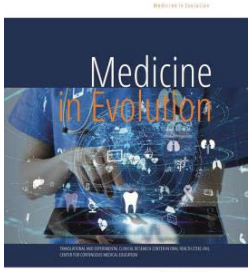
Digitalizing ceramic inlays – a dental lab view



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Abstract

Case presentation: Ceramic dental inlays are known as very high-quality prosthetic works, similar to physiognomic composite fillings, made in the laboratory based on impressions. This gives them a special aesthetic, similar to the natural tooth.

Material and method: In this study we realized two types of ceramic inlays in the dental laboratory: on the second upper right bicuspid – a mesio-occluso-distal type, and on the first upper left molar – an occluso-mesio-palatal type for the same patient. We used Empress Multi CAD® ceramics (Ivoclar, Lichtenstein) together with the DentalCAD software (Exocad, Germany).

Discussions/Conclusions: Ceramic inlays are laborious micro prostheses that require a lot of involvement, attention and precision, any imperfection could compromise the adaptability of the final piece. They ideally restore the coronary morphology from both a functional and aesthetic point of view, and thanks to this fact, they are ideal for patients where there are special aesthetic imperatives.

Keywords: ceramics, CAD-CAM, aesthetics, inlays

INTRODUCTION

Inlay and onlay systems can be made using sintered, cast, pressed or mechanically milled ceramics. Ceramic inlays are classified into two categories: all-ceramic and metal-ceramic. The development of the all-ceramic concept in the last ten years has led to the opening of new ways in fixed prosthodontics, namely adhesive dentistry, through the biocompatibility of materials. These have gained place thanks to double-acid etching techniques (ceramics with HF and dental hard tissues with H3PO4), the development of CD and dentinal adhesives that have changed the concept of aggregating these single-dental prostheses) [1].

The introduction of CAD-CAM systems represented a real revolution in dentistry. With this, a ceramic inlay can be designed and manufactured in a single session. The reconstruction of the three-dimensional image is based on the accumulated information and consists in calculating the three coordinates in space (X, Y, Z) with the help of mathematical algorithms for each point of the prosthetic field. After the optical impression is made, the computer later reproduces the image of the imprinted structures on a monitor to allow the user to control the design of the restoration. After designing the morphology of the restoration, the data about its shape are transformed into a set of instructions that will be transmitted to the milling device [2].

Aim and objectives

The aim of this case report was to emphasize that digitally techniques in dental labs, such DentalCAD (Exocad, Germany), could maximize productivity. They are safe and robust, could lead to satisfying results even when used in complex cases, and are easy to use, flexible and fast [3,4].

CASE REPORT

At clinical examination we found two old incorrect composite restorations on 1.5 and 2.6, in a young female patient with a good oral hygiene. The first proposal was to replace these restorations with new composite ones, but the patient refused. Finally we decided to realize two types of ceramic inlays in the dental laboratory: on 1.5 – a mesio-occluso-distal type, and on 2.6 – an occluso-mesio-palatal type (Figure 1).

Figure 1. Working model with the two types of inlays (1.5 and 2.6)

Model scanning

Before scanning the model, we must enter the patient's data and select the type of work we want to do (Figures 2, 3) into the DentalCAD software.

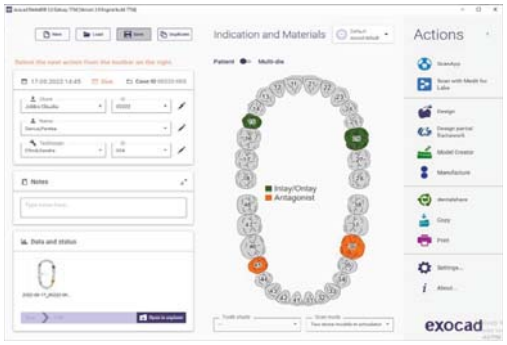


Figure 2. Entering case data into ExoCad

Figure 3. The choice of material

After entering the data and selecting the desired job type, we will open the scanning software and select the scanning strategy we will use. In this case we opted for scanning the model with movable abutments (Figure 4).

