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CLINICAL ARTICLE

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DSDapp use for multidisciplinary esthetic planning

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Abstract

Objectives: Digital smile design (DSD) is useful in planning multidisciplinary esthetic treatments. However, DSD requires clinician training and skill to ensure its effective use. The Digital smile design application (DSDapp) was recently developed, to facilitate such planning. The objective of this study was to illustrate the use of the DSDapp for esthetic planning in a clinical case that included periodontal plastic surgery and ceramic laminate veneers.

Clinical considerations: An intraoral digital scan was performed, and a photograph was obtained using an iPad (frontal facial full smile). The images were analyzed using the DSDapp. All reference lines were inserted, and dental shapes predetermined by the app were superimposed on the photographs. A digital diagnostic wax-up was performed considering the plan created in the DSDapp. After 3D printing the wax-up, a mock-up transferred the planning to the oral cavity. Following this, the patient was referred to a periodontist for the periodontal plastic surgery. After the healing period, the teeth were prepared for computer-aided design/computer-aided modeling lithium disilicate ceramic laminate veneers.

Conclusions: DSDapp use accelerated the initial planning steps. Smile planning can be performed during the clinical session with the patient's active participation. In addition, the DSDapp facilitated better communication within the multidisciplinary team.

Clinical significance: The DSDapp relies more on intuition than on skill and training to execute the treatment plan. The DSDapp provides immediate feedback to the patient, offering greater predictability and helps monitor the planning through all the clinical stages.

KEYWORDS

CAD/CAM, ceramics, digital dentistry, laboratory technology, prosthodontics

1 | INTRODUCTION

The art of planning is a fundamental component for the success of any medical treatment, especially when it comes to esthetics.[1,2,3] Disharmony between the hard and soft tissues can cause embarrassment when smiling and restlessness in others.[4,5] To solve the patient's concerns and questions, a thorough facial evaluation and mapping of the areas that cause discomfort are necessary.[6,7] In this context, dental planning using the digital smile design (DSD) software can help resolve complex cases.[8,9] DSD allows greater predictability of the outcomes and facilitates communication with the patient from preestablished facial photographs and digital drawings.[8,9] However, despite its innovative potential, the use of DSD requires clinician training and skill to ensure its effective use.[1,10]

This technique was recently simplified with the DSD application (DSDapp by Coachman)[11] for the iOS platform. The app allows planning within a few minutes and does not require much skill to use. The patient's photographs can be obtained directly from the iPad or imported from other photography sources and intraoral scans. The facial and dental reference lines can be immediately defined over the patient's facial photograph to ensure that critical observations are not ignored.[1,6] Therefore, a great advantages of using the DSDapp is that planning can be performed during the first clinical session.

Additionally, planning occurs with the active participation of the patient. The use of traditional DSD and other digital planning tools requires more execution time, making it difficult to perform in a single session.[12] Thus, the DSDapp decreases the number of clinical sessions with immediate patient feedback.[8]

In digital planning, it is necessary to consider some fundamental aspects of the treatment plan to minimize possible failures and achieve expected results.[13,14] The size, shape, proportionality, and color of the teeth are points to be analyzed.[1,10] Other factors such as midline deviations, maxillary inclination, and the relationship between the teeth, gums, and lips should also be taken into consideration.[10] Changes or discrepancies not observed clinically can be diagnosed in the DSDapp, with the possibility of planning their corrections.

The digital planning can also be enhanced by using a complete digital workflow with intraoral scanning and wax-up, minimizing flaws, and distortions.[15] When there is an association between DSD and intraoral scanning for ceramic veneers with previous periodontal surgery, the chances of possible changes in the case are minimized.[3,16] Digital wax-up favors the reproduction of the DSD previously approved by the patient.[12] Therefore, the periodontist and the dental technician can easily interpret the dentist's initial plan and reproduce the proposed treatment.[8,12]

A patient's opinion is imperative during any esthetic planning.[17,18] Therefore, tools that facilitate communication with the owner of the new smile are essential. The objective of the present study was to report a clinical case with a multidisciplinary approach to periodontal surgery and ceramic laminates in which the DSDapp and digital scanning were used for esthetic planning.

2 | CASE REPORT

A 25-year-old patient sought dental treatment with the complaint of gaps between her maxillary teeth and discrepancies when smiling. Intraoral clinical examination showed generalized diastemas and tooth size disproportion (width/length ratios). Excessive gingival display and asymmetry of the gingival margin due to the altered passive eruption were also diagnosed after periodontal probing and cone-beam computed tomography image analysis (Figure 1). The clinical case was planned in the DSDapp and continued in sessions/steps.

