

## ASPECTS OF AESTHETIC REHABILITATION BY IMPLANT-SUPPORTED FIXED PROSTHESIS IN A COMPLETE EDENTULOUS CASE

Maria-Antonela Beldiman<sup>1</sup>, Monica Tatarciuc<sup>1</sup>, Diana Diaconu-Popa<sup>1</sup>,  
Georgiana Macovei<sup>1\*</sup>, Violina Budu<sup>2</sup>, Laura Checheriță<sup>2+</sup>,  
Liana Aminov<sup>2\*</sup>, Odette Luca<sup>1</sup>

<sup>1</sup> "Gr. T. Popa" U.M.Ph. - Iași, Romania, Faculty of Dentistry, Department of Prosthodontics, Oral-Implantology, Dental Prostheses Technology and Removable Dentures

<sup>2</sup> "Gr. T. Popa" U.M.Ph. - Iași, Romania, Faculty of Dentistry, Department of Odontology-Periodontology and Fixed Restorations

Corresponding authors: Georgiana Macovei, e-mail: georgiana.macovei@umfiasi.ro  
Liana Aminov, e-mail: liana.aminov@umfiasi.ro  
Laura Checheriță, e-mail: laura.checherita@umfiasi.ro

+ The author with the same rights as the first author.

### ABSTRACT

**Aim of the study** Treatment possibilities for complete edentulous cases by placing implants result in superior functional results, for better aesthetics, as well as stability, strength and support of prostheses and improved masticatory efficiency. **Materials and methods** The objective of this study is to highlight the importance of fabricating appropriate implant-based fixed prostheses through the appropriate selection and design of all their components in the treatment plan for our patient, with total edentulousness. A 56-year-old patient presented himself at the dental office, with complete edentulous status, in both arches, and the treatment was the "Fast and Fixed" option of "All on 6" in the maxilla jaw and "All on 4" in the mandible, with framework from zirconia and PEEK, respectively. **Results** The rehabilitation of complete edentulous status with fixed implant supported prostheses is one of the challenging treatments, because of the aesthetic and functional factors that should be considered. **Conclusions** There is a superior prognosis of oral rehabilitation with implants compared to traditional methods, and statistical data shown a high success rate of around 95% for 10 years. Fixed restorative systems on dental implants are considered the ideal solution for replacing missing teeth in the case of total edentulous arches.

**Key words:** aesthetic rehabilitation, complete edentulous status, implant-supported fixed prostheses

### INTRODUCTION

Management of patients with edentulous arches needs critical planning to provide the best possible outcome, which includes aesthetics, masticatory efficiency, phonetics, retention, as well as time and being cost effective for patients (1).

Treatment possibilities for complete edentulous cases by placing implants result in superior functional results, for better aesthetics, as well as stability, strength and support of prostheses and improved masticatory efficiency. Monolithic zirconia

has been considered a suitable material for fixed dentures on implants due to its mechanical properties, and due to the highly translucent monolithic zirconia it can increase the aesthetic goal of total rehabilitation.

Digital technology is currently used to solve problems and inconveniences experienced with conventional methods during the diagnostic workflow process and the long treatment time. Immediate loading of implants with a fixed prosthesis in edentulous patients has now become an established and viable treatment concept (2,3), but the use of

digital technology includes laboratory work for prosthesis fabrication.

## MATERIALS AND METHODS

This work aims to present the positive results obtained in a rehabilitation treatment of a patient with multiple functional, aesthetic and physiological problems, caused by complete edentulous status. The treatment option chosen to solve these problems was the use of an implant-supported hybrid prosthesis.

The objective of this study is to highlight the importance of fabricating appropriate implant-based fixed prostheses through the appropriate selection and design of all their components in the treatment plan for our patient, with total edentulousness.

A 56-year-old patient presented himself at the dental office in order to replace his bimaxillary total removable prostheses, and choose the implant prosthesis treatment option, for functional, aesthetic and physiological reasons. Since the patient has complete edentulous status, in both arches, we proposed, the "Fast and Fixed" option of "All on 6" in the maxilla jaw and "All on 4" in the mandible, with full prosthetic parts of zirconia and mixed PEEK - composite/ acrylic resins, respectively.

