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Case Report

Full-Digital Workflow for an Aesthetic Rehabilitation: A Case Report

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Abstract

Nowadays, digital tehnologies incorporated in our daily practice, help us to provide optimized and personalized oral health care. This case presentation is aimed at describing a full-digital protocol of an aesthetic rehabilitation of a young female patient and evaluating its clinical performance.

Keywords: Digital Impression; Aesthetic Rehabilitation; Intraoral Scanner

Introduction

Constant technological evolution brings shifts in perspective across various fields, one of which is dental medicine. Dentists' practice is significantly impacted by access to information and the ability to digitize certain clinical stages.

Intraoral scanners offer us the possibility for precise digital impressions of dental arches. Due to the competitiveness of this method for recording structures within the oral cavity, the traditional impression process using trays and impression materials is likely to be replaced.

Whether we're talking about the ability to preview orthodontic treatment progress using intraoral scanner software, producing small prosthetic pieces "in office" that can now be scanned, designed, and milled in record time, or the correlation we can establish between digital impressions of dental arches and CBCT investigations to create 3D-printed surgical guides, it's undeniable that digital impressions will soon be a part of every dentist's practice.

At the end of the 20th century, in 1985, Dr. Werner Mormann, together with electronics engineer Dr. Marco Brandestini, developed the concept that would be named CEREC 1 [1]. This system consisted of a 3D intraoral scanning system and a milling machine for creating prosthetic restoration from solid ceramic blocks. CEREC 1 was followed by CEREC 2 in 1994 and then CEREC 3 in 2003, with each version featuring numerous improvements over the previous one [2].

For a considerable period of time, the CEREC system had no competitor on the market. In 2008, the appearance of the Cadent iTero intraoral scanner made it possible to capture the entire arch. In 2011, Align Technology acquired Cadent and incorporated the iTero scanner into the Invisalign aligner production protocol. Following this advancement, all major dental equipment manufacturers focused their efforts on creating faster and more precise IOS (IntraOral Scanners).

The components of an intraoral scanner are:

- The handpiece, which performs the actual intraoral scanning;
- The software, which integrates the data collected by the handpiece;
- A high-performance computer, capable of running the software.

The main purpose of the IOS (IntraOral Scanner) is to capture the three-dimensional geometry of objects as precisely as possible. The most commonly used digital format is Open STL (Standard Tessellation Language). This format is already used in many fields and is represented by a sequence of triangular surfaces, each of which is defined by three points and a perpendicular to the surface defined by them. Later, in response to the need to record clinical situations more accurately, more complex file types were developed, capable of capturing color, texture, and transparency. One such format is the Polygon File Format (PLY) [4].

The recording of information from the oral cavity is achieved by projecting light from the scanner handpiece onto the dental surfaces and reflecting it back to the integrated sensor or camera. Using algorithms and numerous calculations, the software reconstructs a three-dimensional model of the scanned structures. The technology used by the handpiece to capture data determines the accuracy, speed, and resolution of the scan [5].

Advantages and disadvantages of digital impressions

The advantages of digital impression are enhanced patient cooperation due to increased comfort, improved patient understanding of their clinical condition and treatment plan, better cooperation with patients who have gag reflex and a more pleasant experience. The communication with the dental lab is improved, the risk of impression distortion is eliminated and the production time for prosthetic restorations in the lab is reduced [6-10].

The disadvantages include the high acquisition costs for the required technology, the required time, patience and manual skill to master the learning curve. The accuracy may be impacted by the presence of saliva on the dental surfaces, by shiny enamel or full-metal/amalgam restorations, by deep preparation margins or by bleeding soft tissues [11-14].

One of the most interesting area in nowadays dentistry is cosmetic dentistry [15]. Many patients wants a “Hollywood smile” with white and aligned teeth [16,17]. A minimally invasive restoration procedure is represented by laminated veneers, which offers superior esthetic results [18,19]. The introduction of digital technology has revolutionized the veneers preparation and bonding also aided by 3D printed guides, leading to a predictable result [20,21].