2.1 | Session 1, step 1: Intraoral scanning

A complete intraoral digital scan was performed (TRIOS 3; 3Shape, Madrid, Spain). This allowed the transformation of real dental structures into virtual images. An occlusal analysis was performed using the intraoral digital scanner (Figure 2). The intraoral digital scan was also used to carry out planning in the DSDapp.

2.2 | Session 1, Step 2: Digital smile planning using the DSDapp

The DSDapp requires the inclusion of two images for planning: a frontal facial full smile photograph and a close view of the smile. The

FIGURE 1 Initial clinical aspect
(A) Facial photography of the smile.
(B) Close-up photography of the smile revealing an excess of posterior gingival display and discrepancy between the gingival margins of the central incisors

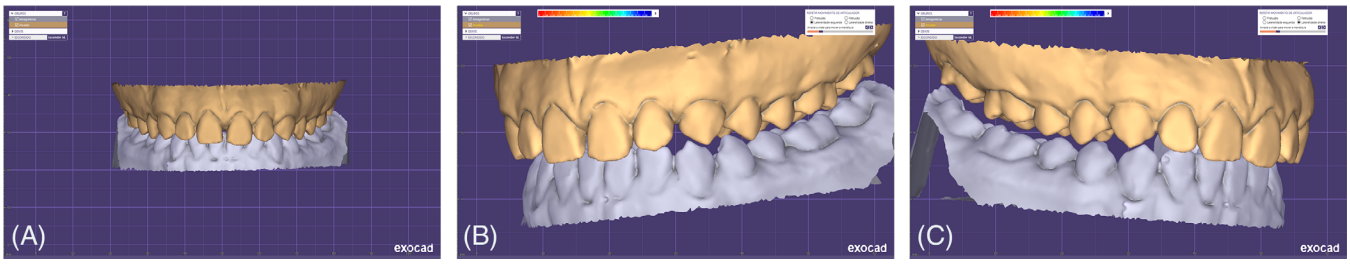
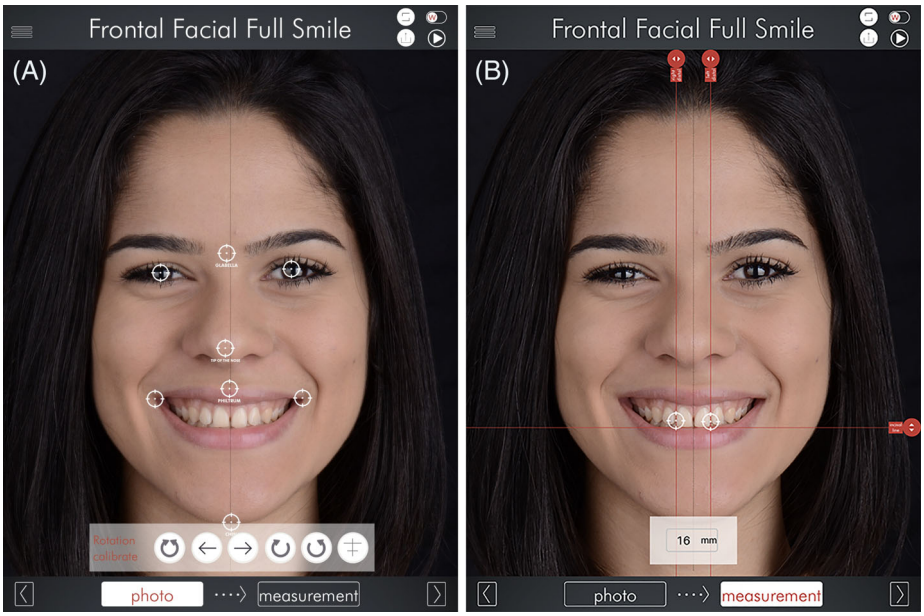


FIGURE 2 Occlusal analysis using the digital intraoral scan (A) Digital models obtained through the intraoral scan mounted on a digital articulator. (B, C) Lateral movements made by the digital articulator showing loss of canine guidance

FIGURE 3 Digital smile design application (DSDapp) interface (A) Facial analysis to determine the horizontal plane and facial midline references. (B) Reference lines to guide the intraoral scan position. At this step, it is possible to update the DSDapp with a reference of the tooth length and determine the distance between the distal aspects of the central incisors



images can be obtained through an iPad or imported from the intraoral digital scan. The app offers the functionality of superimposing the intraoral digital scan, and this image works as a close view of the smile photograph, enhancing the precision. In this case, the facial photograph was taken using an iPad, and an intraoral scan was used for a close view of the smile.

