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Clinical case

Semi-Chairside Workflow for Ceramic Veneers

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ABSTRACT

Introduction: 3D technology and digital dentistry software allow prior planning and visualization of results, improving the effectiveness of the professional in situations of high complexity and aesthetic demand, such as treatments on anterior teeth. **Objective:** To present a semi-chairside workflow for ceramic veneers, using CAD/CAM technology in the clinic and laboratory to achieve aesthetic restorations quickly and efficiently. **Case presentation:** A 42-year-old female patient, resident in Santiago, Chile, whose four maxillary incisors were treated with a semi-chairside workflow to correct size, shape and colour. It began with clinical whitening in three sessions, then the mock-up technique was employed as a diagnostic method with the digital smile design previously carried out in the DentalCAD® by exocad software. Once the preparations were completed, the digital impression was taken with Cerec® software and merged with the initial design in the In-Lab CAD v. 22.0 software. The restorations were milled on a Cerec MC XL milling machine from IPS e.max® CAD blocks. The colour was adjusted with IPS Ivocolor® stains and the cementation process was executed with dual resin cement through the protocol for glass ceramics. **Conclusions:** The utilisation of digital impression equipment is the basis for integrating the smile design developed in laboratory software and dental preparations, facilitating the replication of the entire initial design in the final restorations thanks to the correct communication between the professional and the laboratory and the management of CAD/CAM technology in semi-chairside workflows.

Keywords: Digital Dentistry, Cerec, CAD/CAM, Digital Impression, Mock-Up, Digital Smile Design, Veneers, Ceramics, Lithium Disilicate.

INTRODUCTION

Digital dentistry has recently experienced multiple advances thanks to the development of technology. For example, Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) technology has enabled great advances in restorative dentistry, allowing the implementation of new treatment modalities and changes in the education and training of new dentists[1]. Furthermore, the ability to efficiently design and fabricate aesthetic restorations from an optical impression, and with good marginal adaptation, has been facilitated in both clinical and laboratory settings, which would not otherwise be possible[2].

Digital workflow in a clinical treatment can be carried through with chairside or semi-chairside techniques, the difference between them lies mainly in the involvement of a dental laboratory during the process. In a chairside workflow the entire treatment is created directly in the clinic with the preparation and milling of the teeth, the intraoral digitisation and scanning, and finally the milling of the restoration for immediate cementation, all in the same clinical session. In a semi-chairside workflow, we work together with the laboratory to compose multiple designs of greater complexity due to the greater number of tools in laboratory software[2].

One of the most commonly used methods today to test and evaluate a smile design is a technique known as direct mock-up. The technique plays an important role as a diagnostic tool to preliminarily assess function and aesthetics, and at the same time, facilitates the detection of treatment limitations. It is defined as the manufacture of a self-polymerising bisacrylic resin guide installed directly in the mouth on the surfaces of unprepared teeth, using a silicone matrix or key previously made on the 3D print of the digital wax-up, which can also be used as a carving guide, achieving greater enamel conservation and a more predictable biomechanical and aesthetic union[3,4]. Additionally, this same material can be handled as provisional when we are in a semi-chairside workflow.

On the other hand, for the development of aesthetic treatments, ceramics have been the material of choice due to their long-term mechanical and chromatic stability, and their great aesthetic capacity which imitates the aspect properties of natural teeth while maintaining acceptable biomechanical and biocompatible characteristics of the material. Lithium disilicate glass ceramic is composed of 65% lithium disilicate in the form of crystalline structures, resulting in a flexural strength of 530 MPa, a fracture toughness of 2.11 MPa and good translucency[5,6].

One of the lithium disilicate ceramic blocks that is utilised in the digital flow is the IPS e.max® CAD from Ivoclar Vivadent. Depending on their level of translucency, they are classified as: HT (high translucency), MT (medium translucency), LT (low translucency), MO (medium opacity) and I (impulse). In turn, each of these is subclassified according to shade and size.