Clinical Case Report

A 25-year old female patient came into our dental office expressing dissatisfaction with the appearance of her maxillary teeth, which show volume changes (abrasions) and lack of harmonious shapes (Figure 1, Figure 2). The patient desires an aesthetic rehabilitation that will involve minimal sacrifice of the hard dental tissues, as they have previously undergone orthodontic treatment that aligned the teeth in the arch curve and balanced the occlusion. A treatment plan, with laminated veneers and crown lengthening, was presented but the patient refused any surgical intervention. A written informed consent has been provided by the patient, accepting the proposed treatment plan and giving the permission to publish all the case details and any accompanying photos.

Figure 1: Initial appearance-frontal view.

Figure 2: Initial appearance – maximum intercuspation position – frontal view.

Following the clinical examination, it was observed that the patient has abrasions of varying degrees on the teeth, multiple simple carious lesions, and dental asymmetries. To meet the patient's aesthetic desires, a decision was made to treat twelve maxillary teeth, which will be covered with all-ceramic veneers.

To create a diagnostic cast, the first clinical step involves recording the dental arches and the intermaxillary occlusal relationship. Impressions were taken using the MEDIT i500 intraoral scanner. The impression process began with the maxillary arch according to the IOS manufacturer's guidelines, followed by the opposing arch and then recording the right and left occlusion over a segment of approximately four teeth (Figure 3, Figure 4, Figure 5).

The workflow for creating the diagnostic cast was entirely digital; impressions of the arches, along with clinical photographs of the patient, were sent electronically to the dental laboratory.

Figure 3: Preliminary maxillary impression – palatal view.

Figure 4: Digital impressions of the dental arches in maximum intercuspation – frontal view.

Figure 5: Bilateral recording of intermaxillary occlusal relationships – frontal view.

This information provided the dental technician with the data needed to design a virtual wax-up using lab-specific software and to convert it into a physical model via 3D printing (Figure 6).

Figure 6: 3D printed cast of the diagnostic wax-up – palatal view.

In the next clinical phase, the lab information was transferred into the oral cavity through a mock-up to confirm both aesthetics and functionality (Figure 7, Figure 8, Figure 9, Figure 10).

Figure 7: Mock-up in maximum intercuspation – frontal view.

Figure 8: Mock-up in edge-to-edge position in propulsion – frontal view.

Figure 9: Mock-up in right lateral movement – frontal view.

Figure 10: Mock-up in left lateral movement – frontal view.

After testing the mock-up, occlusal balance in maximum intercuspation was observed, with appropriate inclination of the maxillary teeth's facial surfaces, and the incisal plane and smile line maintained. The patient was also satisfied with the dental aesthetics.

In the third clinical phase, based on conclusions from the mock-up, minimally invasive preparations limited to the enamel were performed. After preparing the dental surfaces, gingival retraction was done, followed by finishing. The shade of the future restorations was also determined during this phase.

Dental surfaces were scanned using the MEDIT i500 intraoral scanner. The arches were recorded according to the manufacturer's recommended protocol, beginning with the occlusal surfaces on each arch and then capturing the remaining tooth surfaces. The final step was recording the right and left occlusion over a segment of about four teeth each (Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17).

Figure 11: Final maxillary impression – palatal view.

Figure 12: Final maxillary impression – frontal view.

Figure 13: Final mandibular impression – occlusal view.

Figure 14: Digital impressions in maximum intercuspation – frontal view.

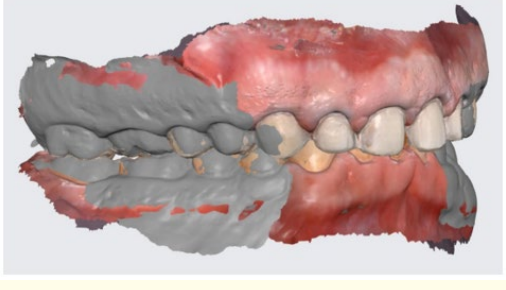

Figure 15: Right side recording of intermaxillary occlusal relationship – lateral view.

