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Digital smile design as a communication tool for predictable clinical results: An update and review

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Abstract

Increasing aesthetic preferences and technological changes in dentistry have occurred over time, resulting in predictable, more aesthetic and more functional results. First, the development of digital dentistry, especially the CAD/CAM systems, following these developments, the ability to make smile designs with the effect of digitalization in anterior restorations led to the emergence of reliable and more guaranteed restorations for both the patient, dentist and dental technician. This review summarizes the information and offers suggestions with features to be considered in digital smile design and digital smile design software.

Keywords: dental aesthetic, digital dentistry, digital smile design, smile design software

1. Introduction

These days patients prefer dental and medical treatments for aesthetic purposes (Samorodnitzky-Naveh et al., 2007). While protecting the health, function of teeth and soft tissues in restorations made with conservative approaches in aesthetic dentistry, it is aimed to create a new smile with the most natural effect (Gürel, 2003; Iliev, 2016). The results of medical and dental anamnesis, clinical examination, photographs, and study models reveal a suitable diagnosis and treatment plan for aesthetic dentistry, but these are not enough to analyze the patient's smile. In addition, at the start of treatment, it is necessary to determine the relationship between the face, lips, teeth, and gingiva while accessing their function for predictable results with the final product (Coachman et al., 2017; Goldstein et al., 2018). For this purpose, Digital Smile Design software is a useful tool to show the possibilities of increasing the smile of the patient by creating an esthetic treatment scheme (McLaren et al., 2013). This software provides excellent communication between the dentist and the patient, while providing the dentist with an ideal means of communication with the dental technician by choosing the right treatment through algorithms. Dental process planning keeps a digital pathway so the patient can observe the outcomes before the process begins. These processes provide correct layout and guarantee aesthetic, functional and predictable results. (Moss et al., 2005; Ahrberg et al., 2016). At the same time, digital systems enable the dentist to follow-up and evaluate the patient during the treatment period (Mehl et al., 2013).

The aim of this study is to enlighten dentists about digital smile design parameters and current digital smile design software.

2. What is the smile design?

The smile design is the combination of aesthetic principles that make facial aesthetics compatible with the dentogingival structures (Davis, 2007). Or, more simply, it can often be described as the aesthetic treatment of anterior teeth in the visible aesthetic region (Zimmermann and Mehl, 2015). These aesthetic concepts were created with information gathered from cases, diagnostic moulds, photographic records, scientific dimensions, and fundamental aesthetic beauty principles (Davis, 2007).

The digital smile design starts with properly captured photos. It allows for a comprehensive workflow that simulates the patient's treatment process. Facial application is generally completed by applying guidelines which standardized parameters are improved for the front and profile look of the face. The process of designing a smile relates to various anatomic areas concerned in the process such as teeth, gingiva, mucous membranes, lips and skin based on symmetry, shape and golden ratios (Cervino et al., 2019).

3. Aesthetic concepts

The basic concepts for aesthetic analysis have been reported to be facial, dentogingival and dental aesthetics (Magne and Belser, 2010; McLaren and Culp, 2013). The American

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Academy of Cosmetic Dentistry mentioned the artistic parameters of the smile design in order to reproduce nature aesthetically (Blitz et al., 2001). Smile aesthetics is about color, shape, texture, tooth alignment, gingival contour, and their relationship with the face (Levin, 1978; Morley and Eubank, 2001; Frese et al., 2012). To plan a proper aesthetic rehabilitation, it is necessary to meet the expectations of the patients at the end of the treatment considering all these parameters (Meereis et al., 2016).

3.1. Facial features

Facial aesthetics are supported standardized aesthetic rules that include correct alignment, proportion and dimensions of the face (Davis, 2007). Facial examination is accomplished using guidelines in which standardized features are improved for the anterior and profile look of the face. Horizontal guidelines applied to the anterior examination comprises of interpupillary and intercomissural lines (Chiche and Pinault, 2004; Cohen, 2007). Vertical guidelines comprise of the facial, dental and mandibular midlines, which are very significant in defining the amount of symmetry of the face (Naini, 2011) (Fig. 1). The more symmetry between the right and left sides of the face is seen as a face closer to perfection. The dentist should visualize and record the vertical and horizontal lines to assess the existing symmetry on the patient's face. In the final assessment, it was stated that the relationship of the patient's face and teeth will be determined with this record (Calamia and Wolf, 2015).