Ceramic veneer treatments with high aesthetic requirements are defined as a thin bonded ceramic restoration that covers the vestibular surface and part of the proximal surfaces of the teeth, which in turn results in a conservative preparation with minimal wear on the tooth[1, 2]. For maxillary anterior teeth, typical preparation involves the entire buccal surface to a depth of approximately 0.5 mm. In some cases, when there is a need to lengthen teeth or close interproximal spaces, incisal and/or proximal coverage is indicated, which can be extended as a palatal chamfer or simply as a horizontal incisal reduction (butt joint)[1, 7].

Therefore, the purpose of this work is to present a semi-chairside workflow for ceramic veneers in the anterior sector, employing CAD/CAM technology in conjunction with laboratory software to attain aesthetic restorations quickly and efficiently.

CLINICAL CASE PRESENTATION

A 42-year-old female patient, resident in Santiago, Chile, came to the clinic seeking for an aesthetic solution for her maxillary anterior teeth in terms of size, shape and colour. Intra- and extraoral examination revealed a disharmony of the aesthetic parameters of the smile and multiple composite resin restorations in the four maxillary incisors, all of which were vital (Figure 1A-B). The patient did not show any signs of temporomandibular pain. The diagnosis was completed with an orthopantomography and a series of dentoalveolar images of the four maxillary anterior teeth, obtaining images that coincided with what was observed clinically.

For this case, a completely digital planning and execution treatment was chosen. MT-Lithium disilicate glass ceramic CAD/CAM blocks (IPS e.max® CAD, Ivoclar Vivadent AG, Schaan, Liechtenstein) were chosen for the restorations. The initial smile design and digital mock-up were done

Figure 1. Initial photographs. A. Initial extraoral photograph. B. Initial intraoral photograph showing the disharmony in relation to the size, shape and colour of the four incisors.

in Digital Design software (DentalCAD®, Exocad GmbH, Darmstadt, Germany) using the initial intraoral scan plus portrait and smile photographs taken at the first session (Figure 2A-E). The treatment began with clinical tooth whitening in three sessions, four cycles of 8 minutes each, accomplished with a whitening kit (Pola Office, SDI Limited, Bayswater, Australia) with 35% hydrogen peroxide. The patient's initial shade was A1 from the shade guide (SR Vivodent A-D Shade Guide, Ivoclar Vivadent AG, Schaan, Liechtenstein). Following the sessions, a shade Bleach 4 from the shade guide was reached. After 14 days, the preparation of the veneers began because it is necessary to adequately dissipate the free oxygen radicals and estimate a possible colour regression –which did not occur– before starting the definitive treatment.

For the direct mock-up test with the proposed initial design, bisacrylic resin, shade A2 (3M™ Protemp™ 4, 3M Espe Deutschland GmbH, Seefeld, Germany) was carried out on a preliminary impression key made with addition silicone (3M™ Express™ XT Putty Soft, 3M Espe Deutschland GmbH, Seefeld, Germany) as a diagnostic tool, where the patient participated in the final modifications of the design (Figure 3A-B).

Preparations of the four maxillary incisors for labial veneers with incisal butt joint finish were performed, applying the bur kit (Intensiv Style Indiretto, StyleItaliano, Genoa, Italy) (Figure 3C). The last step in the preparation was to place a #00 separation cord (Ultrapak™, Ultradent Products Inc., South Jordan, UT, USA) and polish with rubbers (Enhance®, Dentsply Sirona Inc., Charlotte, NC, USA). Despite the slight gyroversion of the left maxillary canine, it was decided not to include the canines since they were intact and thus a natural look could be added to the design of the new smile. Once the dental preparations were completed, the