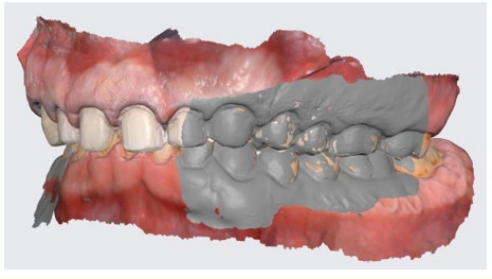

Figure 16: Left side recording of intermaxillary occlusal relationship – lateral view.

Figure 17: Bilateral recording of intermaxillary occlusal relationship – frontal view.

The necessary information for the restorations was sent electronically to the dental laboratory as a monochromatic 3D file, which was then imported into the design software (Figure 18). To provide a complete set of information, intraoral photographs from the diagnostic modeling phase and photos of the preparations were also sent to the lab.

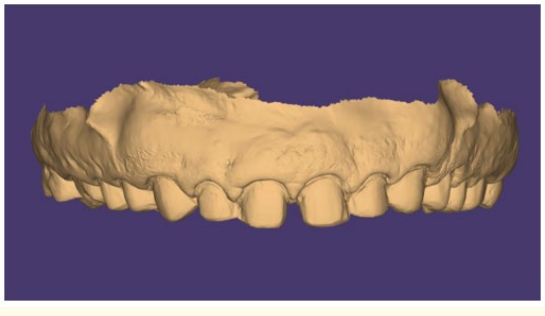

Figure 18: STL file in design software – frontal view.

After creating the twelve all-ceramic veneers in the dental laboratory and clinically validating them through a trial fitting, adhesive cementation was performed in the oral cavity, following the manufacturer's protocol (Figure 19, Figure 20, Figure 21, Figure 22).

Figure 19: Final post-cementation appearance – frontal view.

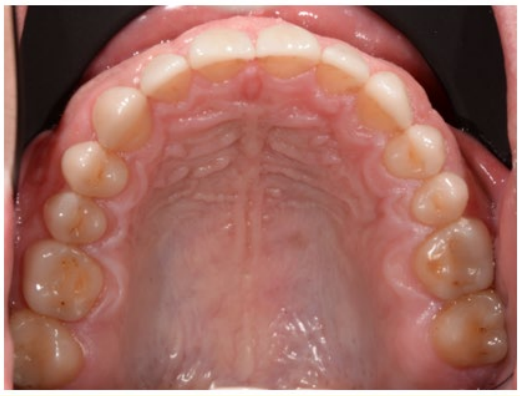

Figure 20: Final post-cementation appearance – palatal view.

Figure 21: Final post-cementation appearance in maximum intercuspation – right lateral view.

Figure 22: Final post-cementation appearance in maximum intercuspation – left lateral view.

Discussions

Choosing a digital intraoral impression protocol is confirmed by various clinical studies as a competitive method to the traditional impression protocol [22-25]. Although intraoral scanning is not yet a standard practice for most dentists, technological advances, increased accessibility, and the elimination of current limitations may lead to the eventual replacement of traditional impression methods with intraoral scanning [26,27].

The presented workflow provides the opportunity to offer temporary restorations that represents the proposed final shape, color and contour of the definitive restorations. The patient can choose to make any changes in order to achieve the desired result.

The intraoral scanning process demonstrated several advantages, such as the ability to accurately capture oral cavity structures, seamless communication with the dental laboratory, and enhanced patient understanding of the treatment plan through direct visualization of the clinical situation. The technological workflow for creating restorations was almost exclusively digital, eliminating multiple clinical and technical steps that are prone to error. One of the key factors for clinical success in indirect restorative treatment is the precise registration of the dental arches, with intraoral scanning proving to be a competitive alternative to the analog protocol.

Conclusions

Considering the multiple advantages of digital impressions and the ability to resolve a wide range of cases using this new, alternative method, this case report explored a topic of interest and demonstrated, through the clinical steps, the adaptability of this protocol in commonly encountered clinical procedures.

Nevertheless, understanding the limitations and potential errors associated with using this digital technique for capturing information from the oral cavity can be a determining factor in achieving a highly accurate impression.

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