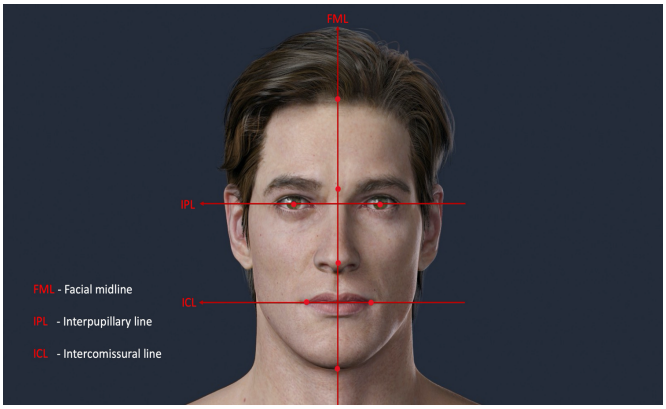

Fig. 1. Anatomical lines (vertical and horizontal guide lines) related to face using in digital smile design

Another important factor in facial aesthetics is lip dynamics. The upper and lower lips are the frame of the smile, which include the teeth and gingiva. Soft tissue markers of this frame are lip width, intercommissure width, interlabial space, smile index (width/height) and gingiva (Ackerman and Ackerman, 2002). The condition of the lips at rest should be analyzed in terms of lip structure during the lower and upper lip contact and smile, which determines to what extent tooth and gingiva appear. It has been reported that lip assessment can also be useful to reveal tooth and tissue asymmetries or defects (Blitz et al., 2001).

The lip line is an important determinant of the amount of visible incisal edge screen (Tian et al., 1984). In the absence of dental abrasion in the resting position, it has been reported that the visible incisal edge of the lips and maxillary central incisors should be 2 to 4 mm, and this distance may differ greatly depending on the age and gender of the patient (Vig and Brundo, 1978). In addition, for a nice smile, the smile line described as a fictional line figured throughout the incisal edges of the upper jaw front teeth is also an important factor. In optimal dental placement, this line should pursue the curvature of the lower lip (Ahmad, 1998).

3.2. Dentogingival features

Dentogingival features comprise of gingiva health and morphology like gingiva shape and contour, free gingival position, the position of the gingival zenith, color and pigmentation of the gingiva, position of the papilla, gingival line, buccal corridor dimensions, inflammation status, interdental papilla status and black triangle formation (Prato et al., 2004; Magne and Belser, 2010; Camare, 2010; Pawar et al., 2011; Nascimento et al., 2012; Priya et al., 2013; Patel and Chapple, 2015) (Fig. 2). A dentist should pay attention to these parameters while designing a smile. Designing the teeth within the limits of the gingival architecture significantly affects the aesthetics of the smile. Irregular papillary position on the anterior teeth or inflamed gingiva can have a dramatic effect on aesthetics. While some details may seem negligible, even a small black triangle can disrupt all efforts to create a beautiful smile (Batra et al., 2018).

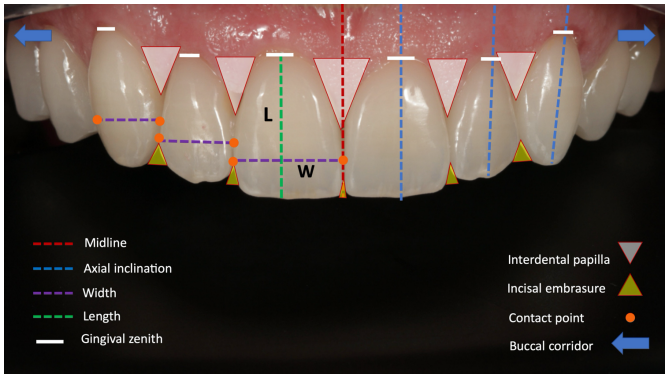

Fig. 2. Dental and gingival landmarks using in digital smile design

3.3. Dental features

The position, form, size and color of the maxillary anterior teeth are very important in terms of the aesthetic results of the smile design (Feraru et al., 2016). Some anterior teeth are in flatter form, while others are in a more convex form. Or some teeth have a rectangular look, while others have a more oval look. Different features such as these are indicative of the smile specificity of the patient (Dawson, 1974). It is considered by some researchers that the width of maxillary central incisors should be between 75-86% in length (Dickerson, 1996; Magne and Belser, 2003; Chu, 2007). The length of the teeth has also been reported to affect aesthetics. It is stated that the length of maxillary central incisors is between 10-22 mm on average (Magne et al., 2003). The midline identifies a vertical line shaped by the contact of the maxillary central incisors. It is asserted that the midline should be orthogonal to the incisal plane and concurrent or overlapping the midline of the face

