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Digital techniques for anterior teeth form selection in complete edentulism

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Abstract: *The aim of this study was to compare two computerized digital esthetic design methods (DSD and Visagismile) in order to properly choose the appropriate form of the maxillary frontal teeth for complete bimaxillary edentulous patients and to validate the use of these applications in complete edentulism. An online questionnaire was submitted to a group of 100 persons (dental doctors, dental medicine students and persons activating in other fields); the respective persons were requested to choose the form of maxillary frontal teeth for a group of four complete bimaxillary edentulous patients, whose esthetic design had been performed by using the two computerized progams. Following the respondents' analysis of the esthetic previews elaborated for the four patients 60% of the total answers were in favour of DSD while the remaining 40% were in favour of Visagismile; these percentages are identical with the ones obtained on the basis of the answers given by dental doctors and dental medicine students. In case of the respondents activating in other fields the percentages were 66% in favour of DSD and 34% in favour of Visagismile. Based on the results of the study the two computerized methods were validated also for cases of complete edentulism but further studies to confirm this validation are still required. These two methods improve the dental doctor/patient communication and certainly provide a higher predictability of the esthetic results of prosthetic restorations not only for dentate patients but also in cases of complete edentulism.*

Keywords: *esthetic preview, complete edentulism, DSD, Visagismile*

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INTRODUCTION

Choosing the most appropriate form for maxillary frontal teeth has always represented a challenge in the prosthetic restorations of complete edentulism as doctors had available a limited number of parameters (facial profile, sex, age, personality), which were often subjective methods of analysis and, as a consequence, the esthetic results had a low degree of predictability. [1].

Modern dental medicine uses digital technologies also in the field of dental esthetics, thus ensuring that the esthetic results of the prosthetic restorations meet as many requirements as possible having, at the same time, a high degree of predictability, given the possibility to preview the results.

A considerable number of such digital applications for smile simulation have been developed, among which: DSD App, VisagiSmile, Photoshop CS6, Keynote, Planmeca Romexis Smile Design, Cerec SW 4.2, Aesthetic Digital Smile Design, Smile Designer Pro [2].

Smile planning applications adjust the digital technology to the smile design process. They can be used as multi-use conceptual tools, diagnosis and treatment plan preview instruments and can facilitate the communication with the patient and the dental technician, enhancing the predictability of the final results and allowing a thorough analysis of the facial and dental features otherwise superficially evaluated through clinical diagnosis, photographic assessment or by using models [3]. Among the esthetic software programs used at present in dentistry Visagismile and DSD are considered to be the most powerful tools in assessing and modifying the design of deficient smiles. [4].

Apart from the well-known DSD (Digital Smile Design) concept a new one, Visagismile, has been developed in the last years starting from the Hippocratic four types of temperament (sanguine, choleric, phlegmatic and melancholy) and the Jungian archetypes and symbols (basic geometric shapes and primary and secondary colours) [5]. The artist Philipp Halawell explained and developed the Visagism concept, which implies the creation of an image expressing a person's (patient's) type of personality, concept that has been integrated in the dental medicine, thus obtaining a teeth form that ensures a correlation between dental-facial harmony and the personality type [3].

The Visagism concept analyzes the relation between the facial features, temperament and patient's harmonious teeth configuration. The concept has been developed in the last years and validated for a large number of clinical cases (over 800). The software program is user-friendly, the doctor uploading one standard photography of the patient on the application, where it will be calibrated and the points composing the facial map of the patient will be selected. Based on the facial map and one brief psychological questionnaire (named "personality interview") filled in by the patient the application will establish the patient's temperament and appropriate teeth design. Afterwards the doctor can edit the dental configuration and superpose it on the patient's teeth in the photography so that the patient can preview the esthetic aspect to be obtained at the end of the treatment. All details related to the future teeth will be sent to the laboratory directly from the application in order to obtain the final prosthetic restoration [6].

We identified a large number of studies regarding the application of the esthetic software programs on dentate patients while the number of studies regarding the application of these programs on edentulous patients is quite limited. Starting from this finding we applied the two digital methods for choosing the form of the maxillary frontal teeth to complete edentulous patients.

The purpose of our work is to establish which of the two computerized methods used for choosing the form of the maxillary frontal teeth is more appropriate in case of complet edentulism.

MATERIALS AND METHODS

We performed a comparative study on a group of four patients of the Complete Denture Department of the Faculty of Dental Medicine within the University of Medicine and Pharmacy, "Carol Davila", Bucharest, Romania.

We used the following criteria for including the patients in the studied group: complete bimaxillary edentulous patients (both with and without dentures) and patients who gave their consent for participating in the studied group and for being photographed. The criteria for excluding the patients from the studied group were: dentate patients and non-cooperating patients.