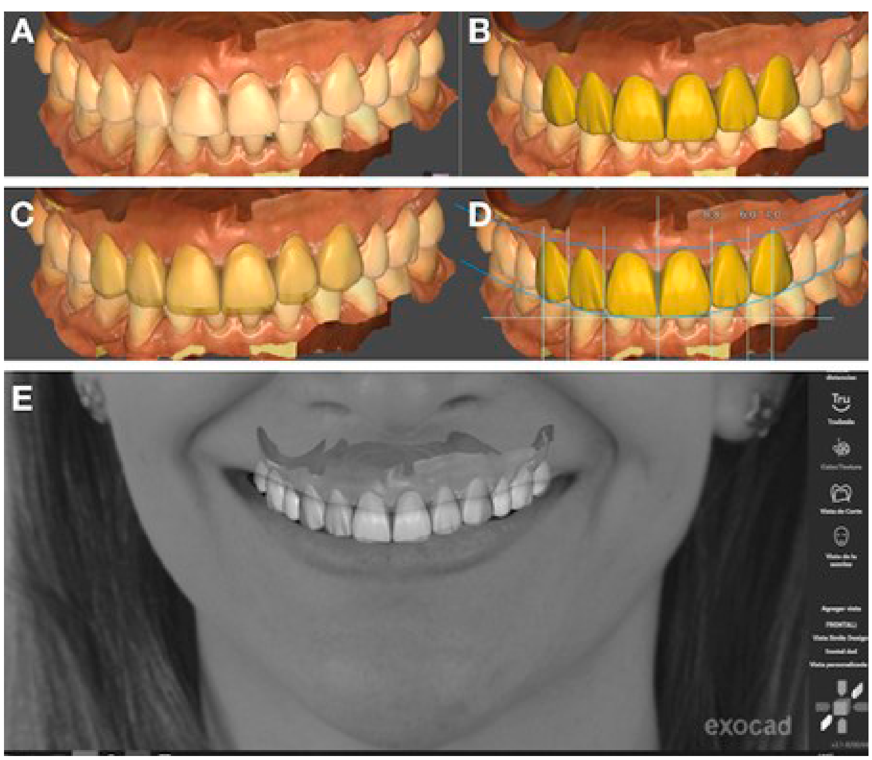

Figure 2. Photographs of the Digital-Planning Flow. A. Initial scanning of the maxillaries with Primescan and Cerec® software. B. Digital smile design in DentalCAD® by exocad software. C. Superimposition of the digital smile design on initial models. D. Digital smile design with aesthetic parameter lines. E. Digital mock-up in DentalCAD® by exocad software with smile photograph.

digital impression was conducted with the intraoral scanner (Primescan, Dentsply Sirona Inc., Charlotte, NC, USA) and Cerec® software version 5.2.4 (Dentsply Sirona Inc., Charlotte, NC, USA), with the separation cord in place and a lip and cheek retractor (OptraGate®, Ivoclar Vivadent AG, Schaan, Liechtenstein) to facilitate the digital impression (Figure 3D).

The final design of the definitive restorations was created in InLab CAD software version 22.0 (Dentsply Sirona Inc., Charlotte, NC, USA) in conjunction with the previous digital design developed in DentalCAD® by exocad software, with the aim of getting a copy of the design initially tested and accepted by the patient through the direct mock-up handled as a diagnosis (Figure 3E). As a provisionalisation method, a mock-up was manufactured again with bisacrylic resin, shade A2, with the previously approved smile design, which the patient wore in her mouth for four days until the day the cementation was completed.

The restorations were milled from CAD/CAM blocks of MT lithium disilicate glass ceramic, shade BL4, using a milling machine (Cerec MC XL, Dentsply Sirona Inc., Charlotte, NC, USA) and placed on a 3D printed verification model where the veneers were fitted and finished, providing a customised finish and texture (Figure 3F). A first intraoral test of the restorations was done, where minimal details of shape were retouched, to lead to crystallisation in an oven (Programat® P300, Ivoclar Vivadent AG, Schaan, Liechtenstein) between 840° and 850° C. Afterwards, the cementation try-in was performed where the veneers were positioned on the tooth preparations with try-in cement, shade A1 (3M™ RelyX™ Veneer Cement Kit, 3M Espe Deutschland GmbH, Seefeld, Germany) to evaluate the need for colour corrections. The technician then made final shade adjustments by staining the restorations with IPS Ivocolor® (Ivoclar Vivadent AG, Schaan, Liechtenstein).

