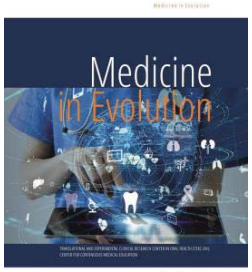
Digital vs. Conventional Wax-Up



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Abstract

Case presentation: This article aims at presenting a case of an esthetic previsualization using both digital and conventional wax-up technique in order to compare their results in terms of functional and esthetic outcome, workflow, time and costs.

Material and methods: For the digital method, the Smile Cloud application was used for Digital Smile Design, afterwards the project was imported into 3Shape Dental Designer software for designing the digital wax-up and a printed model was produced for the clinical mock-up. For the conventional method, alginate impressions and a facial bow registration were taken and the models mounted in a semi adjustable articulator were used to transfer the data provided by the dentist in order to design the analog wax-up.

Discussion/Conclusion: The digital wax-up has the advantages of a better macro and micro texture on the future restorations, it is less time consuming in terms of design and additional changes, but also being a more expensive option due to extensive equipment needed.

Keywords: digital wax-up, conventional wax-up, digital smile design

INTRODUCTION

In a world where smiles are advertised everywhere as a symbol of beauty, dynamism and youth, the prosthodontist has the mission of improving constantly the knowledge and techniques, therefore improving patients' lives. In order to obtain a predictable outcome, both esthetically and functionally, dentists may use the wax-up technique, which is nowadays seen as the first mandatory step in treatment planning. As Michelangelo used models as a source of inspiration for his works of art, the prosthodontist can use the wax-up technique in order to pre-visualize the final smile and facial aesthetics.

The wax-up can be made conventionally adding wax to a model poured from classic impressions, or in a digital way, by using the digital intraoral scan of the patient; additionally, intra and extra oral standardized photographs are imported into a digital smile design dedicated software. The software implies a library of natural dental morphologies, hence offering personalized aesthetics for each case by taking into consideration the patients' unique characteristics. Using the artificial intelligence and the digital articulators, the dedicated software uses functional parameters (such as sagittal condylar inclination and Bennett angle) while creating the digital project. Following the digital steps, the time for the previsualization of the case shortens, thus motivating the patients (1).

Aim and objectives

The aim of the present study is to compare the analog wax-up technique made by conventional additive technique with the digital wax-up technique, by taking into consideration the esthetic results, the amount of time needed to perform them, the financial costs, the occlusion and, lastly, the possibility of making further modifications of the project. These techniques were compared for the same subject, who benefited from the wax-up technique both made digitally and conventionally, with the future purpose of the maxillary teeth rehabilitation.

CASE PRESENTATION

The case included in this study is a female patient, aged 32 years old, whose main complaint was the aspect of the smile after completing a long orthodontic treatment. At the clinical evaluation the following issues were noticed: diastema, a slight deviation of the interincisal upper midline on the left side, a slight asymmetry of the lip, the asymmetry of the occlusal plane, absence of the micro and macro texture, gum exposure in the premolars and incorrect tooth proportions and tooth-to-tooth proportions. The patient expressed also the desire for a brighter color (Fig.1)

Conventional wax-up

For the conventional wax-up, the first step was the impressions taken with alginate (Cavex Cream Alginate, *Cavex*) and a facial bow registration (Artex Facebow, *Amann Girrbach)*. All the data were sent to the dental technician, alongside with the patient's chart, where all the future modifications decided by the doctor and the patient were written. For the functional parameters an electronic axiography was performed (Cadiax Compact 2, *Gamma Dental*) (Fig. 2).

The gypsum type IV stone casts were made (Garreco Dental) and the stone casts were mounted in the semi adjustable articulator (Artex, *Amann Girrbach)* and the articulator was programmed (Fig.3). Afterwards the dental technician added the wax to the models selectively taking into consideration the preferences communicated by the doctor and the patient (Fig. 4). After a meticulous check of the wax-up, the technician made a mock-up key,

using addition silicone putty (Fegura Sil Putty, *FEGURAMED*) (Fig. 5). The key was used and the prosthodontist made the conventional mock-up using a bright resin (Protemp 4 Bleach, *3M*) (Fig. 6).

Figure 1. Clinical examination and the decision for the treatment plan

Figure 2. Impressions of the prosthetic field

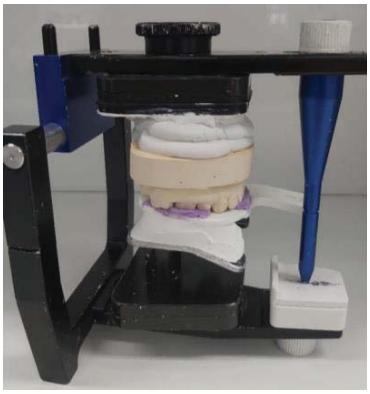

Figure 3. Mounting articulator

Figure 4. Addition of the wax on the models

Figure 5. Mock-up key for the conventional technique

Figure 6. Conventional mock-up

Digital wax-up

For the digital wax-up, a set of intra and extra oral standardized photographs using a DSLR Nikon D3500 was taken. The digital impression was taken with the intraoral scanner (Trios 3, 3Shape) (Fig.7). The collected data was introduced in Smile Cloud application and the digital smile design was performed. The workflow implied the following steps: the facial

references were set, the lip contour and the restorative space were determined (Fig. 8,9), and the most suited dental morphology according to the patient's characteristics was chosen by the algorithms from the teeth library (Fig.10). The project was afterwards made available to all team members and to the patient for a better collaboration. After overlapping the digital wax-up on the patient's photography, the project was presented to the patient and the desired modifications were noted, increasing its confidence in the future treatment. Any modifications considered necessary by the patient were performed instantly by the digital team. The CAD design of the project was, therefore, verified and approved by the patient.

