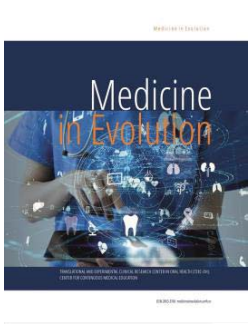
# Digital workflow for ten upper veneers: a case report

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## Abstract

Aim and objectives: The purpose of this article is to present the case of ten upper veneers using a full digital protocol in the interest of evaluating the results both estethically and functionally, duration of the whole process, overall cost, the efficiency of the workflow and patient's satisfaction.

Material and Methods: The digital workflow consisted of a previsualization of the final result by using the Smile Cloud application, therefore creating a digital wax-up and printing a model for the mock-up. The ten upper preparations from first molar to first molar were performed. In the end, after the intraoral scanning of the preparations, the restorations were milled from ceramic ingots in CAD-CAM 5-axis milling unit and tried-in in order to verify the integration and adaptation, finally ten upper monolithic veneers being cemented.

Results: The digital workflow allows to have a predictible final result – especially esthetically, offering a natural final touch thanks to micro and macro textures, alongside with color choice and shade integration, improving the whole facial aspect.

Conclusions: In terms of time and predictability, the digital workflow offers a better time-management and faster results, alongside with an improved esthetic outcome. The duration of the entire clinical process was shorter compared to the average time for conventional protocol, increasing patient's satisfaction for the whole treatment. Overall cost can surpass the usual one of traditional workflow, as the CAD-CAM system used, the software updates and the special-created materials for digital protocol require significant financial investment.

**Keywords:** digital workflow, veneers, digital smile design

## INTRODUCTION

When in comes to digital workflow, designing a final restoration using CAD-CAM (computer-assisted design and computer-assisted manufacturing) is likely more profitable in terms of time and efficiency than using the conventional protocol – the patient can actively be a part of their own treatment plan by choosing between the projects made in the Digital Smile Design system, giving valuable feedback which drastically enhance the communication between the dental team and the patient, thus avoiding any medico-legal issues by previsualizing the outcome and obtaining a predictable result [1].

The digital smile design is an essential step of the process – not only it permits to predict the final makeover, but it motivates the patient to be compliant and confident in the dental team's treatment and being tolerant during each step of the treatment [2].

The digital wax-up created after the digital smile design is used in order to make a mock-up, an important clinical step during the treatment – this pre-op mock-up not only gives the patient the opportunity to previsualize the final result, but it represents a good moment for making adjusments both aesthetically and functionally. Therefore, the dentist can assess the future aspect of the restorations before doing irreversible procedures (like preparing the teeth), so it reduces the risk of misjudgement and making mistakes [3].

With all the benefits of the digital protocol in terms of predictability, efficiency and time-management, the downsides of this treatment approach consists in a permanent need of software updates which implies professionally continuous evolution and financial investment, alongside with its limitations, like a required minimal thickness value of the restorations [4].

### *Aim and objectives*

The purpose of this clinical report was to present the digital protocol used for a case of ten upper veneers and examining the results regarding the duration of the entire clinical process, functional and esthetic outcomes, final costs and patient's satisfaction, by taking into consideration the opinions and desires during the clinical steps, especially in the mock-up and try-in sessions.

The aim of choosing a digital protocol was not only to determine the improvement of communication between the patient and the dental team and to evaluate the overall benefits using de digital workflow in terms of predictability, time-efficiency and quality of restorations, but also to assess the facial and aesthetic integration of digital manufactured veneers.

## MATERIAL AND METHODS

The patient was a 32 years old woman interested in improving the aspect of the upper teeth, but also wishing for a natural, yet functional and esthetic result (Fig. 1, Fig. 2). The patient followed an orthodontic treatment and after the final clinical evaluation there were some esthetics concerns, such as tooth-to-tooth disproportions, assymetric occlusal plane and lack of morphology in terms of micro and macrotexture. Analysing the aspect of the smile and taking into considerations the young age and the patients' desires, it was decided to make ten upper veneers, from first molar to first molar.