The planning began with facial analysis using the frontal facial full smile photograph. Reference lines were then defined: (1) horizontal plane and (2) facial midline. For the study of the horizontal plane, intercomissural and interpupillary lines were used as references.[19] Facial midline was defined using the glabella and philtrum as references.[20] The intraoral digital scanning file was then superimposed on the facial photograph for proportionality analysis of the upper anterior teeth (Figure 3).

In the sequence, the gingival and incisal lines were defined. The gingival line will change depending on the patient's age and sex. Younger patients and female patients usually show more of the central incisors when the lip is at rest.[21] It is essential to highlight that all planned modifications at the incisal edge must undergo careful functional analysis.[22] The incisal lines and the curvature of the patient's smile were then traced with the insertion of points and outline of the teeth. Ideally, the smile curvature should stay in harmony with the curvature of the lower lip.[23] The only tooth that should touch the smile curve is the one that guides the lateral and protrusive movements of the jaw (Figure 4).

Subsequently, the dental shapes with drawings preestablished by the application were selected. The patient's face shape, opinion, gingival profile, and natural tooth shapes were considered to favor better harmonization of the smile/face ratio (Figure 5).

Then, the positioning of the dental formats were adjusted (Figure 6A), and adjustments were made for brightness, saturation, warmth, contrast, tint, and blur (Figure 6B).

A before/after planning simulation is the last step of the DSDapp. This step helps both the patient and the clinician to decide the most harmonic and esthetically pleasing smile. Upon patient's approval of the digital planning (Figure 7), treatment was performed as described.

2.3 | Session 2: Digital wax-up and mock-up

The images obtained in the planning using the DSDapp and the scans were sent to the laboratory (DSD Planning Center, Madrid, Spain) for

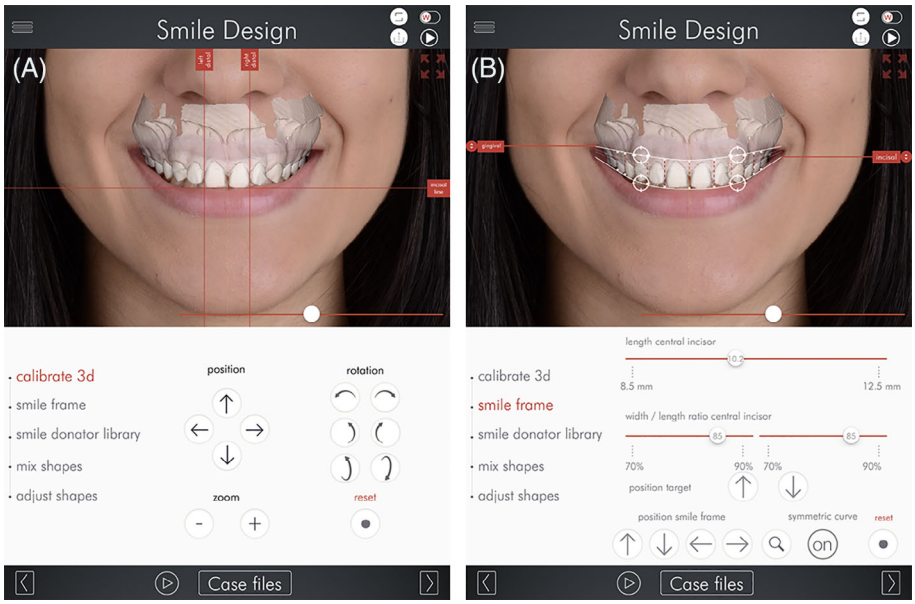


FIGURE 4 Digital smile design application (DSDapp) interface (A) Calibration of the digital intraoral (IO) scan with the facial photograph enhancing the measurement precision owing to its 3D nature. (B) Definition of the incisal edge of the central incisors, tooth dimensions, and smile curvature. The smile frame will guide the position of the dental format. All options can be changed even when the entire process is completed

FIGURE 5 Digital smile design application (DSDapp) interface (A) In the smile library, it is possible to choose among several dental formats. (B) It is also possible to mix the tooth anatomies to better harmonize with the patient's smile

a digital wax-up. A study model was prototyped from the waxing on a 3D printer (Form 2, Formlabs, Massachusetts). Using the DSDapp does not dismiss the need to perform a mock-up because it only generates 2D images of the smile simulation (Figure 8). The mock-up gives the patient a real perspective of the tooth size, shape, and volume. Therefore, it allows an esthetic analysis in a 3D view as well as functional and phonetic analysis.