After the application of the implants and the healing period (during which the patient wore a provisional prosthetic appliance, made of PMMA), the impressions of both jaws arrive in the laboratory together with the transfer abutments and prosthetic screw abutments. (Fig. 1) After disinfecting the impressions, we screwing the analogues that will represent the implant support on the working cast. Once the analogues are installed, we move on to casting the *Gingifast* artificial gum, and the next step is pouring the gypsum paste in order to obtain the working casts, upper and lower.

With the relationships registered in the oral cavity of the patient, we mounted the

casts into an articulator, and then, we proceeded to insert the Inno Multi Unit prosthetic abutments on the analogues using the corresponding screwdrivers. After that we created the digital worksheet and scanned the cast using the lab scanner to be able to move on to digital modelling in the Exo Cad (CAD-CAM) application. (Fig. 2 - 4)

After scanning, we obtained the digital casts on which we designed the prosthetic works. The next step is to define the parcels using the Margin Line Detection option, that in ExoCad technology allows precise detection and highlighting of the edge line of the dental preparation. This ensures a perfect fit and an excellent adaptation between the tooth and the restoration in the manufacture of fixed prostheses on the implant.

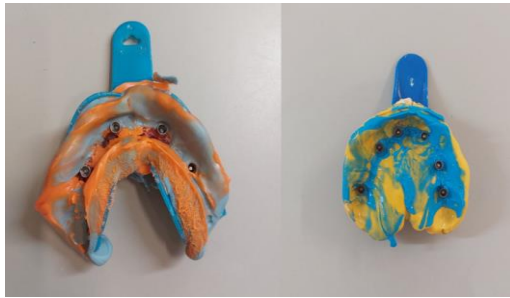
At the screwing direction definition stage, we used the Screw Channel Definition option, so, the screw channel can be precisely defined in the prosthetic restoration on the implant. This feature allows for proper positioning and orientation of the fixation screw within the restoration. (Fig. 5)

In the next stage, we have to choose the teeth from a gallery of different morphologies and shapes pre-defined in the ExoCad program and position them on the dental arch.

The "tooth placement" function in ExoCad technology allows the virtual placement of teeth on digital casts in the design of fixed prostheses on the implant, and helps achieve a precise fit and natural aesthetics, ensuring a satisfactory end result for the patient. (Fig. 6).

For the upper arch, since we use monolithic zirconia for the framework, we took the option of automatic creation of the connectors. In ExoCad technology, crown connectors in implant-fixed prostheses are made using specialized software, which allows precise design of connectors, ensuring a perfect fit with adjacent implants. Thus, stability and optimal adjustment of the fixed

prosthesis on the implant is obtained. (Fig. 7)



**Figure 1. Lower and upper impressions**



**Figure 2. The working casts prepared for mounting into articulator**



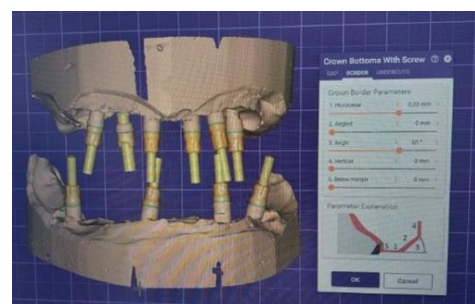
**Figure 4. Margin Line Detection in Exocad**



