to design ceramic restorations. VisagiSMile and DSD App share the use of the concept of visagism which suggests that temperament can be used as a factor in smile design. The DSD App is being developed by Coachman, who had previously published studies on the use of Keynote for digital smile design. It is expected that programs meant for purposes other than dentistry will have a greater scope due to their wider variety of functions and adaptability.

## 2. Materials and methods

A review of literature was performed by electronic search of Pubmed and Google Scholar. The keywords: “facial esthetics”, “esthetic parameters”, “smile analysis”, and “smile reconstruction” were used to retrieve articles for standardization of esthetic parameters. Seventeen articles were chosen using the following inclusion criteria: articles published from 2007 to 2017, studies that directly addressed parameters for dentofacial esthetics, human studies, and articles written in English language. These articles were summarized to determine the parameters for dento-facial esthetic evaluation that were used to compare the DSD programs. The keywords “digital smile design”, “photoshop”, “keynote”, “smile designer pro”, “esthetic digital smile design”, “Visagism”, “Cerec” and “plan-meca romexis smile design” were used to retrieve articles from each program included in this study. Sixteen articles were selected based on the following inclusion criteria: articles published from 2007 to 2017, clinical studies where DSD programs were used, human studies, and articles written in English Language. Additionally, the program developer’s audiovisual

educational materials for each program were used for more accurate descriptions.

A set of parameters for dento-facial esthetic evaluation frequently reported in recent literature were chosen to assess the functions of the studied programs. The ability of DSD programs to perform comprehensive dentofacial esthetic analysis was evaluated using these parameters. Additionally, direct comparisons of other features (3D functions, CAD/Cam connectivity, practicality features) were included to better characterize each program. The evaluation was made based on the information found in the available peer reviewed publications and developer educational materials.

## 3. Results

In order to compare the competency in esthetic analysis of each program, 12 facial, 3 dento-gingival and 5 dental analysis parameters were selected from the reviewed literature (Calamia et al., 2011; Camare, 2010; Cohen, 2007; Farias et al., 2010; Heasman, 2013; Magne and Belser, 2010; Naini and Gill, 2008; Naini, 2011; Nascimento et al., 2012; Patel and Chapple, 2015; Pedrosa et al., 2011; Prendergast, 2012; Priya et al., 2013; Ungureanu and Leon, 2014; Vaidya et al., 2014; Vassantha Kumar et al., 2011; Ward, 2015). According to these parameters (Tables 1–3), the number of esthetic features assessed by each of the studied programs was counted as a score out of 20 (Table 4).

Photoshop scored 20/20 in its ability to fulfil the analysis of facial, dentogingival, and dental esthetic parameters followed by keynote with 19/20 (Culp et al., 2013; Helvey, 2007a, 2007b, 2007c; McLaren and Culp, 2013). The aforementioned programs can consider all the studied esthetic parameters due to the practitioner’s ability to process any kind of photograph

**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 <sup>c</sup> | X <sup>c</sup> | ✓            | ✓    |
| Horizontal proportions   | ✓             | ✓       | ✓              | X              | X              | X              | ✓            | X    |
| Vertical proportions     | ✓             | ✓       | ✓              | X              | X              | X              | X            | X    |
| Facial profile angle     | ✓             | ✓       | ✓              | ✓ <sup>b</sup> | X              | X              | X            | X    |
| Nasolabial angle         | ✓             | ✓       | ✓ <sup>a</sup> | ✓ <sup>b</sup> | X              | X              | X            | X    |
| E-plane                  | ✓             | ✓       | X              | X              | X              | X              | X            | X    |
| H-plane                  | ✓             | ✓       | X              | X              | X              | X              | X            | X    |

<sup>a</sup> Application to measure lip and nose position/dimensions.

<sup>b</sup> Application to view and adjust the antero-posterior position of prosthetic restoration in relation to the lips, nose, and profile.

<sup>c</sup> Photograph is not taken in maximum intercuspation which makes mandibular midline analysis unreliable.