(Miller et al., 1979). When viewed from the front, the axial inclination of the anterior teeth tends to incline towards the midline, making it more prominent from the central incisors to the canine teeth. It is very important in terms of appearance that the maxillary anterior teeth are proportional to each other. Many dentists accept and apply the Golden Ratio principles stated by Lombardi and then improved by Levin (Rufenacht Claude, 1990). With the ideal arrangement of anterior six teeth of these ideal sizes, an open space is formed between the contact points and the proximal surfaces of the incisal edges. This area is expressed as incisal embrasure. These embrasures end at the point where they touch the adjacent teeth. Incisal embrasures should show gradual improvement from the central tooth to the posterior (Wheeler, 1965) (Fig. 2).

In view of tooth color, there are four main features (value, hue, chroma and translucency) and features like structure and brilliance that could reform the impression of dental form and value (Culp et al., 2013). Color selection in smile design should be customized according to the satisfaction of each patient. It has been mentioned that informing the patient about the general rules for the natural appearance of the teeth and the color selection can also be favourable to meet the patient's hope in a realistic way (Blitz et al., 2001).

4. Esthetic rehabilitation

One of the most remarkable innovations in dentistry is the emergence of Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) technology. This technology enables dentists to replicate from an anatomical and functional perspective and achieve remarkable results (Moss et al., 2005; Ahrberg et al., 2016). Digital dentistry includes high- and low-resolution data, 3D photos and various programs that allow dentists to collect data and create digital restorations and digital patients using various data (Ringer, 2007; Beuer et al., 2011). Digital Smile Design is one of these programs. Providing an effective communication between the patient-dentist-dental technician, the program is an excellent tool for correct detection of problems, visualization of possible solutions, and thus balancing expectations and increasing mutual trust. With the help of the photo protocols taken with certain parameters on the face, the dentist can identify and emphasize inconsistencies in face, dentogingival and dental morphology, discuss treatment options with magnified images on the monitor, and find the best solution (Fig. 3). Thus, by determining which material to use with the appropriate treatment option and communicating to the dental technician, both the treatment cost is reduced and time saving is achieved (Coachman et al., 2012; www.dentalphotomaster.com, 2020). In addition, it is possible to make comparisons between drawings and reference lines and before and after images by evaluating the results obtained at each stage of treatment (Goodlin, 2011; Coachman and Calamita, 2012; McLaren et al., 2013; Lin et al., 2015) (Fig. 4). In recent years, as technology advances, many software programs have been developed to be used in digital smile design for aesthetic rehabilitation. These software programs provide a stronger diagnostic and therapeutic predictability in the analysis of features that can be overlooked regarding the patient's face and teeth in clinical evaluation (Coachman and Calamita, 2012).

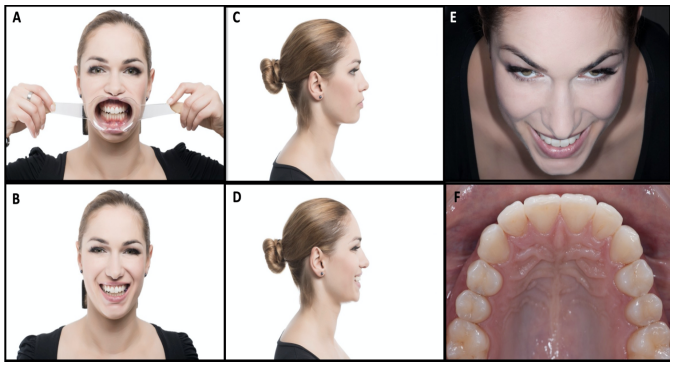

Fig. 3. Photo protocol for digital smile design. A: Front view with teeth retracted. B: Front view with full-smile. C: Profile with lips and teeth in contact. D: Profile with full-smile. E: 12 o'clock photo. F: Occlusal view of the upper arch. (www.dentalphotomaster.com, 2020)