A silicone index (Virtual, Ivoclar Vivadent, Schaan, Liechtenstein), made from the prototype model was filled with bis-acrylic resin (Systemp, Ivoclar Vivadent, Schaan, Liechtenstein) and positioned in the mouth. With the mock-up in place, the patient was able to evaluate the proposed treatment. All necessary occlusal adjustments were made.

After planning in the DSDapp and functional analysis with the mock-up, ceramic laminates along with periodontal plastic surgery were proposed. Once the patient accepted the treatment plan, the following steps were performed.

2.4 | Session 3: Periodontal plastic surgery

With the mock-up in place, the patient was referred to the periodontist. All images and the digital plan created in the DSDapp were also sent. Using the DSDapp makes it possible to quantify the thickness of gingival tissue that needs to be removed during periodontal plastic surgery (Figure 9A).

FIGURE 6 Digital smile design application (DSDapp) interface (A) Refinement of the tooth drawings position, length, width, and angulation. (B) Color adjustment

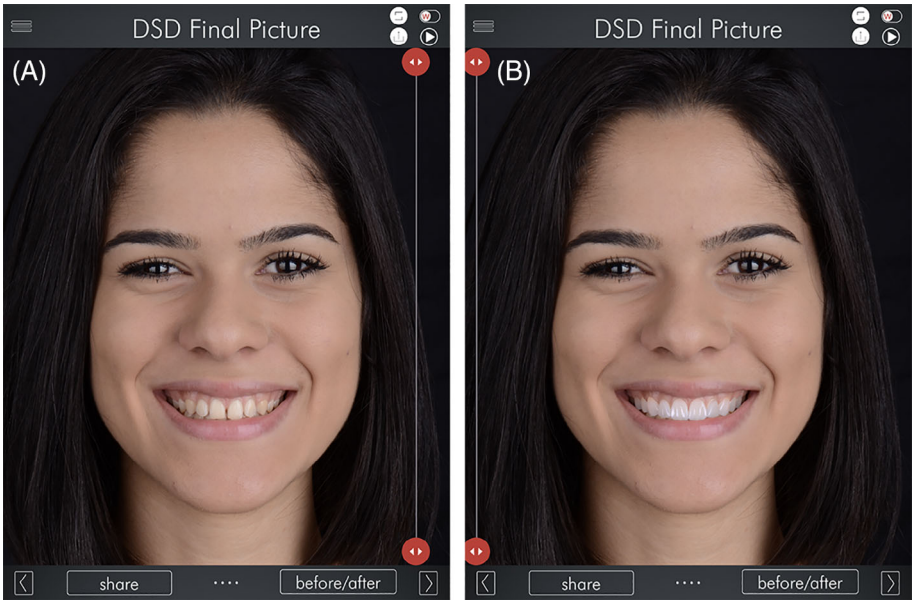


FIGURE 7 Digital smile design application (DSDapp) interface (A) Initial clinical aspect (B) After the digital planning

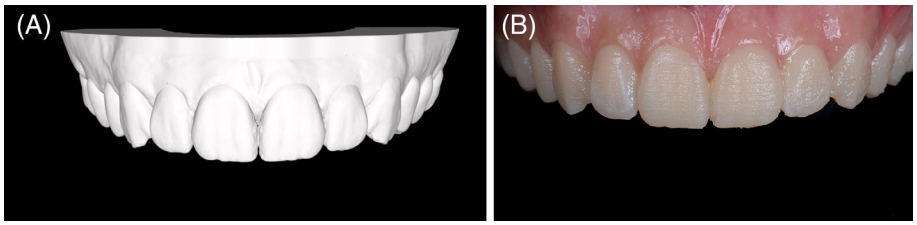


FIGURE 8 (A) Digital wax-up model guided by Digital smile design application (DSDapp) planning. (B) Mock-up fabricated using bis-acryl resin placed intraorally to analyze the esthetic, functional, and phonetic outcomes. This mock-up was also used to guide the periodontal plastic surgery

