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DIGITAL TECHNOLOGIES FOR FIXED PROSTHESES IN ORAL REHABILITATION

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ABSTRACT

Aim of the study Aesthetic, morphological and functional oral rehabilitation using fixed ceramic prostheses is an important method to improve the appearance of an oral cavity, to change the physiognomy in the anterior area of the dental arch, or in the case of teeth lost, both in the anterior and posterior areas of the upper/lower dental arch. **Material and methods** The paper aims to present a clinical case, for which oral rehabilitation was performed by applying fixed metal-ceramic prostheses, both on maxillary and mandibular arches (on implants), using modern technology (CAD/CAM) for the stage of scanning, designing of the metal structure and final restorations. **Results** A complete digital approach for oral rehabilitation with fixed dental prostheses has not yet been scientifically investigated, and therefore it is used a mixed analog–digital workflow, today. **Conclusions** The theme approached, through the practical aspects using modern technologies of design and computerized milling (Exocad, CAM), in case of rehabilitation of reduced edentulous, both in the classic situation of preparation and in case of application of structures on implants, offers the possibility to appreciate each of the stages of the workflow, to understand the importance of observing the computerized technology (by scanning and CAD design).

Key words: digital technologies, oral rehabilitation, fixed prostheses

INTRODUCTION

The use of digital technology in dental practice allows a modern approach to prosthetic treatment, both in the clinic, but especially in the dental laboratory.

Aesthetic, morphological and functional oral rehabilitation using fixed ceramic prostheses is an important method to improve the appearance of an oral cavity, to change the physiognomy in the anterior area of the dental arch, or in the case of teeth lost, both in the anterior and posterior areas of the upper/lower dental arch.

Continuous technological progress in both computer-based development and dental-fabrication processes ensures new opportunities in clinical workflow [1].

The technological process is split into subtractive methods, such as milling or laser ablation, and additive processing, such as three-dimensional printing and selective laser melting.

Traditionally, the standard treatment approach consisted of conventional impression techniques and stone casts for the manufacturing of porcelain-fused-to-metal reconstructions using the lost-wax-technique. In contrast, computerized engineering technology is related with consistent precision and reproducible production results in a streamlined work process with reduced manpower [2, 3].

MATERIAL AND METHODS

The paper aims to present a clinical case, for which oral rehabilitation was performed by applying fixed metal-ceramic prostheses on implants, both on maxillary and mandibular arches, using modern technology (CAD/CAM) for the stage of scanning, design of the metal structure and final restorations; The technological stage of application of the ceramic masses at the level of the metallic structure was followed in particular, evaluating the characteristics and advantages of this technique for the aesthetic component.

A 35-year old patient, went to the dental office for the prosthetic solution of the edentulous spaces determined by the absence from the maxillary arch of 25, 26, and the absence of 35 and 36, for lower arch, which was solved by applying 2 Alpha Bio implants.

There were registered the impressions by traditional method, both maxillary and mandibular, in order to obtain the casts – for lower one, there were placed also the analogous elements for implants. The casts, prepared from extra-hard gypsum paste in a mixing vacuum, than were obtained (from extra-hard plasters) with removable abutments by the Pindex method. (Fig. 3 - 4)

Figure 1. Upper arch – lateral area

Figure 2. Lower arch – lateral area

Figure 3. Impression registered

Figure 4. Impressions and casts

The basic workflow algorithm begins with creating the so-called Job as an option, and then choosing the material. In the updated version there is a great integration of the scanning software - exoscan (colLab Scan v.20.04, Exocad), and the CAM software -

exocam. After preparing the working casts, we proceeded to make prosthetic parts, using modern CAD-CAM technology - the first stage is to scan each model, the removable abutments, and the casts positioned in the occlusion relationship.

The scanning stage of the working casts, of the corresponding removable abutments and of the cast's occlusion, was followed by the verification of the images made in order to be able to prefigure the virtual aspects of the fixed prostheses, with the help of the software, through the design component.

The virtual abutments that were scanned, together with the virtual casts, are analysed and an element corresponding to each abutment is chosen from the Exocad program library, choosing also the material to be used, in the computerized milling stage through the component CAM, the future prosthetic parts.

Once the modeling is done using the CAD component of the Exocad software, the validated image is saved, and will be transferred to another component of the program, through which the next steps aimed at milling can be completed, in order to obtain the corresponding models for the metallic structures.