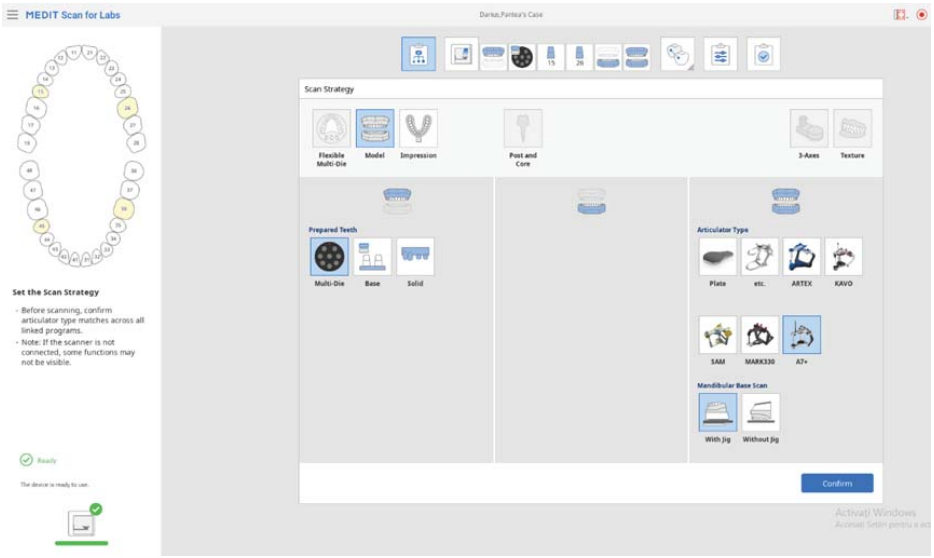


Figure 4. Choosing the scanning strategy

We started with scanning the maxillary model, after which we did the separate scanning of the movable abutments (Figures 5,6). Next was the antagonist model scan (Figure 7) and the occlusion scan (Figure 8).

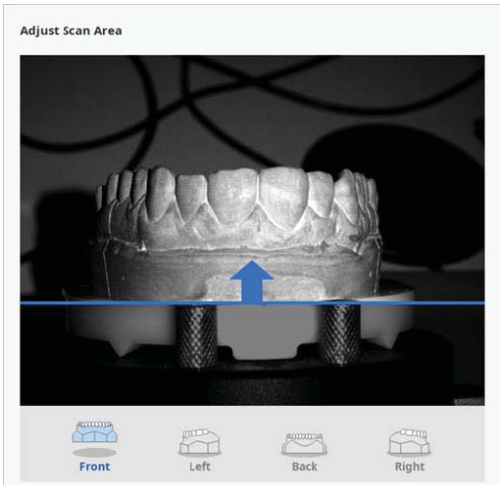


Figure 5. Selecting the scan area

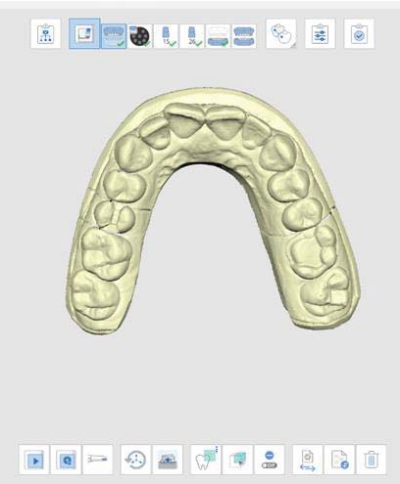


Figure 6. The scanned working model

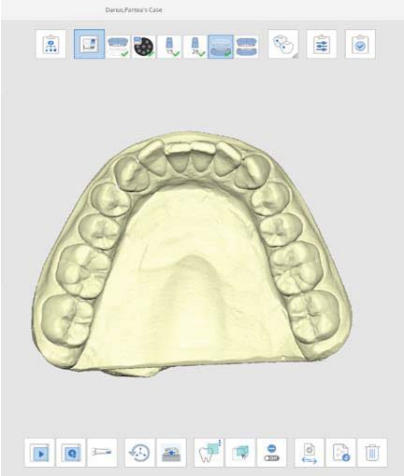


Figure 7. The scanned antagonist model

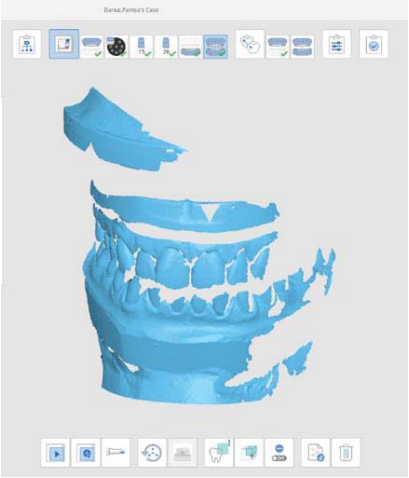


Figure 8. The scanned occlusion

After both models and the occlusion have been scanned, their overlay follows. Initially, the scans of the abutments and the working model are superimposed, followed by superposition of the occlusion with the two models (Figure 9).