After local anesthesia, with the mock-up still in place, periodontal probing was performed. An osteotomy was performed only at the buccal surface using a flapless technique with a micro-chisel. This osteotomy technique was indicated due to the patient's thin tissue type. The bone morphology was respected, preserving the biological width (distance between the osseous crest and the base of the gingival sulcus). This surgical technique has the advantage of being conservative since there is no tissue detachment and no requirement for

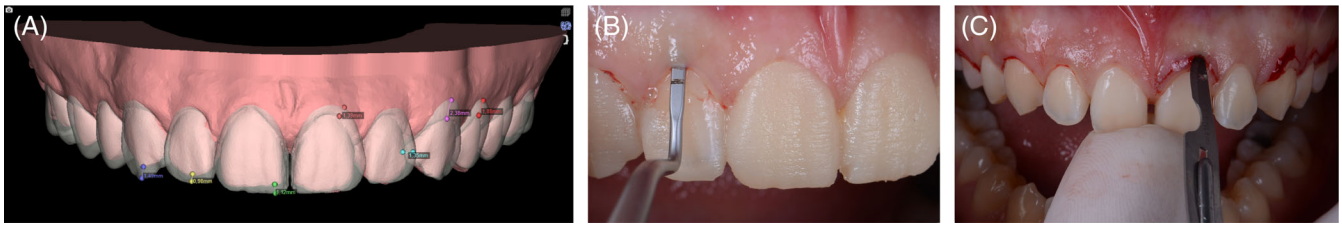


FIGURE 9 Periodontal surgical procedure (A) Surgical planning performed (B) Periodontal probing before the surgical procedure. (C) Internal bevel using a scalpel blade

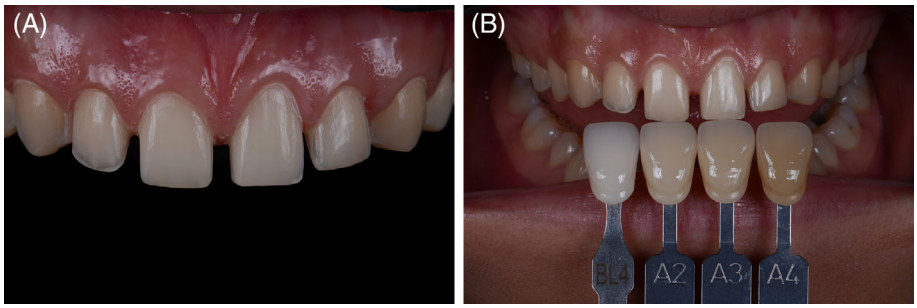


FIGURE 10 (A) Final aspect of the tooth preparation for ceramic laminate veneers. (B) Color communication with the dental technician

FIGURE 11 Functional photographs of the occlusion. (A) Protrusive movement (B, C) Lateral movements

sutures (Figure 9). A 30 day healing period was respected before proceeding to session 4.

2.5 | Sessions 4 and 5: Ceramic laminates

After gingival healing, a new digital intraoral scan was performed. A new wax-up with the new margins was manufactured to guide the tooth preparation process and the provisional phase.

Tooth preparations (0.3 mm average tooth reduction) were made for the ceramic laminate veneers using fine grit diamond burs coupled to a multiplier contra-angle handpiece (1:4.5). Preparations were made to define the finish lines for the ceramic laminates. Due to the presence of diastemas, the preparations also involved the interproximal area, ensuring a healthy environment for the papillae (Figure 10).

After the preparation was completed, a new intraoral scan was performed and sent to the lab to manufacture the ceramic laminate veneers. The ceramic laminate veneers were made in monolithic e.max lithium disilicate with a medium opacity and superficial stain characterization (IPS e.max Press MO, Ivoclar Vivadent, Schaan, Liechtenstein), milled in computer-aided design/computer-aided modeling (CAD/CAM), and cemented with light-cured resin cement (Variolink Esthetic, Ivoclar Vivadent, Schaan, Liechtenstein). Occlusal adjustments were made, and disocclusion guides were verified (Figure 11).

The final clinical aspect is shown in Figure 12. During the try-in, we noticed that the upper lateral incisors were slightly medially inclined. However, during dry and damp proof using a try-in paste, the patient reported being satisfied and did not wish to modify the inclination.