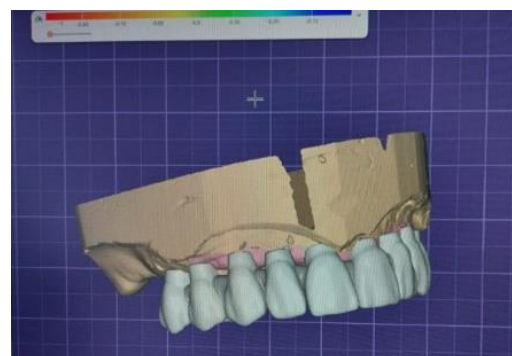
**Figure 3. Lab scanning of the casts**



**Figure 6. The "tooth placement" function in ExoCad**



**Figure 5. Screw Channel Definition in ExoCad**



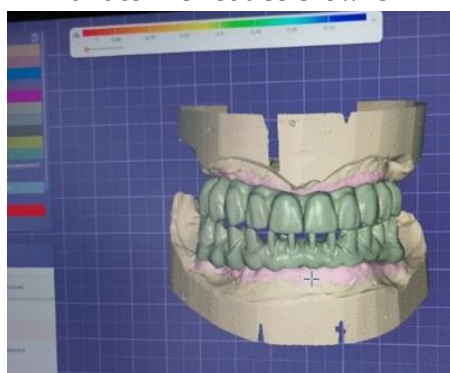
**Figure 7. ExoCad - Precise design of connectors**

For the mandibular cast, it was necessary to perform the anatomical crown reduction with the Anatomic Crown Reduction option, to achieve the desired shape and size, to obtain adequate space for dental restorations/connectors in fixed implant prostheses. In the final stage, the Merge option join and finish the prosthetic frameworks, allows the digital combination of fixed prosthesis components on the implant, ensuring proper alignment and verification of aesthetics and functionality. This process optimizes the production of digital prostheses and guarantees accurate and quality results. (Fig. 8 and 9)

After going through all these steps in ExoCad, we sent the STL models to the computer for 3D milling.



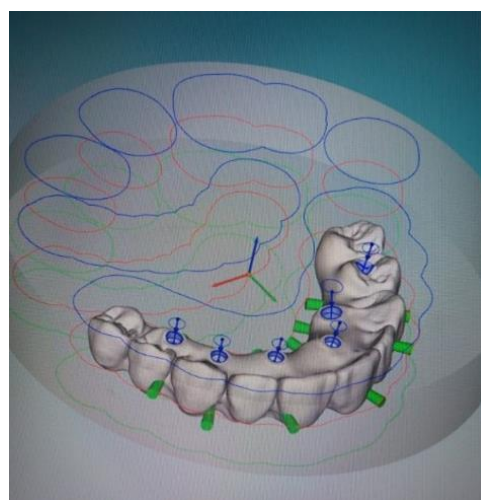
**Figure 9. Lower aspect with anatomic reduce crowns**



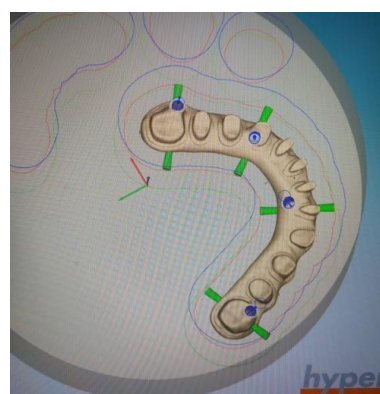
**Figure 8. Anatomic Crown Reduction in ExoCad**

With the digital works once arrived at the computer intended for milling, we introduce

them into the milling program where we choose the disk from which they will be milled, the milling strategy and then, attached some support that will be removed at the end of manual milling in order not to risk fracturing the works. We chose the Zirconia Multilayer and PEEK milling discs in accordance with the shade, colour, size and shape of the future prosthetic work. (Fig.10 and 11)



**Figure 10. Digital positioning of maxillary work from Zirconia Multilayer in blank.**



**Figure 11. Digital positioning of mandibular work from PEEK in blank.**

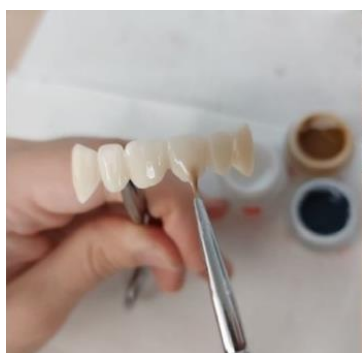
The Multilayer Zirconia work will be milled first, from A1 colour Aconia multilayer zirconia blank and 20 mm high, in the Arum milling machine - after milling, the work is oversized and has a chalky consistency and

needs to go through a sintering program in a special oven that will raise its temperature to 1500 degrees Celsius for 14 hours. (Fig.12)