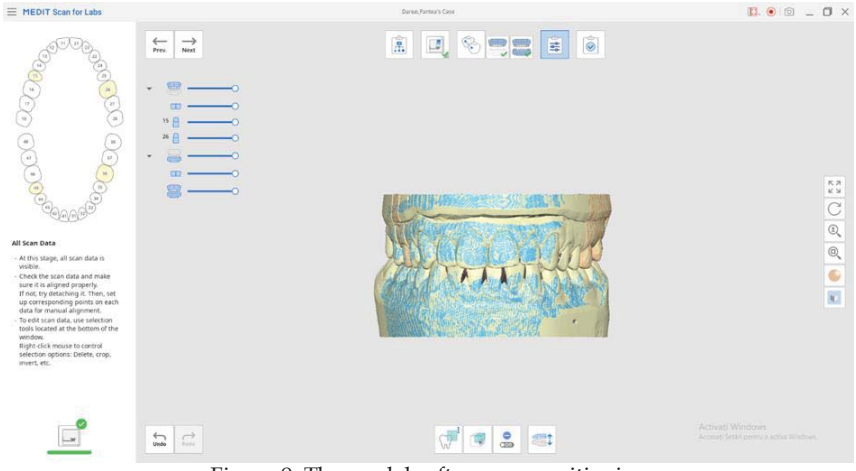


Figure 9. The models after superpositioning

Designing the inlays

The first step of the design creation was drawing the edges of the preparations. Initially we selected "*Detect*", where we positioned points for automatic detection of the edges of the preparation, and then we selected "*Correct/Draw*" to adjust the positioning of the edges of the preparation (Figures 10,11).

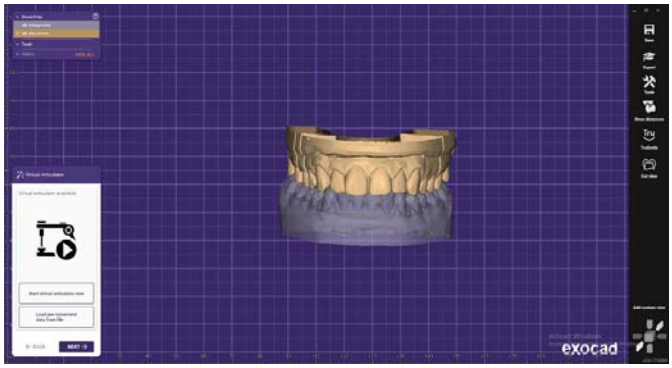
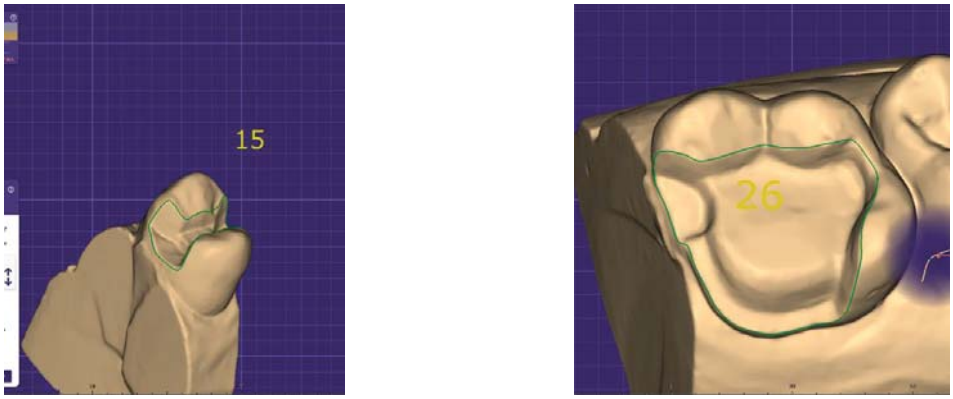