The cementation process is managed with the protocol for glass-ceramic cement (3M™ RelyX™ Universal Resin Cement, 3M Espe Deutschland GmbH, Seefeld, Germany). The etching of the ceramic veneers was carried out with 9% hydrofluoric acid (Ultradent™ Porcelain Etch, Ultradent Products Inc., South Jordan, UT, USA) for 20 seconds and washed with water

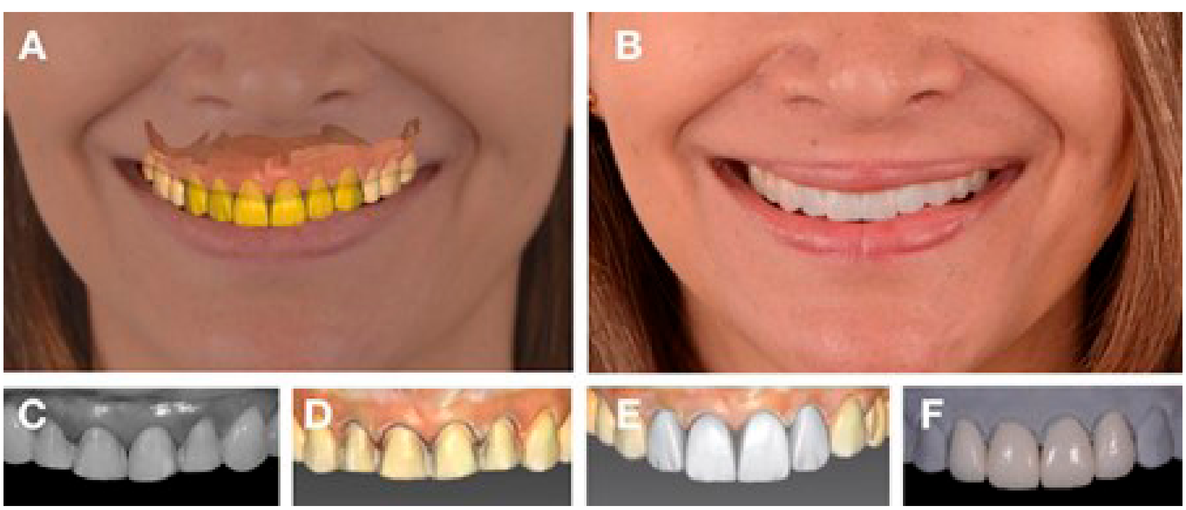

Figure 3. Photographs of the Digital-Execution flow. A. Digital mock-up in DentalCAD® by exocad software. B. Physical mock-up with bisacrylic resin, shade A2. C. Intraoral photograph showing the preparations of the four maxillary incisors for labial veneers with incisal butt joint finish. D. Digital impression with Primescan and Cerec® software. E. Digital impression joined with digital design in InLab CAD software preliminarily made in DentalCAD® by exocad software. F. Front view of the IPS e.max® CAD ceramic veneers on the 3D printed model, where they were adjusted and characterised.

for 15 seconds. The surface was dried and universal adhesive (3M™ Scotchbond™ Universal Plus Adhesive, 3M Espe Deutschland GmbH, Seefeld, Germany) was applied by actively rubbing for 20 seconds and then air-drying for five seconds. Total enamel etching was fulfilled with 35% orthophosphoric acid (Ultra-Etch™, Ultradent Products Inc., South Jordan, UT, USA) for 15 seconds, and the surface was washed and dried for 5 seconds. The universal adhesive was actively rubbed onto the surface for 20 seconds and excess solvent was removed by vigorous blotting for 5 seconds.

Resin cement, shade A1 was applied for cementation, starting with the central incisors and individually cementing the lateral incisor veneers, isolating the adjacent preparations in each case with Teflon (IsoTape, TDV Dental Ltda., Pomerode, Brazil). First, each surface was light-cured for 2 seconds to facilitate the removal of excess cement. Then, each surface was light-cured for 10 seconds (vestibular and palatal), followed by the removal of the separating cord (Figure 4A). A clinical check-up was executed two weeks later, where the patient did not present symptoms. The occlusion and disocclusion patterns were assessed without the need for corrections, and it was observed how she satisfactorily recovered the aesthetic parameters of shape, size and colour (Figure 4B-C).