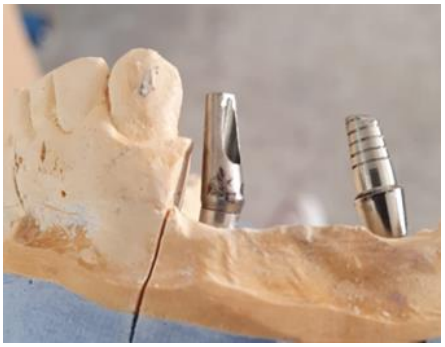

Figure 5. Mandibular cast - analogue implant

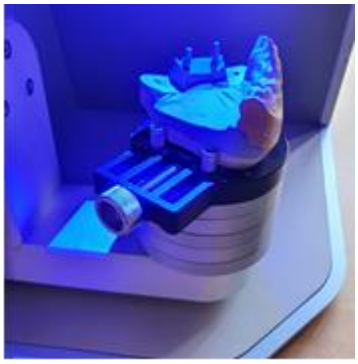

Figure 5. Mandibular cast – scan the analogue implant

Figure 6. Upper cast

Figure 8. Lower virtual cast

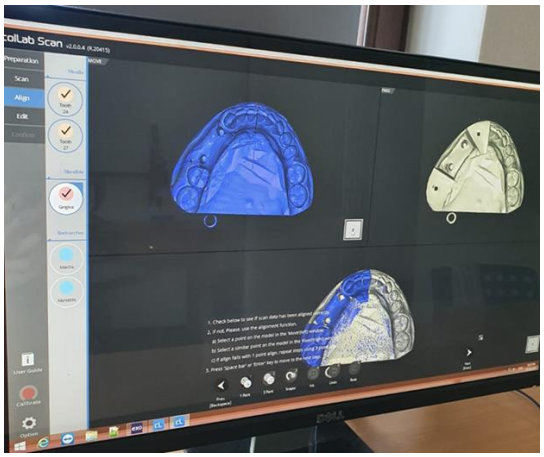

Figure 9. Mandibular cast - analogue implant

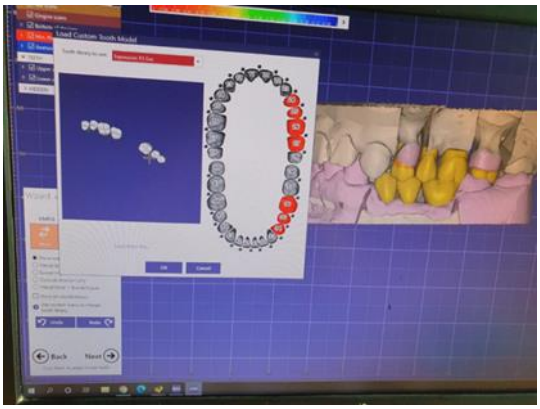

Figure 10. CAD design of fixed prosthetic structures

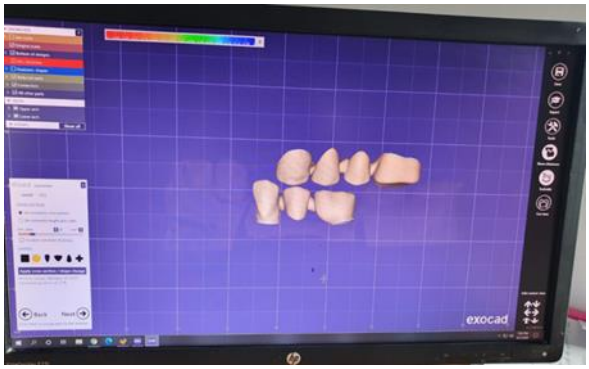

Figure 11. The virtual aspect of the metallic structures of fixed prosthesis

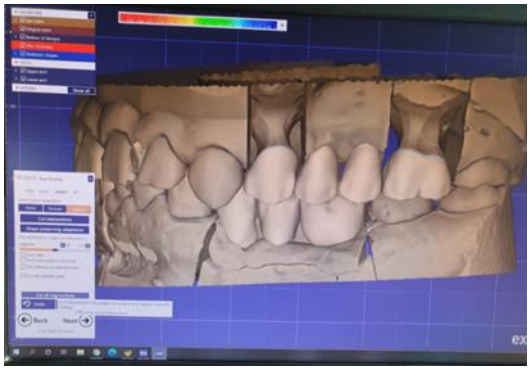

Figure 12. The virtual image of fixed prosthesis

Figure 13. The wax-pattern of the metal structure

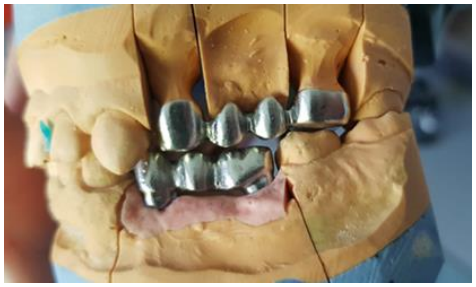

Figure 14. The appearance of metal structures

Figure 15. The appearance of the fixed prosthesis in occlusion

RESULTS AND DISCUSSIONS

Once the wax patterns of the metal structures were made, they were transformed into metal structures, using the Cr-Ni alloy for casting. The sandblasting stage has a special importance in metal-ceramic technology because, in addition to an intense cleaning of the metal structure, a surface conditioning is achieved, by the appearance of micro-retentions, which create the premises of a stable metal-ceramic connection. For the metal frame, a pressure of 3-5 bar was used, at a distance of 30-35 mm from the metal structure, granules with a diameter of 120-250 μm, for about 5 seconds so as not to break the metal wall and an incidence of the jet 45 º particle designs.