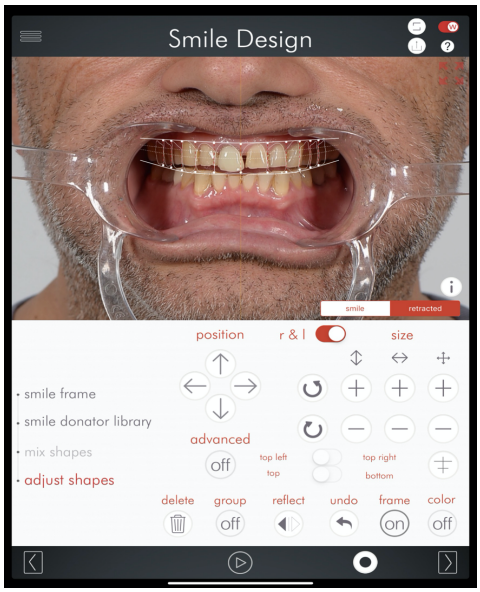

Fig. 4. It is possible to make comparisons between drawings and reference lines with softwares

5. Digital smile design software

5.1. Coachman (DSDApp LLC)

The DSD application was advanced by Coachman, who formerly announced research on using Keynote for digital smile design. Three photo views are required. Photos with full face and only teeth are taken, the first at maximum smile, the second at rest. Thirdly, a retracted full maxillary arch photograph is taken. In addition, at the same time, the video containing all feasible tooth and smile situations, including 45 degrees and profile views, are taken. Then the recorded photos and videos are added to the slide presentation. Smile designs can be realized in presentation software such as Keynote or Microsoft PowerPoint. This advanced visualization makes it easy to choose the ideal restorative technique (Coachman and Calamita, 2012) (Fig. 5-A).

Fig. 5. Digital smile design softwares. A: Coachman (DSDApp LLC). B: Planmeca Romexis Smile Design (PRSD). C: Smilecloud, ADN3D Biotech. D: Smile Designer App

5.2. Planmeca romexis smile design (PRSD)

Planmeca Romexis Smile Design software, which was released in 2015 and gives the opportunity to make smile design in a very short time, does not need any extra supportive program to run on Windows and MacOS. First of all, when the patient smiles naturally, full face photographs are taken from the anterior region. The software then creates a tooth image with automatically determined W/L ratios. It is stated in the program that these tooth images can be edited for a maximum of 14 teeth and five different character types. In the software containing the VITA Classical and VITA 3D-Master tooth shades (Vita) in its library, the colors of the existing teeth can be defined and cooperated with virtual diagnostic wax-up thanks to a Color Picker tool (Zimmermann and Mehl, 2015) (Fig. 5-B).

5.3. Smilecloud, ADN3D biotech

Smile Cloud, a new cloud-based technology platform, gives users the opportunity to store patients' medical data, personal data, photos, videos, intraoral scanners (STL) or cone beam computed tomography scanners (CBCT), and radiographs. After the necessary loading is done, the artificial intelligence finds the proper shape of the teeth and aligns. The dentist can change this design if she/he wishes. It can also be used for the STL file for mock-up model, preparation and surgical guidance (Chen et al., 2020) (Fig. 5-C).

5.4. Smile designer app

Smile Design App, the online digital smile design software, uses the "Smile Design Algorithm" method coded quickly and easily. In this "Smile Design Algorithm" system, not only the face and teeth feature of the patient, but also information such as "which profession the patient has" or "character characteristics of the patient" are also recorded. It has been reported that the smile design for all CAD/CAM systems of this software can export PNG image output, the pre-designed STL outputs of tooth models can be printed with 3D printers (www.smiledesigner.app, 2020) (Fig. 5-D).

5.5. Smile designer pro

This digital smile design program, specially designed for use in the field of dentistry, needs additional photos as well as a front-face smile photo. The software, which has limited features in terms of front and profile aesthetic parameters, has been reported to have five ready-made templates for determining tooth forms and the software is similar to the Photoshop program in terms of design and interface (Zimmermann and Mehl, 2015; Omar and Duarte, 2018) (Fig. 6-A).