**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                  | ✓             | ✓       | ✓    | ✓ <sup>a</sup> | ✓       | ✓   | ✓            | ✓    |
| Occlusal plane/Incisal curve | ✓             | ✓       | ✓    | ✓              | ✓       | ✓   | X            | ✓    |

<sup>a</sup> Provided with tooth shade guide.

**Table 4** Total score of facial, dentogingival and dental analysis features found in the analyzed DSD programs.

| Software                       | Score out of 20 |
|--------------------------------|-----------------|
| Photoshop CS6                  | 20              |
| Keynote                        | 19              |
| Aesthetic Digital Smile Design | 18              |
| Cerec 4.2 software             | 13              |
| DSD App by Coachman            | 10              |
| Smile Designer Pro             | 10              |
| VisagiSMile                    | 10              |
| Planmeca Romexis Smile Design  | 10              |

(frontal, lateral, occlusal, retracted, etc.), as well as draw reference lines and angles freely. Keynote could analyze all parameters but was unable to modify and generate fine anatomic features on the tooth surface (Coachman and Calamita, 2012; Coachman et al., 2012) (Table 3). Both Photoshop and Keynote are image editing softwares that are not specific for dentistry. Their interfaces are not readily designed for patient documentation and digital smile design; therefore, additional user training is required. Their potential to measure, superimpose and directly modify images is limited mainly by the user's ability to understand and manipulate the software functions.

The ADSD program scored 18/20 as it includes limited facial profile analysis functions (Bini, 2014, 2015) (Table 1). The program is specifically designed for digital smile design and the work interface has been planned for a clinical setup. It requires less expertise to effectively use the software; however, the functions are limited to those already included in the program.

Cerec SW 4.2 (Kurbad and Kurbad, 2013; Rihal et al., 2017), DSD APP (Coachman et al., 2017; Paolucci et al., 2012), SDP, PRSD, and VisagiSMile (Feraru et al., 2016; Iliiev, 2016; Sharma et al., 2015) programs had similar scores:

13/20, 10/20, 10/20 and 10/20 respectively (Table 4). Major drawbacks of these programs were found in the facial esthetic parameter analysis, which are primarily used for image calibration in these programs. Frontal facial parameters were limited, and facial profile parameters were only partially included in Cerec SW 4.2 while absent in the rest of the programs (Table 1). Additionally, some of them were unable to modify fine anatomic features which may result in a less natural digital simulation of the smile (Table 2). The DSD APP is expected to include all aspects of frontal and profile facial analysis later in 2017 with the addition of an orofacial surgery simulation extension.

Cerec SW 4.2, ADSD, DSD App, SDP, PRSD, and VisagiSMile, programs include multiple functions for dental and dentogingival assessment and planning (Tables 2 and 3). The programs are based on a series of preexisting teeth grids that are superimposed over the patient's teeth (Table 5). The user is able to control the final design through direct adjustment and modification of the grid's tooth dimension, shape and shade. DSD App and SDP have mobile phone interfaces that allow direct upload of images and portability (Table 5).

Three dimensional smile designs are possible using DSD App, PRSD, and Cerec SW 4.2 (Table 5). Furthermore, Cerec SW 4.2 and PRSD can be used jointly with CAD/CAM to produce temporary and final restorations that replicate the designed smile (Table 5). The DSD App integration with CAD/CAM is expected later in 2017 with the addition of a 3D smile design extension.

#### 4. Discussion

Cosmetic dentistry is the integration of all the areas of dentistry; therefore, for a practitioner to decide the best treatment approach, he or she must perform a comprehensive esthetic evaluation. This will constitute the milestone for correct diagnosis and subsequent treatment planning. DSD is a new tool that has been introduced to the world of cosmetic dentistry in recent years. DSD programs are used for objective esthetic

**Table 5** Additional features found in computer programs used for DSD.

| Feature           | Photoshop CS6  | Keynote        | ADSD | Cerec SW 4.2 | DSD App        | SDP | Visagi-SMile | PRSD |
|-------------------|----------------|----------------|------|--------------|----------------|-----|--------------|------|
| Teeth grids       | X <sup>a</sup> | X <sup>a</sup> | ✓    | ✓            | ✓              | ✓   | ✓            | ✓    |
| 3D design         | X              | X              | X    | ✓            | ✓              | X   | X            | ✓    |
| CAD/CAM           | X              | X              | X    | ✓            | X <sup>b</sup> | X   | X            | ✓    |
| Patient Interface | X              | X              | ✓    | ✓            | ✓              | ✓   | ✓            | ✓    |
| Mobile app        | X              | X              | X    | X            | ✓              | ✓   | X            | X    |

<sup>a</sup> Teeth grids have to be prepared and saved by the user prior to clinical application.