In order to achieve the aesthetic component on the metal structure, we performed the deposition, modelling and sintering of the layers of ceramic masses (Vita, VITA Zahnfabrik), by going through the steps within the specific algorithm.

From a clinical perspective, the important aspects to be considered for prosthetic work performed by computerized techniques are long-term longevity in the oral cavity, significant reduction in working time, reasonable costs and clinical versatility. The digital technologies had a huge impact on dental workflow that led to quality improvements (more precise, effective and personalized treatments), labour cost reductions and time saving (reduced production or treatment time, shorter waiting times and higher patient satisfaction). [4]

The individual work steps in the digital procedure are similar to those of the traditional procedure, comprising classical impression-taking procedures, fabrication of a dental master cast, and use of the lost-wax casting technique and completion of individual restorations with hand-layered veneering ceramics (5). Changes are growing in the field of implant prosthodontics treatment such as use of an intraoral optical scanner and computer-assisted design/ computer-assisted manufacturing production of frame-works. The result of this evolution is the mixed analog–digital workflow presently in use (6).

A complete digital approach for treatment with implant-supported fixed dental prostheses has not yet been scientifically investigated and therefore cannot be recommended for routine use at this time.

CAD/CAM technologies have a lot of advantages, but it still cannot and should not replace traditional know-how and therefore cannot replace skills and technical expertise. In digital methods, the data collected will always be available and it can be used to produce the provisional restoration and the final restoration; this avoids repeating the same steps twice. [7]

It is observed that digital protocols are increasingly influencing prosthodontics treatment concepts [8]. The complete digital workflow has the potential to become a game changer in fixed prosthodontics. [6]

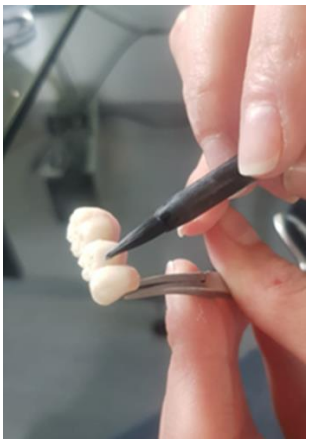

Figure 16. Checking the details - glaze layer

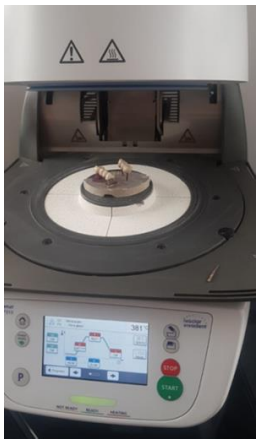

Figure 17. Sintering of the final layer

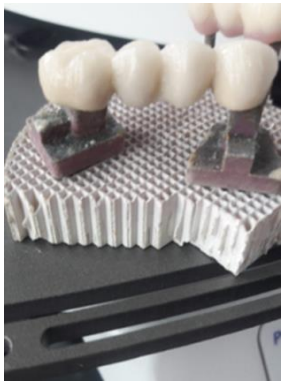

Figure 18. The final appearance of the sintered layer

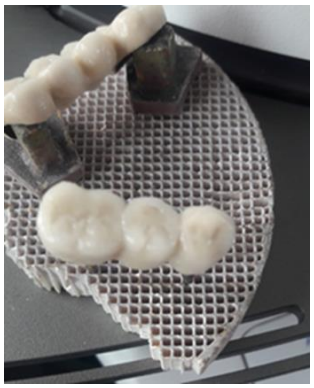

Figure 19. Final fixed prosthesis

CONCLUSIONS

1. The theme approached, through the practical aspects using modern technologies of design and computerized milling (Exocad, CAM), in case of rehabilitation of reduced edentulous, both in the classic situation of preparation and in case of application of structures on implants, offers the possibility to appreciate each of the stages of the workflow, to understand the importance of observing the specific, computerized technology (by scanning and CAD design).
2. Special attention must be paid to the principles of fixed ceramic prostheses, which must ensure the best conditions for the rehabilitation of dental arches.
3. The application of digital scanner / CAD-CAM technology is considered a valid alternative to the conventional one, both for the stage of scanning, and design through CAD software, computer milling through the CAM component. The precision of computerized scanning and digital design for the use of data transfers is saved in the data libraries.
4. Due to its high precision and the absolutely passive matching of the substructure that is essential for the physiology of implants and in the long term, for the reliability of rehabilitation on implants, the CAD/CAM system is an invaluable tool for the evolution of the

prosthetic workflow from a technological point of view.

5. Today, the skills for metal-ceramic technology can be transferred to newer technologies, whether it requires the production of an all-ceramic monolith restoration or the placement of a ceramic mass manually, or by CAD/CAM.

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