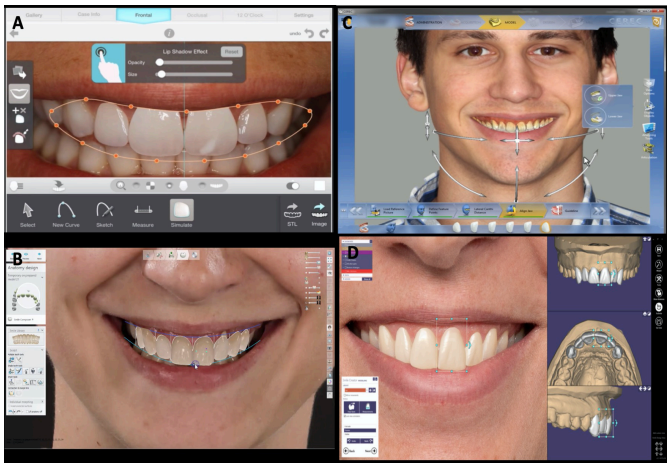

Fig. 6. Digital smile design softwares. A: Smile Designer Pro. B: 3Shape Smile Design (PRSD). C: Cerec SW. D: Exocad Smile Creator

5.6. 3Shape smile design

3Shape Smile Design uses the principles of Digital Smile Design (DSD) and a smile design is made directly over the 2-dimensional picture taken from the patient. The software allows the patient, dentist and dental technician to evaluate directly from the same photo, while technicians then transmit patient-approved smile designs to the 3Shape Dental System software to complete the procedures. In the system using the Real View engine, the 2D image is combined with the 3D digital image from the scanner. Before the completion of the restoration, the mock-up model can be produced upon the request of the dentist (www.3shape.com, 2020) (Fig. 6-B).

5.7. Cerec SW

It has been reported that Cerec SW software can control many steps and algorithms with artificial intelligence. Full face image is required for the software, which provides marginal compatibility of multiple preparations and clearer models. After uploading the file to the software, it was stated that 16 important points should be specified in the image. Then, after making various calibrations by the software using these points, the 2D image is converted to 3D. The Cerec Smile Design tool is located on the toolbar and can be activated during the CAD design process (Zimmermann and Mehl, 2015; Skramstad, 2020) (Fig. 6-C).

5.8. Exocad smile creator

With the Smile Creator integrated into the Chairside CAD platform, the photos taken using existing patient photos or webcams are automatically converted into 3D objects and then synchronized with 3D scans of the teeth. With the guided

workflow and extensive library, it is stated that a smile can be created using 2D shapes and then it can be converted into 3D images (www.exocad.com, 2020) (Fig. 6-D).

6. Conclusion

Digital smile design is an instrument that can help the dentist from the first session to the last, provide an understanding of aesthetic problems, and produce reliable and predictable results for the trio of patient-dentist-dental technician. Using the digital software technologies, the dentist can evaluate the patient's anterior tooth region and include the smile analysis in routine treatment planning.