Figure 1. Initial situation – intraoral frontal photography

Figure 2. Dento-labial and dento-facial analysis

The digital workflow consisted of multiple steps, starting with an entire set of photographs, both intra and extraoral, taken with a DSLR Nikon 3500 with a 105 mm macro lens. The intraoral scanner used for the digital first impression was Trios 3 (3Shape Co., Copenhagen, Denmark). Afterwards, the images and the intraoral scanning were imported into de Smile Cloud online application to perform a smile analysis and digital design of the future veneers. The references used for designing future restorations were the facial ones, alongside with the lip contour. The Smile Cloud applications offers multiple types of natural teeth in its library, and thank to the algorithms integrated in the application, it was easier to choose between different shapes of dental morphologies in order to make a suitable digital smile design project.

In the Smile Cloud online application, the interdisciplinary team was able to see the project, and the communication with the patient was easier thanks to the Smile Cloud Passport feature, which gives the opportunity to discuss with the patient via chat, in order to modify the project according to patient's desires and thoughts, making the entire process of treatment more trustworthy. Finally, after all the modifications were made by the digital team, the project was approved by the patient and imported into the 3Shape Dental System (3Shape Co., Copenhagen, Denmark).

The dental technician, having the chosen digital smile design project, was able to go further with the digital wax-up by superimposing the project and the initial scanning, thus printing a model using a 3D printer (Asiga MAX 4K, Asiga). On this model it was made a silicone key using putty and light body addition silicone material (Virtual, Ivoclar Vivadent). The silicone key was used for performing a mock-up in the dental office using resin material (Protemp 4, Bleach, 3M), so the whole team – patient – dentist -dental technician - can assess the functionality and the esthetics, along with taking a new set of photographs in order to analyze every detail (Fig. 3, Fig. 4).

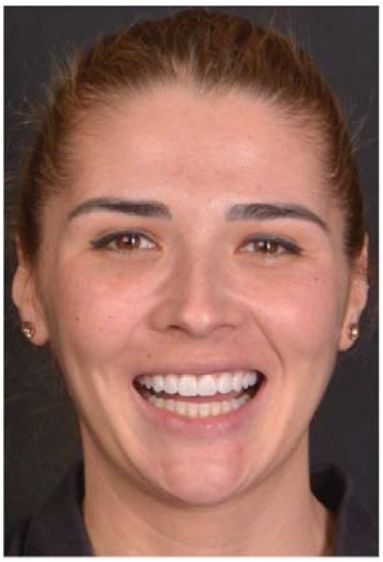

Figure 3. The mock-up – facial integration

Figure 4. The mock-up – labial analysis

After the teeth preparations from the first molar on the right side to the first molar on the left side (Fig. 5, Fig. 6, Fig. 7) were done, another scan was made and a Smile Cloud feature was used to superimpose the digital wax-up and the scanning of teeth preparations. By doing so, the clinician verified the existing space for the future restorations in order to obtain minimal invasive preparations (Fig. 8), so the enamel structure could be preserved as maximum as possible.

Figure 5. Teeth preparations on right side

Figure 6. Teeth preparations on left side

Figure 7. Teeth guided preparation – frontal view

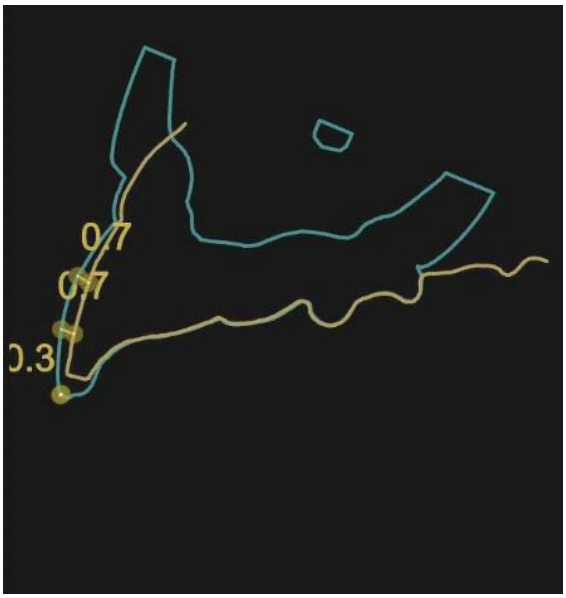


Figure 8. The difference between the scanned preparated tooth and the digital wax-up

The material chosen for the final restorations was leucite-reinforced glass ceramics for CAD-CAM system (IPS Empress CAD multi B1, *Ivoclar Vivadent*).

Before even the preparation began, the technician made provisional veneers using the shell technique, so the prepared teeth are protected and the patient can get used with the future aspect of their teeth (Fig. 9, Fig. 10, Fig. 11). The technician digitally prepared the teeth on the wax-up model in order to fabricate the provisional restorations, sent them to the dental office so the clinician only relined with resin material into the provisionals while inserting them on the teeth, in order to obtain optimal marginal fit.