Figure 10. The ExoCAD model



a b

Figure 11. Selection of preparation limit (a – for 1.5 and b – for 2.6)

The next step was the selection of the insertion axis. It was selected by rotating the model until it reached the axis we wanted for the future restoration, then we selected "*Set current view as insertion axis*" when the model was in the desired position (Figure 12).

a b

Figure 12. Insertion axis selection (a – for 1.5 and b – for 2.6)

The next step was to make the inside of the prosthetic work: to select the thickness and the angle we want for the edges of the preparation; the thickness of the cementation space, as

well as the shape and minimum number of cuttings with which the inlay will be milled. Here we paid attention to have enough thickness so that cracks do not appear during milling (Figure 13).

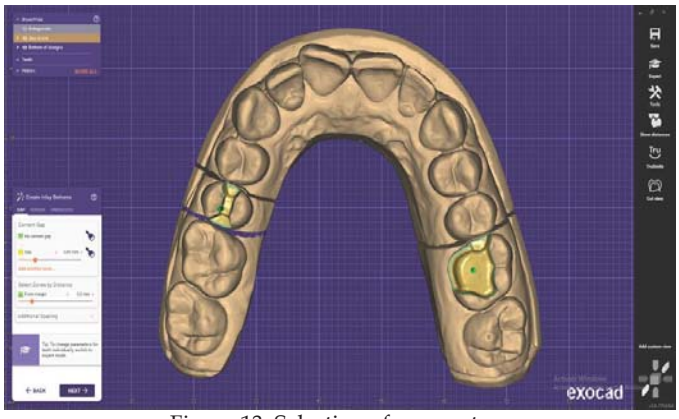


Figure 13. Selection of parameters

In the next step, we chose and positioned the tooth from the library, adapting it to the given case (Figure 14). We had different tools that helped us adjust the dimensions and position of the chosen tooth (Figure 15).

Figure 14. Selecting teeth from the software library

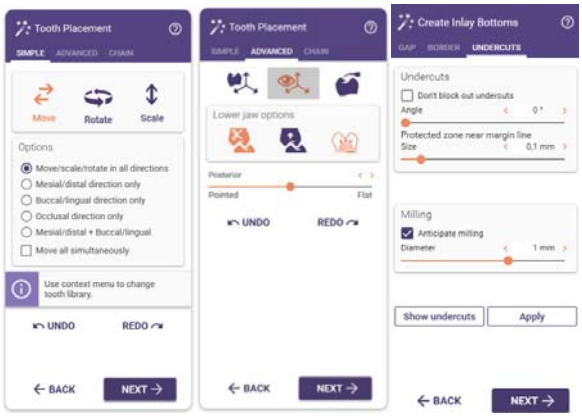
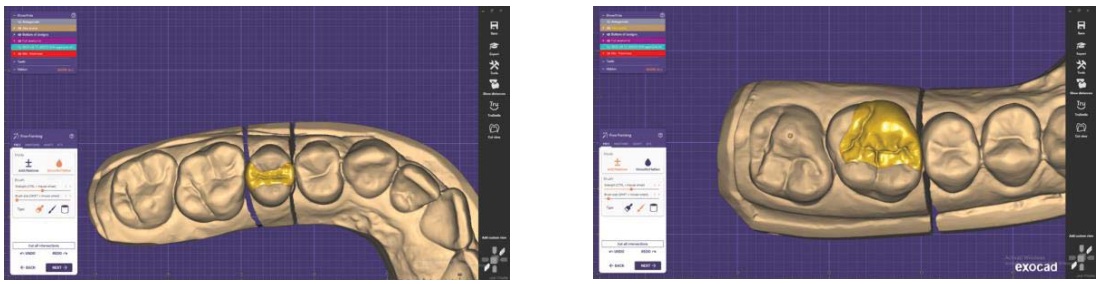


Figure 15. Software tools used to adapt the teeth to the model

After adapting the teeth to the model, we changed their morphology, so that it was correctly registered in the arch. After this we checked and made the contact points with the opposing teeth and the proximal contacts with the adjacent teeth (Figure 16).



a b

Figure 16. Inlay modeling and adaptation (a – for 1.5 and b – for 2.6)