For each patient a full set of photographs was taken, according to the protocols of the two software programs and all the data and photographs thus obtained were loaded and processed using Visagismile, DSD Keynote and Microsoft Excel programs. Previews of the form of the future artificial frontal teeth were obtained for each patient using both software programs; in achiving these previews, different steps were followed, as described in Table 1.

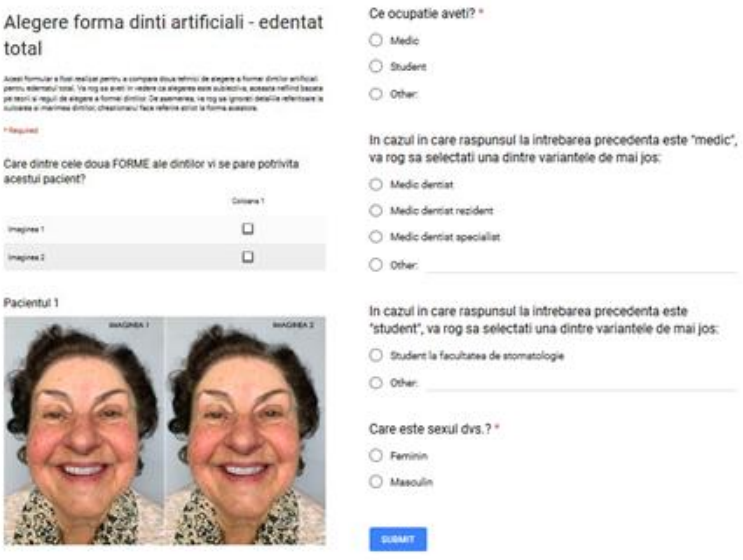
The ideal digital form of the future artificial maxillary frontal teeth was achieved for each of the four patients of the studied group by using the two computerized programs.

Table 1. Comparison between the steps for obtaining the previews corresponding to DSD Keynote and Visagismile programs

Keynote DSD	Visagismile
- Load the photograph on the software program and position the photograph in accordance to the calibrating lines - Draw the smile line and the mesio-distal limits of the future frontal teeth - Choose the forms of standard teeth that are preset by the program - Selection of the best fitting teeth-form by the doctor together with the patient - classical criteria for selection are taken into consideration (reversed face, age, sex, personality etc.)	- Load the photograph on the software program - "Auto face reading" command performs the automatic calibration - The facial map results automatically by joining 27 facial points and a "facial type" is obtained, according to the four types of temperament (choleric, sanguine, melancholy, flegmatic) - The patient is subjected to the psychological test (a short interview consisting of four questions) - The software automatically ranks the facial type in percentages depending on the statistical parameters of the facial map and the results of the interview - Patient's preferences as well as design related information can be inserted in the program in order to be submitted to the laboratory - Based on all the information inserted so far the program proposes a teeth design

In order to comparatively evaluate the two computerized methods used for choosing the form of maxillary frontal teeth with the aim of establishing which one is more appropriate for patients with complete edentulism, we submitted a questionnaire to a number of 100 persons. Out of 100 submitted questionnaires, 2 were considered invalid and 98 valid; the 98 persons were represented by 12 dental doctors, 53 students at the Faculty of Dental Medicine and 33 persons activating outside the medical field. This self-administered questionnaire (SAQ) included several questions and the two previews generated by the software programs (Figure 1), allowing us to receive feedback regarding the results obtained by using the two computerized methods from persons both activating in the dental medical field and outside the medical field. The questionnaire was filled in under the anonymity protection as the persons included in the study were not requested to provide personal information such as surname, name or personal identification number.

Figure 1. The self-administered questionnaire submitted online



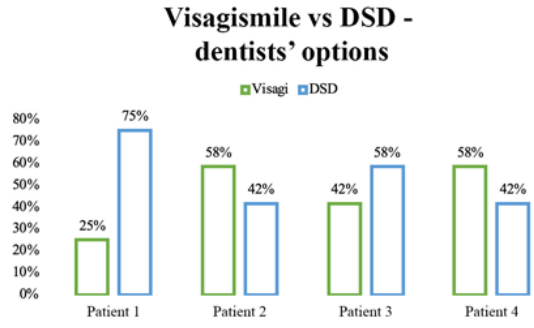
The questionnaire consisted of eight questions, of which the first four (closed-ended questions) regarded directly the four patients of the studied group while the remaining four were open-ended questions, referring to general information. The questionnaire, which was elaborated using Google Forms, was filled in online and it took sixteen days to receive all the answers. The information resulting from the answers to the questionnaires was further used, by employing Microsoft Office Excell 2018, to create statistical bases.