<sup>b</sup> Announced for 2017.

analysis and virtual treatment planning by editing photographs and/or scanned models of patients. In this article, the inclusion of facial, dentogingival and dental parameters of comprehensive dentofacial analysis for esthetic evaluation in the DSD programs was assessed. The highest scores were observed in Photoshop CS6 and Keynote; therefore, more comprehensive esthetic analysis can be achieved using these programs even though they are not specific for dental practice. The majority of programs specific for dental practice seem to overlook facial esthetic parameters and focus on dentogingival and dental esthetic parameters instead.

Photoshop and Keynote were not specially created for digital smile design; however, these two programs define, measure and modify the highest number of dentofacial esthetic parameters discussed in this document. Photoshop and Keynote fulfilled facial analysis criteria; therefore, they could be used for analysis of complex cases that require treatment beyond restorations alone and where orthodontic or surgical interventions are to be considered. Although there are digital smile design programs available specifically for dentists, it is possible to use Photoshop and Keynote to create and show patients the proposed dental cosmetic treatment. Their major drawback is that a moderate to advanced degree of training is required by the dentist in order to utilize the software functions in the process of smile design. A number of authors have used Photoshop for DSD and determined the basic functions to be used in the diagnostic process. These include editable teeth grids, division of the observation areas, measuring techniques, guidelines for the diagnostic wax-up and prediction of final restoration (Helvey, 2007a–c; McLaren and Culp, 2013; Zaccaria and Squadrito, 2015). The competency of Keynote in DSD has also been described in the literature (Coachman and Calamita, 2012; Coachman et al., 2012; Ungureanu and Leon, 2014). Similar to Photoshop, Keynote provides the ability to define reference lines and angles and obtain the needed measurements.

Fewer reports have been published using professional dental DSD programs relative to Photoshop or Keynote. In fact, no scientific articles were found where SDP and PRSD had been used. Its evaluation in this article relies only on product specifications and developer educational materials. The ADSD program was developed and designed to comprehensively analyze and digitally simulate a smile, while considering facial, dentogingival and dental parameters, and can be connected to a CAD/CAM to produce a digital wax-up (Bini 2014, 2015). Until now, ADSD is the only dentist specific program that includes a more comprehensive facial analysis to complement the dentogingival and dental analysis functions. CAD/CAM companies, such as Sirona have improved the esthetic features of anterior restorations in their computer software. When assessed, Cerec SW 4.2 could construct a 3-D digital model of the patient's face to allow control of all the dimensions of digitally designed restorations including functional assessment of the articulation of the models (Rihal et al., 2017). The DSD App is being developed by a researcher who published studies on the use of Keynote for digital smile design (Coachman and Calamita, 2012; Coachman et al., 2012) and, therefore, shows similarities with the image editing software. The program has recently been introduced to the market, but a publication showing its potential is already available (Coachman et al., 2017). The DSD App, additionally, uses the concept of Visagism. This concept, introduced by Dr.

Braulio Paolucci, construes smile design based on personality traits. VisagiSMile is a program fully developed over the Visagism concept (Feraru et al., 2016; Iliev, 2016). The approach to facial analysis in VisagiSMile differs from the facial esthetic parameters used in this study; therefore, it scored low on our comparison tables.

DSD programs incorporate digital technology to the smile design process and can be used as tools for diagnosis, treatment plan visualization, and communication with the patient and technician that can increase treatment outcome predictability. However, not all the DSD programs available today provide the same competency for comprehensive analysis of the dentofacial esthetic parameters. Although this is one of the most important elements to be considered when choosing a DSD program, other factors such as ease of use, case documentation ability, cost, time efficiency, systematic digital workflow and organization, and compatibility of the program with CAD/CAM or other digital systems may also influence the user's decision.