In the end, we finished with the tools from the soft design of the future inlays, and then we saved them. So we were able to move on to the next stage: milling the inlays (Figure 17).

a b

Figure 17. The final aspect of the inlays (a – full arch and b – only inlays)

The milling

We started by choosing the ceramic blocks that we will mill. We used blocks of IPS Empress CAD Multi in this case [5-9]. Next was positioning the design into the ceramic block we have chosen, making sure it was positioned entirely within the ceramic block (Figure 18).

a b

Figure 18. The ceramic blocks Empress®CAD Multi (a) and the positioning of the prosthetic piece within ceramic block (b)

We checked if the cutter of the milling machine can touch all the surfaces of the future prosthetic work, in order not to have extra ceramic amount compared to the design. We positioned the ceramic block in the machine and started milling (Figure 19). We used a PrograMill PM7 (Ivoclar, Liechtenstein) milling machine. After cutting the rods we verified the adaptation of the inlays on the cast model (Figure 20).

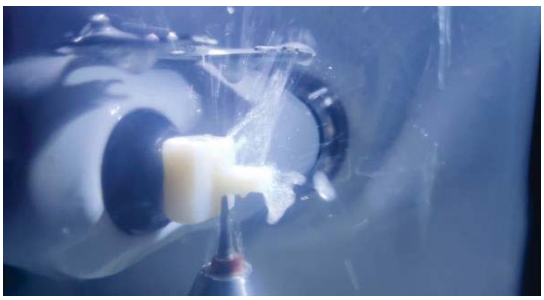


Figure 19. Inlay milling

Figure 20. The inlays on the model (after milling and rods ablation)

Stain burning

After adapting and processing the prosthetic piece, we cleaned it of impurities with the steamer, and then we proceeded for the application of stains and shades.

For a good adhesion, we applied IPS IVOCOLOR liquid on the occlusal face, thus obtaining more intense shadows from several burns and highlighting the occlusal morphology. To highlight the grooves and pits, we used A2 color and essence mahogany stains (Figure 21). We mixed stains white with glaze and applied them to the occlusal ridges to highlight them. For firing we selected the program IPS e.max CAD staining Technique => Stain firing e.max Ceram and entered the inlays into the oven.

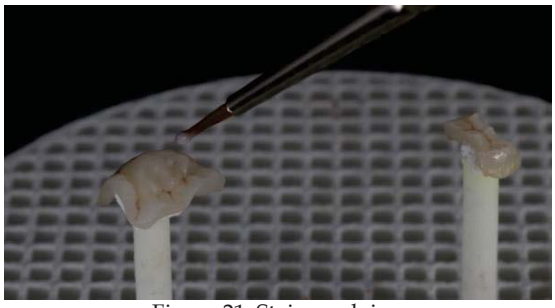
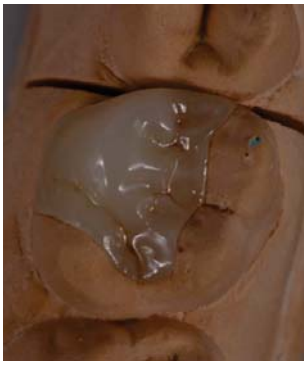


Figure 21. Stain applying

Glaze firing

We mixed IPS e.max® Ceram Paste Glaze with glaze liquid and applied the glaze to the occlusal face of the work in an even layer so that it does not pool. We selected the program and put the work in the oven (Programat EP3010 G2 Ivoclar Vivadent), at a temperature of 770°C with vacuum. After glazing we checked the contact points again. The final result was that one from Figure 22 and 23.

a



b

Figure 22. The inlays after glazing (a – on 1.5 and b – on 2.6)

Figure 23. Inlays final aspect

DISCUSSIONS

The objective of making ceramic inlays is to offer the patients a prosthetic work that meets all functional and aesthetic requirements, preserves the vitality of the teeth, integrates perfectly into their physiognomy and is in harmony with the entire arch. Manufacturing technology requires a longer time, compared to restorations made directly in the office.

As we can clearly see, the path to "excellence" is not easy, especially when the aesthetic treatment must be performed using a minimally invasive approach. This certainly requires an understanding of the patient's expectations and a great team effort between the general dentist, specialists and the dental laboratory involved. Only then can we really talk about a successfully completed aesthetic.

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