3 | DISCUSSION

In the case presented here, the correction of dental shapes and proportionalities with ceramic laminate veneers was indicated. According to Hamzeh et al,[24] ceramic laminate veneers can affect the quality of life of young adults, improve their satisfaction with their appearance, and reduce embarrassment when smiling. Gresnigt et al[25]

FIGURE 12 Final clinical aspect of ceramic laminate veneers. (A) Smile harmonizing with the patient's face. (B) Close evaluation of the smile

state that ceramic veneers are an alternative for restoring dental shapes and have good clinical results with survival rates ranging from 82% to 96% after 10 to 21 years.

DSD software is a versatile tool that can aid in treatment, improving the team's understanding of esthetic issues, and increasing patient acceptance rates.[11] The DSDapp allows the definition of the reference lines directly in the application, the analysis of dentofacial features and proportions, and the relationship between teeth, lips, and gingival tissues. The patient can visualize the planning of the case in the first clinical session. The use of conventional DSD on a computer requires more time for preparation, making it difficult to perform during the same clinical session with the patient's participation in this process.[10] The DSDapp facilitated good communication and positive interactions with the other involved professionals. Through digital planning, it was possible to indicate to the periodontist where and how much gingival tissue should be removed. Periodontal plastic surgeries are interventions that must always be planned appropriately.[1] The use of reference lines on smile images serves as a guide for periodontal plastic surgery. These references help clinicians consider limitations, risk factors, gingival asymmetries, and disharmonies that violate esthetic principles.[26] According to Santos et al,[27] periodontal plastic surgeries are well accepted by patients, especially when planned using DSD.

In the present case, during the planning using the DSDapp, it was not necessary to plan dental reductions, as the restorations were larger than the teeth. The DSDapp can also be used for subtractive cases, with teeth of increased buccal contour or with excesses in the incisal region. These situations have limited planning with a conventional wax-up. As the app uses 2D images, it does not take into account the three-dimensionality of teeth. [28] Therefore, the teeth contour and shapes can still be defined. Adjustments in the incisal region can be corrected in the digital waxing step.

Digital scanning was chosen instead of traditional impressions. Digital scanning uses an camera to obtain images of the oral structures. The acquired images are stored and interpreted by the software, which creates a three-dimensional virtual model.[29] This technique was selected because it has advantages such as greater comfort and satisfaction for the professional and the patient, reduced clinical time, and the ability to store and retrieve the information digitally.[30] Conventional impressions can present problems such as low reproducibility of the cervical areas, tearing off in some areas of the impression, the presence of debris impregnated in the impression material, bubbles, and indistinct preparation margins with soft tissues after plaster casting.[31-33]

In the study by Al Hamad et al,[34] the adaptation of ceramic crowns made in the same patient through conventional impressions and digital scanning had no significant differences. The authors concluded that intraoral scanning produced marginal adaptations comparable to those produced by the conventional approach. However, there are different types of intraoral scanners that can present different results on the adaptation of restorations.[35] Intraoral scanners require a direct and complete view of the areas of interest and sharp dental margins.[36] Other intraoral features such as metal restorations, teeth covered with saliva, retromolar regions, and subgingival areas can compromise the accuracy of the digital scans.

Digital scanning also allows real images to be transformed into virtual images, favoring digital diagnostic wax-up. Thus, the wax-up can conscientiously reproduce what was planned through the DSDapp, and the model can later be printed using a 3D printer. For Cattoni et al,[37] when waxing is performed traditionally, the transfer of data from the DSD and communication with the laboratory is difficult, and distortions and errors eventually occur. These distortions could be minimized with digital flow processing. Using the DSDapp does not dismiss the need to perform a mock-up. Digital planning allows a

two-dimensional visualization, which, when transferred to the patient's mouth through the mock-up, the patient can view, a realistic estimate of the outcome with a full perception of size and volume, favoring any occlusal adjustment.[38]

The CAD/CAM system allows digital dentistry with a new perspective of the workflow that involves digitizing the treatment's execution.[39] According to Lin et al,[39] one of the advantages of using CAD/CAM technology is that ceramic laminates can be manufactured from the waxing. In this way, the relationship between the DSDapp, digital scanning, virtual waxing, and ceramic laminate veneer milling by CAD/CAM technology makes the treatment safer and more predictable.[1,40]

4 | CONCLUSION

The use of the DSDapp accelerated the initial planning steps and facilitated better communication with the patient and the multidisciplinary team. The use of this application allowed active participation of the patient during the planning process. Additionally, the digital workflow favored greater predictability of the results and achieved the results planned in the DSDapp.

DISCLOSURE OF INTEREST

The author Ralph Georg is co-founder of the DSDapp app.

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