Figure 9. The provisionals – right side

Figure 10. The provisionals – left side

Figure 11. The provisionals – frontal view

The protocol for the dental laboratory was to superimpose both of the two standard tessellation language (STL) files (the one with the digital wax-up and the last one, with teeth prepared) into the same software, along with using the virtual programmed articulator, the milling process was done with a 5-axis milling unit (Imes-Icore CORiTEC 150 i), finishing and glazing.

Another set of photographs, both extraoral and intraoral, were taken after the final restorations were tried-in (Fig. 12, Fig. 13, Fig. 14, Fig. 15). The patient and the dental team analysed the integration of the final restorations to make some corrections, being able to achieve the initial esthetic desires: the aspect of micro and macro textures and the shade chosen and its integration in the facial harmony. Also, the occlusal analysis was performed in order to assess the functionality of the final restorations.

Figure 12. Tried-in veneers – right view

Figure 13. Tried-in veneers – left view

Figure 14. Tried-in veneers – frontal view

Figure 15. Tried-in veneers – occlusal view

Finally, the ten upper veneers were bonded under rubber dam isolation using a single-component adhesive (Adhese Universal VivaPen, *Ivoclar Vivadent*). The bonding protocol included 4,5% hydrofluoric acid (IPS Ceramic Etching Gel, *Ivoclar VIvadent*) as etching agent, placing the restorations in sodium bicarbonate solution, using an ultrasonic bath and a bonding agent (Monobond Etch and Prime, *Ivoclar Vivadent*), before applying the cement material (Variolink Esthetic, *Ivoclar Vivadent*) (Fig. 16).

Figure 16. The ten final veneers bonded

## DISCUSSIONS

The implementation of the full digital smile design protocol in these particular cases of maxillary veneers facilitated the previsualization of the aesthetic outcomes and helped to obtain minimal invasive preparations verified digitally. Maintaing the preparation design into the enamel is a fundamental parameter in assuring absence of infiltration and quality of bonding between tooth substrate, adhesive cement and restoration for the success of veneers, according to Verniani et al [2].

The patient gave positive feedback in terms of duration of the whole process – by scanning, realizing digital smile design and using the CAD-CAM system, the time spent for each clinical step was reduced, as the communication between the dentist and the technician was optimized, during the treatment, as Verniani et al presented [2].

Making intraoral and extraoral photographs initially, with the mock-up and with the final restorations, also with video documentation, permitted to make adjustments according to patient's desired in order to obtain an improved esthetic and functional outcome, as also mentioned by Stanley in his study [3].

Digital systems implies purchasing the CAD-CAM technology, the softwares and special-created materials, each of those mentioned increasing the overall cost of the treatment, compared to the conventional protocol. As presented by Sanchez-Lara et al [5], there exists a direct dependency between the cost-effectiveness of a digital workflow, the softwares used, and the skills and training level of the user.

The material used for the final veneers was leucite-reinforced glass-ceramic which provides good mechanical due to the 40-50wt% of leucite crystals evenly distributed that increase the mechanical properties in terms of crack deflection and energy dispertion. Also, good aesthetics are provided by having a similar level of material translucency as natural teeth, showing high patient satisfaction in terms of both esthetics and functionality, as presented by Zürcher et al [6].

## CONCLUSIONS

The communication between the dentist, the dental technician and the patient was radically enhanced using the digital protocol, the Digital Smile Design system having a major role in augmenting patients' confidence in the dental team.

The efficiency of the workflow is gained by reducing the number of required sessions in the office, the discussions between the dental team and the patient via Smile Cloud

application are essential for choosing the proper project before any clinical irreversible procedure is done.

Another advantage conferred by the digital workflow is the achievement of a predictable outcome – the mock-up permits to see a preview of the final result and to evaluate the functional aspects, such as lateral and anterior guidance.

Potential errors that might occur during the treatment can be easily surpassed by using the saved files, as it is not necessary to repeat any clinical steps as in conventional method.

However, the initial investment for purchasing the CAD-CAM system and dedicated materials, the software updates required periodically, along with the permanent need of evolving professionally to keep up with the digital technology mush be taken into consideration financially, the final cost being dependent on these factors.

Each of these mentioned attributes presented are promising prospects in terms of aesthetic and functional outcomes for digital prosthodontic treatments.

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