DISCUSSION

This case report describes the step-by-step process to create an aesthetic result in maxillary anterior teeth, with a minimally invasive treatment of ceramic veneers performed with a semi-chairside workflow. While fully chairside workflows with CAD/CAM technology enable the operator to design and manufacture ceramic restorations in a few hours in a single clinical visit, semi-chairside workflows provide the possibility of developing treatments with greater

Figure 4. Final photographs. A. Intraoral view of the IPS e.max® CAD ceramic veneers after cementation. B. Initial extraoral photograph. C. Final extraoral photograph clearly showing how the patient regained her aesthetic parameters in relation to shape, size and colour.

aesthetic complexity by using laboratory software with more design tools, such as InLab CAD v. 22.0 and DentalCAD® by exocad software. Likewise, this workflow allows the design to be estimated in the patient, prior to the final creation of the veneers by means of a test or mock-up, in order to conclude the final aesthetic and functional modifications.

Within the production process of restorations with CAD/CAM technology, we find three options available in the software for the design of the restoration: reference, biocopy or biogeneric individual. When treating clinical cases where it is required to restore multiple anterior teeth with aesthetic problems, the biocopy method is preferred because the initial digital planning uses it as a reference. The design had been tested in the mock-up, corrected and accepted by the patient, thus attaining excellent aesthetic results. This way, the semi-chairside workflow favours employing a mock-up as a diagnostic tool to evaluate the final design of the restoration, and also being able to handle changes to obtain optimal results in cases of high aesthetic complexity[8].

The digital impression technique presents important advantages over the conventional impression technique with elastomeric materials, such as efficiency and improvement of treatment time, the comfort of the technique, and the ability to save and store digital files indefinitely, which helps improve communication between the laboratory and the dental clinic, especially in semi-chairside workflows[9]. The intraoral scanner utilised in our case completes full arch scans in a short time, clearly differentiating various elements in the scanned image such as resin, ceramic, metal and/or gingival tissue restorations with great efficiency and precision. This scanning capability makes it easy to complete both single and full-arch restorations with minimal effort on the part of the user. The Cerec® software 5 has further developed the so-called 5-click workflow, allowing for almost complete automation of the Cerec® workflow[10,11]. Ng *et al.*[12] and Syrek *et al.*[13] mention that although the conventional method of ceramic fabrication has been used for decades with proven long-term results in terms of longevity and survival, the inability to control all variables, plus human error, can result in marginal poor fit and even misfit of ceramic restorations.

The applied pre-crystallised lithium disilicate glass ceramic comes in a blueish presentation and is characterised by a moderate flexural strength of 130 MPa, which results in increased manufacturing efficiency of the restoration and reduced wear on milling tools. Zarone *et al.*[6] mention that one of the most important characteristics of lithium disilicate corresponds to its excellent biocompatibility with soft tissues, especially when the ceramic surface is polished. A clinical study[14] reported on the survival of CAD/CAM ceramic veneers in a private clinic. The authors concluded that IPS e.max® CAD ceramic veneers were clinically successful restorations with a 100% survival and success rate after five years.

Thanks to the correct selection of materials and semi-chairside workflows, we can integrate the speed and simplicity of CAD/CAM technology with the accuracy and precision of the laboratory for the manufacture and design of restorations. Due to the proper understanding and application of the clinical procedure, successful results were reached, in this case of high complexity.

CONCLUSION

Ceramic veneers can be designed and manufactured with great precision managing CAD/CAM technology, gaining perfect integration with the rest of the teeth in the smile. The semi-chairside workflow facilitates communication between the dentist and the patient. As a planning tool, the mock-up can first be designed digitally, then applied in the mouth for a physical try-in as a diagnostic tool, and can also be utilised as a provisional. The employment of digital impression equipment is the basis for integrating the smile design developed in laboratory software and dental preparations, allowing the entire initial design to be replicated in the final restorations thanks to the correct communication between the professional and the laboratory and the application of CAD/CAM technology in semi-chairside workflows.

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