References

1. Ackerman, M.B., Ackerman, J.L., 2002. Smile analysis and design in the digital era. J. Clin. Orthod. 36, 221-236.
2. Ahmad, I., 1998. Geometric considerations in anterior dental esthetics: restorative principles. Pract. Periodontics Aesthet. Dent. 10, 813-822.
3. Ahrberg, D., Lauer, H.C., Ahrberg, M., Weigl, P., 2016. Evaluation of fit and efficiency of CAD/CAM fabricated all-ceramic restorations based on direct and indirect digitalization: A double-blinded, randomized clinical trial. Clin. Oral Investig. 20, 291-300.
4. Batra, P., Daing, A., Azam, I., Miglani R., Bhardwaj A., 2018. Impact of altered gingival characteristics on smile esthetics: Laypersons' perspectives by Q sort methodology. Am J. Orthod. Dentofacial Orthop. 154, 82-90.
5. Beuer, F., Schweiger, J., Edelhoff, D., Sorensen, J.A., 2011. Reconstruction of esthetics with a digital approach. Int. J. Periodontics Restorative Dent. 31, 185-193.
6. Blitz, N., Steel, C., Willhite, C., 2001.Diagnosis and treatment evaluation in cosmetic dentistry: A guide to accreditation criteria. Madison (WI). AACD. 8-47.
7. Calamia, J. R., Wolff, M. S., 2015. The components of smile design: New York University smile evaluation form revisited, update 2015. Dent. Clin. North Am. 59, 529-546.
8. Camare, C.A., 2010. Aesthetics in orthodontics: Six horizontal smile lines. Dental Press J. Orthod. 1, 118-131.
9. Cervino, G., Fiorillo, L., Arzukanyan, A.V., Spagnuolo, G., Cicciu, M., 2019. Dental restorative digital workflow: Digital smile design from aesthetic to function. Dent. J. (Basel). 7, 30.
10. Chen, Y.W., Stanley, K., Att, W., 2020. Artificial intelligence in dentistry: Current applications and future perspectives. Quintessence Int. 51, 248-257.
11. Chiche, G., Pinault, A., 2004. Diagnosis and treatment planning of esthetic problems. In: Esthetics of anterior prosthodontics. Chicago, IL: Quintessence; 13-25.
12. Chu, S.J., 2007. A biometric approach topredictable treatment of clinical crown discrepancies. Pract. Proced. Aesthet. Dent.19, 401-409.
13. 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. Interdisciplinary treatment planning. Vol II: Comprehensive case studies. Chicago, IL: Quintessence. 119-174.
14. Coachman, C., Calamita, M., 2012. Digital smile design: A tool for treatment planning and communication in esthetic dentistry. Quintessence Dent. Technol. 35, 103-111.
15. 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, 183-193.
16. Cohen, S.E., 2007. Fundamentals of dental esthetics: Analysis. In: Atlas of cosmetic and reconstructive periodontal surgery, Third ed., PMPH, 217-238.
17. Culp, L., McLaren, E.A., Swann, L.C., 2013. Smile analysis: The photoshop smile design technique part 2. J. Cosmet. Dent. 2, 94-108.
18. Davis, N.C., 2007. Smile design. Dent. Clin. North Am. 51, 299-318.
19. Dawson, PE., 1974. Evaluation, diagnosis and treatment of occlusal problems. The C. V, Mosby Company. p. 173.
20. Demand for Botox, fillers drives, US cosmetic surgery growth, 2013. [Online]. Available at: http://www.foxnews.com/health/2013/02/20/demand-for-botox-fillers-drives-us-cosmetic-surgery-growth/. (Accessed: 21 April 2020).
21. Dickerson, W.G., 1996. Cooperative treatment planning in creating IPS Empress SMILES. Signature. 2-8.
22. Feraru, M., Bichacho, N., Muzella, V., 2016. Individualizing a smile makeover. Current strategies for predictable results. J. Cosmet. Dent. 32, 109-119.
23. Frese, C., Staehle, H.J., Wolff, D., 2012. The assessment of dentofacial esthetics in restorative dentistry: A review of the literature. J. Am. Dent. Assoc. 143, 461-466.
24. Goldstein, R.E., Chu, S.J., Lee, E.A., Stappert, C.F.J., 2018. Goldstein's Esthetics in Dentistry, 3rd ed., Willey-Blackwell.
25. Goodlin, R., 2011. Photographic-assisted diagnosis and treatment planning. Dent. Clin. North Am. 55, 211-227.
26. Gürel, G., 2003. Predictable, precise, and repeatable tooth preparation for porcelain laminate veneers. Pract. Proced. Aesthet Dent. 15, 17-26.
27. Iliev, G., 2016. Personalized Digital Smile Design for Predictable Aesthetic Results. Balk. J. Dent. Med. 20, 172-177.
28. Levin, E.I., 1978. Dental esthetics and the golden proportion. J. Prosthet Dent. 40, 244-252.
29. Lin, W., Zandinejad, A., Metz, M., Harris, B., Morton, D., 2015. Predictable restorative work flow for computer aided design/computer-aided manufacture-fabricated ceramic veneers utilizing a virtual smile design principle. Oper. Dent. 40, 357-363.
30. Magne, P., Belser, U., 2003. Bonded porcelain restorations in the anterior dentition: A biomimetic approach. Quintessence Publishing Co. Inc. 57-96.
31. Magne, P., Gallucci, G.O., Belser, U.C., 2003. Anatomic crown width/length ratios of unworn and worn maxillary teeth in white subjects. J. Prosthet Dent. 89, 453-461.
32. Magne, P., Belser, U., 2010. Natural oral esthetics. In: Bonded porcelain restorations in the anterior dentition: A biomimetic approach. Quintessence Publishing Co. Inc. 1, 57-98.
33. McLaren, E.A., Garber, D.A., Figueira, J., 2013. The photoshop smile design technique (part 1): Digital dental photography. Compend. Contin. Educ. Dent. 34, 772-776.
34. McLaren, E.A., Culp, L., 2013. Smile analysis: The photoshop smile design technique part 1. J. Cosmet. Dent. 1, 98-108.
35. Meereis, C., De Souza, G., Albino, L., Ogliari, F., Piva, E., Lima, G., 2016. Digital smile design for computer-assisted esthetic rehabilitation: Two-year follow-up. Oper. Dent. 41, 13-22.
36. Mehl, A., Koch, R., Zaruba, M., Ender, A., 2013. 3D monitoring and quality control using intraoral optical camera systems. Int. J.

