DIGITAL VERSUS ANALOG WORKFLOW FOR SIX UPPER VENEERS: A CASE REPORT

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ABSTRACT

Aim of the study: This article aims at presenting a case of six upper veneers both using a full digital protocol and an analog protocol respectively in order to assess the esthetic and functional outcomes, workflow, time, costs and patient's preferences.
Material and Methods: For the digital workflow, a previsualization of the case was made using Smile Cloud application. A digital wax-up was performed and a printed model was used for the clinical mock-up. Guided teeth preparations from canine to canine according to the approved initial design were performed together with an intraoral scanning. Six upper monolithic veneers were milled. For the conventional method, analog data acquisition was performed in order to design the analog wax-up. Further, a mock-up was made in order to assess the future esthetic and functional result. After intraoral scanning of the preps, in the same appointment, polyether impressions, a facebow and occlusal registrations and a shade map were sent to the dental technician in order to design six upper feldspathic veneers.
Results: The final restorations chosen by the patient were those made by using the digital workflow due to the final esthetic result: natural micro and macro textures, shade integration with the adjacent teeth and improved tooth and tooth-to-tooth proportions.
Conclusions: The digital workflow was less time consuming, more predictable and less provocative in terms of possible incidents and corrections. Concerning esthetics outcomes, a better macro and micro texture of the final milled veneers was obtained.

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

INTRODUCTION

In digital workflow, the entire process is fundamentally different from the analog protocol. If the conventional relies on the practitioner' s clinical experience and dental technician's ability and talent to progressively transform an imagined project into clinical reality, the digital protocol means a completely virtual planning of the entire project before carrying out the prosthodontic treatment itself (1).

The acquisition of standardized clinical and imagistic data for digital smile design, the 2D planning and its transformation into a 3D project, as well as the execution of the treatment led by the original digital project are considered to be the main advantages of the digital workflow in prosthodontics (2).

MATERIAL AND METHODS

The aim of the present study was to compare two different protocols for a case of six upper veneers using an analog workflow (conventional wax-up additive technique and layering ceramic technique) and a digital workflow (digital smile design, digital wax-up, CAD/CAM design and milling techniques) in terms of esthetic and functional outcomes, financial costs, time and patient's preferences.

The case included in this study is a male patient, aged 24 years old, whose main complaint was the poor esthetics on the frontal upper teeth: the presence of diastema and interdental spaces from canine to canine, unpleasant shape and tooth color, worn tooth structure with sensitivity (Fig. 1, 2).

Fig.1 Clinical examination

Fig.2 Dento-facial and dento-labial esthetic analysis

Analog workflow

For the conventional protocol, the first step was alginate impressions (Cavex Cream Alginate, *Cavex*) and a facial bow registration (Artex Facebow, *Amann Girrbach)*. Additionally, a dental esthetic checklist was filled up with all the required modifications agreed with the patient. For the functional parameters an electronic axiography was performed (Cadiax Compact 2, *Gamma Dental*).

Type IV plasters were made (Garreco Dental) and mounted in the semi adjustable articulator (Artex, *Amann Girrbach).* Further, the articulator was programmed according to the patient's values for sagittal condylar inclination and Bennett angles. The dental technician did the conventional wax-up using the wax additive technique according to esthetic checklist and functional anterior and lateral guidance. In order to transfer the wax-up into the patient's mouth for a first validation, a mock-up key was made using a putty addition silicone (Fegura Sil Putty, *FEGURAMED*). The mock-up was made using a resin (Protemp 4 Bleach, *3M*) (Fig.3) and the esthetic and functional results were analyzed by the dentist-dental technician-patient team after taking a new set of photographs. No additional changes were needed and restorative material chosen was a feldspathic porcelain, shade B1 (Noritake EX-3, *Kuraray Noritake Dental Inc. Japan*). Guided teeth preparations (Fig.5) from canine to canine were performed according to the final project using individual sagital keys and a transversal silicone key. One step impression technique using a polyether impression material (Impregum Penta and Impregum Soft Light Body, *3M*) was made for the upper arch. The laboratory steps for the final restorations included a Willi Geller cast, refractory dies, porcelain layering, finishing and glazing.

Fig.3 Mock-up (analog wax-up)

Fig.4 Guided teeth preparations

Digital workflow

For the digital workflow, a set of intra and extra oral standardized photographs using a DSLR Nikon D3500 with a 105 mm macro lens was taken. The digital impression was taken with an intraoral scanner (Trios 3, *3Shape*). The collected data was introduced into Smile Cloud application and several digital smile design were made. The 2D design implied the followings: facial references, lip contour and restorative space determination. The most suited dental morphology according to the patient's characteristics was chosen by the algorithms from the natural teeth library. The projects

were afterwards made available to interdisciplinary team, but also for the patient. The desired modifications were made together with the patient, increasing its confidence in the future treatment. The desired modifications were performed on the spot by the digital team together with the patient. The CAD design of the project was, therefore, verified and approved by the patient from the preliminary steps.