**Figure 13. Post-sintering appearance and verification on the working cast**

After the Multilayer Zirconium work was sintered, we were able to move on to polishing and sandblasting, to create a rough surface that the glaze will adhere to more easily. We applied the glaze with the help of a brush, adding Shade A and Blue pigment, and then put it in the oven on a special plate as support - the glaze was sintered in the oven at 930 degrees Celsius, in vacuum, for 15 minutes. (Fig. 13,14)



**Figure 12. Applying the ceramic layers**

After glazing, next step is the application of the false ceramic gingiva, respecting the morphology of the interdental papillae, the attached gingiva and the marginal gingiva. It will be sintered in the oven at a temperature of 900 degrees Celsius in a vacuum for 20 minutes.



**Figure 14. Sintering process in the oven**



**Figure 15. The final aesthetic aspect of the upper fixed prosthesis**

Once the mandibular work was milled, we removed it from the disk, processed it with the acrylic cutters and could proceed to the modelling stage of the aesthetic component - a layer of monobond to the substructure for a firm bond of the substructure composite, and then, an A1 acrylic opaque on the ends and a pink opaque on the gingival area so that the PEEK framework does not show through the partially transparent composite material (Ceramage). (Fig. 16 and 17)



**Figure 16. Appearance of the PEEK substructure after milling and machining**

Then, in the first phase, we modelled the false gum to delimit the parcels and the appearance of the prosthetic dental arch respecting the morphology of the covering periodontium. Then, we modelled the teeth on the skeleton caps by first creating structures that mimic dentin, then applying the more transparent enamel composite to mimic the colour distribution and transparencies of natural teeth.



**Figure 17. Gum and tooth modelling on PEEK substructure**

After each modelling, we put the work in the photopolymerization oven for 5 minutes so that each composite layer is uniformly polymerized. After the polymerization, we mechanically processed the work with acrylic cutters, diamond cutters and separator discs, to which we also added light planning with a polypant to finally even out the surface of the work. Finally, we applied a homogeneous layer of Optiglaze on the entire surface of the work, which will give it a glossy and smooth appearance and surface. (Fig. 18)



**Figure 18. Aesthetic aspects of fixed prostheses**

## RESULTS AND DISCUSSIONS

The success of a full-arch dental restoration requires a crucial balance between the modern and conventional treatment techniques. Use of hybrid dentures for the rehabilitation of edentulous patient as compared to conventional complete denture has multiple advantages like improved masticatory efficiency, retention and patient comfort. (4) Implant retained hybrid dentures is a good treatment option and should be considered in patients with high expectations with financial limitations as it provides good masticatory support, retention, stability and phonetics when compared to conventional complete denture and is a cost-effective option when compared to implant supported fixed partial denture. (1)

The concept of prosthesis-directed implant-supported restoration with ideal implant location would optimize the prosthetic procedure and outcome, so surgical guide is strongly recommended. (5)

Advances in computer-guided surgery allow placement of implants in the fully edentulous maxilla in a minimally invasive manner with increased precision to support the fixed prosthetic outcome. (6,7) Demonstrated viability of immediate functionality and minimally invasive protocols (8) for fixed full-arch restorations may further increase demand and acceptance of this treatment by the patients.

The rehabilitation of complete edentulous status with fixed implant supported prostheses is one of the challenging treatments, because of the aesthetic and functional factors that should be considered.