## 5. Conclusion

The comparison of multiple DSD programs clarifies the competency of all these programs in comprehensive digital smile design that should include facial, dentogingival and dental esthetic parameters. The omission of one or more of the esthetic parameters may lead to a less than ideal treatment plan and outcome. Other important characteristics can be the ease of use of the programs and immediate applicability to a specific clinical setup. Consideration of all relevant factors may affect the choice of the DSD program to be used in clinical practice.

## Conflicts of interest

The authors have no conflicts of interest to declare.

## References

- Bini, V., 2014. Aesthetic digital smile design: software-aided aesthetic dentistry: part I. *CAD/CAM Int. Mag. Digital Dent.* 2, 12–17.
- Bini, V., 2015. Aesthetic digital smile design: software-aided aesthetic dentistry: part II. *Cosm Dent.* 1, 14–22.
- Calamia, M., Johan, R., Mark, S., 2011. Smile design and treatment planning with the help of a comprehensive esthetic evaluation form. *Den. Clin. North Am.* 2 (55), 187–209.
- Camare, C.A., 2010. Aesthetics in orthodontics: six horizontal smile lines. *Dental Press J. Orthod.* 1 (15), 118–131.
- Chiche, G., Pinault, A., 2004. Diagnosis and treatment planning of esthetic problems. In: *Esthetics of anterior prosthodontics*. Quintessence, pp. 13–25.
- Coachman, C., Calamita, M., 2012. Digital smile design: a tool for treatment planning and communication in esthetic dentistry. *Quintessence Dent. Technol.* 35, 103–111.
- Coachman, C., Calamita, M.A., Sesma, N., 2017. Dynamic documentation of the smile and the 2D/3D digital smile design process. *Int. J. Periodontics Restorative Dent.* 37 (2), 183–193.
- Coachman, C., Van Dooren, E., Gürel, G., Landsberg, C.J., Calamita, M.A., Bichacho, N., 2012. Smile design: from digital treatment planning to clinical reality. In: Cohen, M. (Ed.). *Interdisciplinary treatment planning*, vol. 2, comprehensive case studies. Quintessence, pp. 119–174.