The project was imported into 3Shape Dental System (*3Shape*), where the dental technician adjusted the teeth library chosen by the patient without modifying the teeth shapes. The digital wax-up was printed using a 3D printer (Asiga MAX 4K, *Asiga*). The silicone keys were made on the printed model, using putty and light body addition silicone (Virtual, *Ivoclar Vivadent*). The mock-up was made using a resin (Protemp 4 Bleach, *3M*) (Fig. 5) and the esthetic and functional results was analyzed by the dentist- dental technician-patient team after taking a new set of photographs. No additional changes were needed and the restorative material chosen was a leucite-reinforced glass ceramics for CAD-CAM system (IPS Empress CAD multi B1, *IVOCLAR VIVADENT).* Previous teeth preparations from canine to canine were assessed according to individual sagital keys and transversal key. Intraoral scanning of the preparations were made using the same intraoral scanner. The laboratory steps for the final restorations included superimposition of the two STL. files (digital wax-up and preps) into the same laboratory software, the use of programmed virtual articulator, milling process using a 5-axis milling unit (Imes-Icore CORiTEC 150i), finishing and glazing.

Fig.5 Mock-up (digital wax-up)

After 24 hours the two sets of final restorations were tried-in and new sets of intraoral and extraoral photographs were taken. Several corrections were made for both sets of restorations in order to fulfill all the initial esthetic objectives. The marginal fit was excellent for both sets of restorations. The functional occlusion was assessed only for leucite-reinforced glass ceramic veneers because of the low resistance to fracture for the feldspathic restorations.

Together with the patient, the decision making was made and the leucite-reinforced glass ceramic veneers (Fig. 8) were chosen due to the desired esthetic outcome: micro and macro texture well represented for the central and lateral incisors, shade integration with the adjacent and antagonist and better smile dynamics with an additional sign of youth and vitality.

Fig.6 Six leucite-reinforced glass ceramic veneers

The bonding protocol was performed under rubber dam isolation from premolar to premolar using a 5th generation bonding agent (Adper Single Bond, *3M ESPE AG*) for conditioning the enamel. The protocol to adhesively lute glass-ceramic restorations involved etching using 9% hydrofluoric acid (Ultradent 405 Porcelain Etch, *Ultradent*) and silanization (Silano Silane Coupling Agent, *Angelus*).

RESULTS AND DISCUSSIONS

A more efficient communication with the patient and with the interdisciplinary team was obtained with the digital workflow due to the intuitive software interface which resulted in a better planning and execution. An efficient communication with the patient was the most important factor for predictable treatment outcomes also according to Coachman et al. (3).

The low strengths of the feldspathic veneers may lead to possible accidents during try in or cementation phase in case of improper manipulation, sometimes irreversible which may imply the entire redoing of the restorative work. Considering time management and the correction possibilities, the analog workflow is less flexible with limited possibilities of repairs while during the digital workflow, one new restoration could be milled under one hour without distortions as is also mentioned by Cervino et al. (4).

However, it is recommended to take into consideration the higher equipments' costs and multiple dedicated software needed for the digital workflow. A literature review published in 2021 by Lepidi et al. (5) stated that currently, there are over thirty various techniques and methodologies related to virtual mounting in digital workflow.

The digital workflow represented a more pleasant experience for the patient due to the interactive interface used for simultaneous digital projects, constant up-to-date and predictability, all these being possible only in case of a digital protocol as it is also mentioned by Cofar in his study (6).

CONCLUSIONS

The digital workflow was preferred due to a better interdisciplinary communication, the possibility to involve the patient from the very first decision.

The digital workflow offers the reliability of the final restorations according to the initial mock-up, adequate esthetic and functional outcomes in terms of shade integration using industrial shaded ingots with high versatility of monolithic materials, and, not least, adequate anterior and lateral guidance. Additionally, the digital protocol was less

dependent to the craftsmanship of a skilled dental technicians in terms of layering, shade and shape matching and functional occlusion.

Also, financial costs, multiple dedicated software needed for the digital workflow, the necessity of a constant update to information and not least, the learning curve should be taken into consideration when choosing a digital approach.

All the mentioned characteristics are promising regarding the esthetic and functional outcomes for full digital prosthodontic cases.

Acknowledgements

REFERENCES

1. Joda T, Zarone F, Ferrari M. The complete digital workflow in fixed prosthodontics: a systematic review. BMC oral health. 2017 Dec;17(1):1-9.
2. Tallarico M. Computerization and digital workflow in medicine: Focus on digital dentistry. Materials. 2020 Jan;13(9):2172.
3. Coachman C, Blatz MB, Bohner L, Sesma N. Dental software classification and dento-facial interdisciplinary planning platform. Journal of Esthetic and Restorative Dentistry. 2021 Jan;33(1):99-106.
4. Cervino G, Fiorillo L, Arzukanyan AV, Spagnuolo G, Cicciù M. Dental restorative digital workflow: digital smile design from aesthetic to function. Dentistry journal. 2019 Jun;7(2):30.
5. Lepidi L, Galli M, Mastrangelo F, Venezia P, Joda T, Wang HL, Li J. Virtual articulators and virtual mounting procedures: where do we stand?. Journal of Prosthodontics. 2021 Jan;30(1):24-35.
6. Cofar F, Stankov V, Barbur J, Argint A, Popp I, Ciu L, Van Dooren E. Contemporary Planning Tools for Restoration of Congenitally Missing Maxillary Lateral Incisors. Compendium. 2021 Nov;42(10).