There are many different treatment options in order to replace the teeth in

edentulous jaws, which includes removable complete dentures, implant retained over denture, implant supported hybrid over dentures and implant supported fixed bridges. (9-11)

## CONCLUSIONS

1. The success of fixed prosthodontic treatment is based on the suitable choice of the accurate fixation on implant structures, to ensure optimal retention, aesthetics, and stability.
2. Fixed restorative systems on dental implants are considered the ideal solution for replacing missing teeth in the case of total edentulous arches.
3. There is a superior prognosis of oral aesthetic and functional rehabilitation with implants compared to traditional methods, and statistical data shown a high success rate of around 95% for 10 years.
4. The properties of zirconia increase its use for the fabrication of maxillary frameworks, but there is few evidence in scientific literature regarding complete mouth zirconia frameworks supported by implants.
5. For the rehabilitation of a complete edentulous patient in the mandible is recommended the PEEK framework with gingival composite resin, PEEK frameworks have a reduced weight and higher elasticity than zirconia frameworks, which could reduce the risk of mechanical complications.
6. State-of-the-art materials and technology provide patients with functional and aesthetic fixed prostheses, and the systems will continue to improve, becoming more and more versatile, but the collaboration and expertise of the medical team and dental technician remain essential to achieve the best results.

## Acknowledgements

The authors would like to thank for support and constructive assistance to the dental technicians (and dent. tech. Bogdan Bălan) from the Dental Laboratory.

All authors have contributed equally for this research paper.

## REFERENCES

- 1 Gul, M., Nazeer, M. R., Ghafoor, R., Prosthetic rehabilitation of edentulous mandible with two-implant retained fixed hybrid prosthesis: A case report. The Journal of the Pakistan Medical Association, 68(12), 2018, 1828-1832.
- 2 Castellon, P.; Block, M.S.; Smith, M.B.; Finger, I.M., Immediate loading of the edentulous mandible: Delivery of the final restoration or a provisional restoration—Which method to use? J. Oral Maxillofac. Surg., 2004, 62, 30–40.
- 3 De Bruyn, H.; Raes, S.; Ostman, P.O.; Cosyn, J., Immediate loading in partially and completely edentulous jaws: A review of the literature with clinical guidelines. Periodontol. 2000, 2014, 66, 153–187.
- 4 Preciado A., Del Río J., Lynch C.D., Castillo-Oyagüe R., A new, short, specific questionnaire

- (QoLIP-10) for evaluating the oral health related quality of life of implant-retained overdenture and hybrid prosthesis wearers., *J Dent*, 2013; 41: 753-63.
- 5 Ellis E. 3rd, McFadden D., The value of a diagnostic setup for full fixed maxillary implant prosthetics. *J Oral Maxillofac Surg*, 2007; 65: 1764 -71.
  - 6 van Steenberghe D., Naert I., Andersson M., Brajnovic I., Van Cleynenbreugel J., Suetens P.: A custom template and definitive prosthesis allowing immediate implant loading in the maxilla: A clinical report., *Int J Oral Maxillofac Implants*, 2002, 17:663
  - 7 Marchack C.B., An immediately loaded CAD/CAM-guided definitive prosthesis: A clinical report., *J Prosthet Dent*, 2005, 93:8
  - 8 van Steenberghe D., Glauser R., Blombäck U, et al., A computed tomographic scan-derived customized surgical template and fixed prosthesis for flapless surgery and immediate loading of implants in fully edentulous maxillae: A prospective multicentre study., *Clin Implant Dent Relat Res*, 7 (Suppl. 1), 2005, S111
  - 9 Prithviraj D., Madan V., Harshamayi P., Kumar C.G., Vashisht R., A comparison of masticatory efficiency in conventional dentures, implant retained or supported overdentures and implant supported fixed prostheses: a literature review., *J Dent Implant*, 2014; 4: 153-7.
  - 10 Sadowsky SJ. Mandibular implant-retained overdentures: a literature review., *J Prosthet Dent*, 2001; 86: 468-73.
  - 11 Meijer H.J., Raghoobar G.M., Van Hof M.A., Comparison of implant retained mandibular overdentures and conventional complete dentures: a 10-year prospective study of clinical aspects and patient satisfaction. *Int J Oral Maxillofac. Implants*, 2003; 18: 879- 85.