RESULTS

The results obtained after the questionnaire was filled in by the three categories of respondents are presented below:

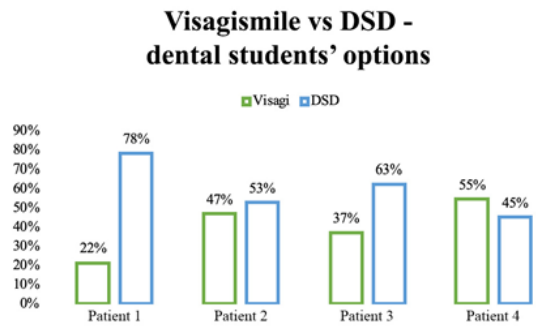
- Dental doctors opted for DSD in proportion of 60% while 40% were in favour of Visagismile (Figure 2);

Figure 2. Options expressed by dentists



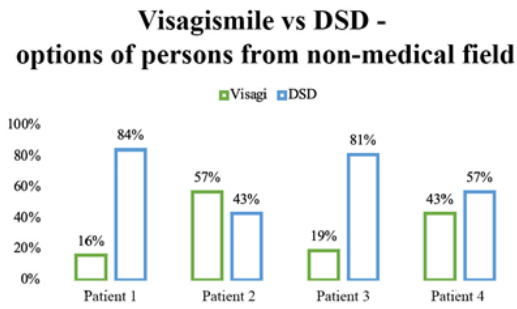
- Dental students were in favour of DSD in proportion of 60% while 40% chose Visagismile (Figure 3);

Figure 3. Options expressed by dental students



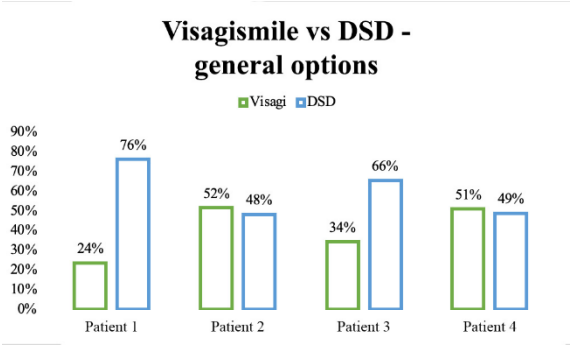
- The persons activating in non-medical fields were in favour of DSD in proportion of 66% while 34% opted for Visagismile (Figure 4).

Figure 4. Options expressed by persons from non medical field



At the level of the whole group of respondents included in the study 60% opted for DSD while 40% were in favour of Visagismile (Figure 5).

Figure 5. General options



DISCUSSIONS

There are still insufficient articles and studies illustrating the use of the smile planning digital applications to patients with complete edentulism. The modern smile design techniques are more effectively controlled through data collection and different digital smile design tools, contributing to all treatment steps up to the fabrication of the definitive restorations, either fixed or removable. Utilizing these digital tools together with classical treatment-planning rules and principles facilitates a controlled and predictable therapy when redesigning a smile [8] both for dentate patients and for complete edentulism cases.

Visagismile concept supports both dentists and

patients in deciding about the aesthetics of the final prosthetic restoration and it is mostly applied for dentate patients. Using a specific protocol, a smile design that corresponds to individual facial features, temperament and personal preferences of the patient can be achieved [7, 8]. This application can also facilitate to a great extent the conception of the complete denture design by allowing the preview of the final result and the choice of the form, colour, size and arrangement of artificial teeth depending on the facial typology and the desire of the patient, who is directly involved in elaborating the treatment plan.

In modern dentistry DSD programs are also successfully used as tools for diagnosis, treatment plan visualization and communication with the patient and the technician; all these elements can improve treatment outcome predictability. As regards the characteristics of the 3D functions, CAD/CAM connectivity and practicality, the DSD application proves to be even more performant than Visagismile. However, not all the DSD programs available today provide the same competency for the comprehensive analysis of the dentofacial esthetic parameters [8]. As in the case of complete edentulism, the actual DSD techniques can be used with certain limitations related to the following facts: dynamics of the lips when smiling; shooting of the initial photographs, which requires a good stability of the dentures; the wax occlusion rims that do not fit all the facial typologies. At the same time, the preview of the final prothestic result obtained by applying DSD offers the complete edentulous patient the possibility of having a realistic view on certain aspects related to teeth form, colour and size, which are not correlated with his/her age and facial typology.

On the other hand, the ability of the digital planning programs to perform an appropriate esthetic analysis is evaluated also depending on the number of the dental-facial esthetic parameters used. Thus, if Visagismile has the advantage of using additional elements related to the patient temperament, DSD uses more dental-facial esthetic parameters. [2] This could be the reason why the majority (between 60% and 66%) of the respondents to our questionnaire expressed their option for the DSD method.

CONCLUSIONS

Dental esthetics is a topical though subjective field and the techniques used for choosing the maxillary frontal teeth, either classical or modern (digital), have particular elements and, as a consequence, our study is a subjective one, based on the opinions expressed by the three categories of respondents.

DSD and Visagismile programs have proved their usefulness for dentate patients and our study could contribute to demonstrating their effectiveness also in case of complete bimaxillary edentulous patients. However, future studies of higher complexity and performed on larger groups of patients are necessary in order to validate the application of such programs in cases of complete edentulism.

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