The project was imported in the 3Shape Dental System, where the dental technician adjusted the teeth library chosen by the patient without modifying the shape of the restorations. The final project, the digital wax-up, was printed using a 3D printer (Asiga MAX UV, *Asiga*) (Fig.11). The silicone keys were made on the printed model, using addition putty and light body silicone (Virtual, *Ivoclar Vivadent*). The dentist performed the digital mock-up using the a bright resin (Protemp 4 Bleach, *3M*) (Fig.12) and the result was analyzed by the dentist-technician-patient team after taking a new set of photos (Fig.13).

Figure 7. Digital impression

Figure 8. Tracing the lip contour

Figure 9. Tracing the restorative space

Figure 10. The biometric library

Figure 11. Printed model of the digital wax-up

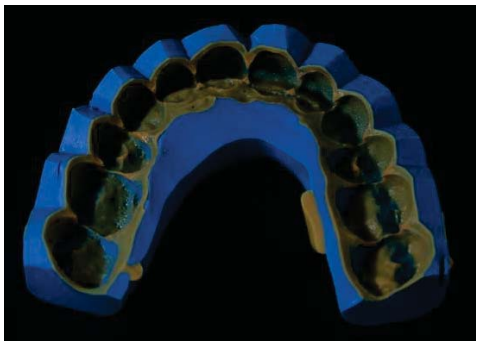

Figure 12. The silicone keys for the digital mock-up

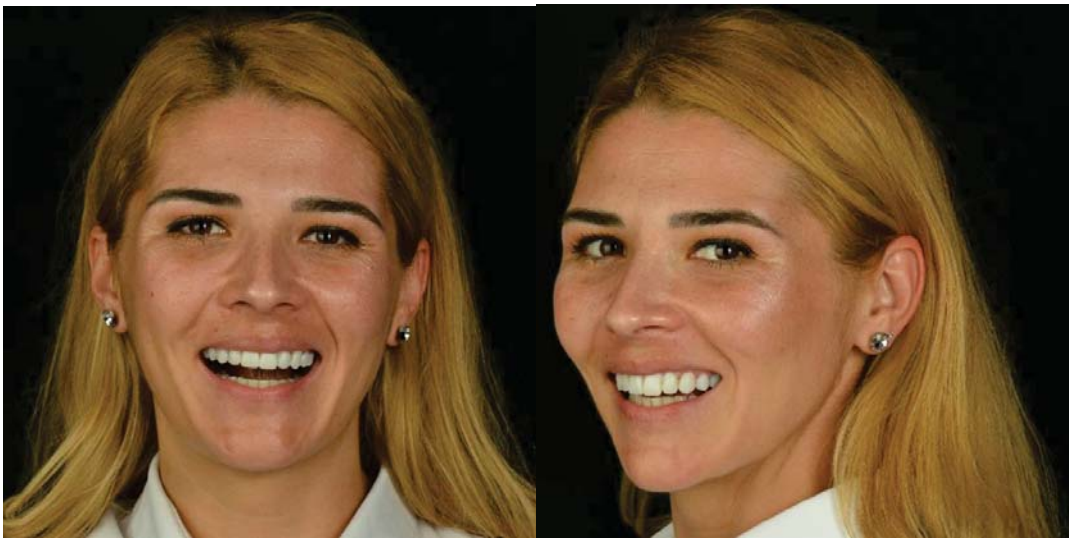

Figure 13. Digital Mock-up

DISCUSSIONS

Using two different techniques, a comparison was made taking into consideration the time spent for each step, the final esthetic result, the ability to make instant changes regarding the patient's desires, the occlusal result and lastly, the cost of the workmanship and the equipments needed. The longer time documenting the case needed in the digital technique is compensated by the shorter time needed to make the project and to print the model, all these steps requesting less time than the conventional technique. These advantages of a digital workflow were also mentioned by Revilla-León et al. (2).

The possibility of creating simultaneous digital projects in order to offer a range of different restorations from which the patient can choose is another advantage of the digital wax-up as is mentioned also by Tallarico et al. (3). The ease of communication between the dentist and the patient and the ease of making changes to the project regarding the patient's desires has the result of shortening the time required for the wax-up while increasing the predictability of the final result. Similar aspects of the digital wax-up technique were also presented by Cervino et al. (4).

A better axial contour of the restoration using a conventional wax-up were obtained, but the natural teeth library involving micro and macro textures presented better esthetics meanwhile showing a higher rate of symmetry with the digital technique. These results are similar to studies conducted by Jafaar et al. (5).

The technological workflow of the digital wax-up involved equipments with a higher cost, such as the intraoral scanner, the 3D printer, the CAD software and the Digital Smile Design software. By comparison, the conventional wax-up technique requires less expensive equipments, therefore requiring a smaller cost, these advantages and disadvantages being similar to those presented by Garcia et al. (6).

CONCLUSIONS

The benefits of creating the wax-up digitally, such as having a greater predictability of the restoration, the ease of making instant changes in the project and the reduced amount of time needed for the completion of the project should be balanced with the higher price of the equipments needed for this technique. Meanwhile, the time spent by a dental technician to make a conventional wax-up and to perform changes to the project is considerably higher than the time needed to create a digital one.

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