Comput. Dent. 16, 23-36.

37. Miller, E.C., Bodden, W.R., Jamison, H.C., 1979. A study of the relationship of the dental midline to the facial midline. J. Prosthet Dent. 41, 657-660.

38. Morley, J., Eubank, J., 2001. Macroesthetic elements of smile design. J. Am. Dent. Assoc. 132, 39-45.

39. Moss, B.W., Russell, M.D., Jarad, F.D., 2005. The use of digital imaging for color matching and communication in restorative dentistry. Br. Dent. J. 199, 43-49.

40. Naini B.F., 2011. Facial symmetry and assymetry. In: Facial aesthetics: Concepts and clinical diagnosis, first ed., Wiley-Blackwell.

41. 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, 145-150.

42. Omar, D., Duarte, C, 2018. The application of parameters for comprehensive smile esthetics by digital smile design programs: A review of literature. Saudi Dent. J. 30, 7-12.

43. Patel, A., Chapple, I., 2015. Periodontal aspects of esthetic dentistry: Managing recession defects. In: Wilson, N. (Ed.), Principles and practice of esthetic dentistry, first ed., Elsevier, pp. 137-163.

44. 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, 135-138.

45. Prato, G.P., Rotundo, R., Cortellini, P., Tinti, C., Azzi, R., 2004. Interdental papilla management: A review and classification of the therapeutic approaches. The International Int. J. Periodontics Restorative Dent. 24, 246-255.

46. Priya, K., Rahul, D.P., Varma, S., Namitha, R., 2013. Norms for crafting a beautiful smile. Amirta J. Med. 2, 4-9.

47. Ringer, J., 2007. Digital smile enhancement: A essential modality for any successful cosmetic practice. Dent. Today. 26, 84-89.

48. Rufenacht Claude, R., 1990. Fundamentals of esthetics. Quintessence publishing Co.; 1990. pp. 73-138.

49. Samorodnitzky-Naveh, gR., Geiger, S.B., Levin, L., 2007. Patients' satisfaction with dental esthetics. J. Am. Dent. Assoc. 138, 805-808.

50. Skramstad, M., 2020. Smile design with primescan and CEREC 5.0 Software [Online]. Available at: https://my.cerec.com/en-us/Topics/smile-design-with-primescan-and-cerec-5-0-software.html (Accessed: 21 April 2020).

51. Tjan, A.H., Miller, G.D., The, J.G., 1984. Some esthetic factors in a smile. J. Prosthet Dent. 51, 24-28

52. Vig, R.G., Brundo, G.C., 1978. The kinetics of anterior tooth display. J. Prosthet Dent. 39, 502-504.

53. Wheeler, R.C., 1965. A textbook of dental anatomy and physiology. W.B. Saunders; pp. 102-131.

54. www.dentalphotomaster.com, 2020. Six basic shots for Digital Smile Design. [Online]. Available at: https://www.dentalphotomaster.com/six-basic-shots-for-digital-smile-design/ (Accessed: 29 April 2020).

55. www.exocad.com, 2020. Smile Creator. [Online]. Available at: https://exocad.com/our-products/exocad-dentalcad/smile-creator (Accessed: 21 April 2020).

56. www.3shape.com, 2020. Smile Design Software history [Online]. Available at: https://www.3shape.com/en/software/trios-smile-design (Accessed: 21 April 2020).

57. www.smiledesigner.app, 2020. Smile Designer App Artificial Intelligence Smile Design [Online]. Available at: http://www.smiledesigner.app (Accessed: 21 April 2020).

58. Zimmermann, M., Mehl, A., 2015. Virtual Smile Design Systems: A Current Review. 18, 303-317.