- Cohen, S.E., 2007. Fundamentals of dental esthetics: analysis. In: Atlas of cosmetic and reconstructive periodontal surgery, third ed., PMPH, pp. 217–238.
- Culp, L., McLaren, E.A., Swann, L.C., 2013. Smile analysis: the photoshop smile design technique part 2. *J. Cosmet. Dent.* 2 (29), 94–108.
- Farias, F.O., Ennes, J.P., Zorzato, J.R., 2010. Aesthetic value of the relationship between the shapes of the face and permanent upper central incisor. *Int. J. Dent.* 1, 1–6.
- Feraru, M., Musella, V., Bichacho, N., 2016. Individualizing a smile makeover: current strategies for predictable results. *J. Cosm. Dent.* 32 (1), 109–114.
- Heasman, P., 2013. Orthodontics I: development, assessment and treatment planning. In: *Master Dentistry: Restorative Dentistry, Paed Den Orth.*, third ed., Churchill Livingstone.
- Helvey, G.A., 2007a. How to increase patient acceptance for cosmetic dentistry: cosmetic imaging with Adobe Photoshop Elements 4.0. *Dent. Today* 26 (2), 148–153.
- Helvey, G.A., 2007b. Computer-generated smile analysis: part 1. *Dent. Today* 26 (7), 148–152.
- Helvey, G.A., 2007c. Computer-generated smile analysis: part 2. *Dent. Today* 26 (8), 108–113.
- Iliev, G., 2016. Personalized digital smile design for predictable aesthetic results. *Balk J. Dent. Med.* 20, 172–177.
- Kurbad, A., Kurbad, S., 2013. Cerec smile design: a software tool for the enhancement of restorations in the esthetic zone. *Int. J. Comput. Dent.* 16 (3), 255–269.
- Magne, P., Belser, U., 2010. Natural oral esthetics. In: *Bonded Porcelain Restorations in the Anterior Dentition: A Biomimetic Approach*, first ed. Quintessence, pp. 57–98.
- McLaren, E.A., Culp, L., 2013. Smile analysis: the photoshop smile design technique part 1. *J. Cosmet. Dent.* 1 (29), 98–108.
- Morley, J., Eubank, J., 2001. Macroesthetic elements of smile design. *J. Am. Dent. Assoc.* 132 (1), 39–45.
- Naini, B.F., Gill, D.S., 2008. Facial aesthetics: 2. Clin assessment. *Dent. Update* 35, 159–170.
- Naini BF. Facial Symmetry and Assymetry, 2011. In: *Facial Aesthetics: Concepts and Clinical Diagnosis*, first ed., Wiley-Blackwell.
- Nascimento, D.C., Santos, E.R., Machado, A.W.L., Bittencourt, M.A. V., 2012. Influence of buccal corridor dimension on smile esthetics. *Dental Press J Orthod.* 17 (5), 145–150.
- Paolucci, B., Calamita, M., Coachman, C., Gurel, G., Shayder, A., Hallawell, P., 2012. Visagism: the art of dental composition. *Quintessence of Dental Technology*, pp. 1–14.
- Patel, A., Chapple, I., 2015. Periodontal Aspects of Esthetic Dentistry: Managing Recession Defects. In: Wilson, N. (Ed.), *Princ Pract of Esth Dent*, first ed., Elsevier, pp. 137–163.
- Patnaik, V.V.G., Singla Rajan, K., Bala, S., 2003. Anatomy of a “beautiful face & smile”. *J. Anat. Soc. India* 52 (1), 74–80.
- Pawar, B., Mishra, P., Banga, P., Marawar, P., 2011. Gingival zenith and its role in redefining esthetics: a clinical study. *J. Indian Soc. Periodontol.* 15 (2), 135–138.
- Pedrosa, V.O., Franca, F.M., Florio, M.F., Basting, R.T., 2011. Study of the morpho-dimensional relationship between the maxillary central incisors and the face. *Braz. Oral. Res.* 25 (3), 210–216.
- Prato, G.P., Rotundo, R., Cortellini, P., Tinti, C., Azzi, R., 2004. Interdental papilla management: a review and classification of the therapeutic approaches. *Int. J. Period Rest Dent.* 24 (3), 246–255.
- Prendergast, P., 2012. Facial proportions. In: *Advanced Surgical Facial Rejuvenation*. Springer, pp. 15–22.
- Priya, K., Rahul, D.P., Varma, S., Namitha, R., 2013. Norms for crafting a beautiful smile. *Amirta J. Med.* 2 (9), 4–9.
- Rifkin, R., 2000. Facial analysis: a comprehensive approach to treatment planning in aesthetic dentistry. *Pract. Periodont. Aesthet. Dent.* 12 (9), 865–871.
- Rihal, A., Dumore, T., Rykiss, L., 2017. Advantages of digital smile design: a case study. (August 2017) Extracted from: <<https://www.oralhealthgroup.com/features/advantages-digital-smile-design-case-study/>> .
- Sharma, A., Luthra, R., Kaur, P., 2015. A photographic study on Visagism. *Indian J. Oral Sci.* 6 (3), 122–127.
- Ungureanu, L., Leon, A., 2014. Esthetic dentistry: a permanent challenge. *Ovidius Dent. J.* 1 (1), 27–35.
- Vaidya, N., Seth, V., Shankar, S., 2014. Concepts of dentofacial esthetics: an overview. *Indian J. Dent. Sci.* 4 (6), 137–140.
- Vassantha Kumar, M., Ahila, S.C., Suganya Devi, S., 2011. The science of anterior teeth selection for a completely edentulous patient: a literature review. *J. Indian Prosthodont. Soc.* 11 (1), 7–13.
- Ward, H.D., 2015. Proportional smile design using: the recurring esthetic dental proportion to correlate the widths and lengths of the maxillary anterior teeth with the size of the face. *Dent. Clin. North Am.* 59 (3), 623–638.
- Zaccaria, M., Squadrito, N., 2015. Photographic-assisted prosthetic design technique for the anterior teeth. *Int. J. Esthet. Dent.* 10 (1), 48–67.