ORIGINAL ARTICLE

THERAPEUTIC MODALITIES USING DIGITAL BRIDGE DESIGN FOR CLINICAL SITUATIONS WITH MODIFIED PROSTHETIC SPACE

Simina Găman[1], Monica Scrieciu[1], Ioana Mitruț[1], Petre Costin Mărășescu[1], Cătălin Popa[1], Daniel Adrian Tirtea[1], Horia Octavian Manolea[1]

[1] Department of Prosthesis Technology, Faculty of Dentistry, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania

All authors contributed equally to this work.

[*] Corresponding author:
Ioana Mitruț
Department of Prosthesis Technology, Faculty of Dentistry, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
Email: *ioana.mitrut@umfcv,ro*

Petre Costin Mărășescu
Department of Prosthesis Technology, Faculty of Dentistry, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
Email: *marasescup@yahoo.com*

Abstract: *Introduction*. After tooth loss, the prosthetic space rarely remains unchanged. Generally, teeth migrate into the prosthetic space. The main treatment methods used by dentists to restore the morphology and function of the masticatory system are restorations such as crowns and bridges. Patients demands for more aesthetic restoration materials have led to an increased demand for metal-free restorations. This is made possible by the availability of new manufacturing systems combined with computer-aided manufacturing (CAD/CAM). *Materials and Methods*. We selected cases of scanned impressions using the Meddit scanner of both maxilla and mandibulary edentulous patients that needed dental bridges both in the anterior and posterior area. After the selection of the most suggestive cases we analized the modifications of the prosthetic potential space and the treatment options using the ExoCAD software for the digital bridge design. *Results*. An analyze of 25 selected cases with modifications of the prosthetic potential space is presented followed by the presentation of 4 representative cases in which we detailed the design procedure for the dental bridges. *Conclusions*. CAD/CAM technology is increasingly being used in dental practices. Advances in CAD/CAM technology allow the dentist to fabricate a temporary restoration for the patient in the dental office. Particularly in the case of bridges with modified prosthetic potential space, the dentist must review this technological step in order to achieve optimal prosthetic results.

Keywords: prosthetic space, dental bridges, CAD/CAM technology

1. Introduction

Restorations, such as dental crowns and bridges, are one of the main treatment modalities used by dentists to restore the morphology and function of the masticatory apparatus.

Mechanical strength and precise adaptation to the dental units are mandatory requirements for crowns and bridges, and simplification of the working steps reduces the time spent on the case [1].

The development of various alloys and precise casting systems has contributed to the successful use of metal-based restorations. However, patients requests for more aesthetic and biologically "safer" materials have led to an increased demand for metal-free restorations. There is also a growing demand for ceramic restorations.

Dental bridges can be made from a variety of materials, including zirconia, metal alloys such as cobalt-chromium or titanium, and composite resins.

Zirconia bridges are used because of their excellent biocompatibility. Zirconia offers excellent strength, natural aesthetics and long-term stability.

Metal alloy bridges offer high strength and durability and are excellent for cases that require more structural support.

Composite resin bridges, while not as strong or durable as ceramic or metal, can be a more affordable alternative in some cases.

It is important to note that the availability of materials may vary depending on the specific capabilities and equipment of the dental laboratory. Dentists and dental technicians are constantly working together to determine which material is best suited to each patient's individual needs, taking into account factors such as strength requirements, aesthetics and budget. The difficulty in processing fully sintered zirconia has led to the widespread use of pre-sintered zirconia processing [2]. There is also a current desire to reduce the amount of light-diffusing alumina sintering additive or to incorporate an optically isotropic cubic phase component into the tetragonal structure [3] to produce zirconia with greater translucency while maintaining adequate strength and hardness.

In addition, new manufacturing systems combined with computer-aided manufacturing (CAD/CAM) systems are now available. The aim of the research community is to combine technology with materials that are suitable for use in dentistry [4].

Dental technology has focused on casting technology based on the lost wax technique, but we are now facing a revolution in crown and bridge fabrication [5].

The aim of this study is to demonstrate the possibilities of designing dental bridges in situations with modified prosthetic potential space using EXOCAD software.

2. Materials and method

We began by selecting the cases from the Meddit library. We selected cases of scanned impressions using the Meddit scanner of both maxilla and mandibulary edentulous patients that needed dental bridges both in the anterior and posterior area. After the selection of the most suggestive cases we analized the modifications of the prosthetic potential space and the treatment options.

For the treatment with dental bridges we followed the fully digital protocol, starting

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with the dental impression directly by intraoral scanning. The impressions were taken with Meddit I700 scanner. The image was then visualised and processed on the computer using the using special software EXOCAD (Exocad GmbH, Darmstadt, Germany). This software allows the dental technician to work with the dentist to create any the digital design of the dental bridge. For every clinical case, the dentist and the dental technician chose the best option depending on the clinical situation and the patient's wishes and the data is sent to the milling machine.

3. Results

Firstly 25 cases with modifications of the prosthetic potential space were selected. The spaces were presented both at the maxilla and mandibular level (Figure 1).

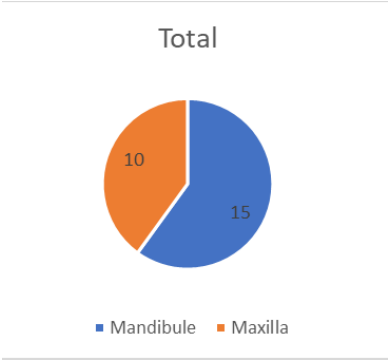

Figure 1. The presentation of the prosthetic potential spaces depending on jaw position.

From the total cases, we analyzed the position of the prosthetic potential spaces depending of the area of the arch (posterior or anterior). We noticed a rather homogenuous division, with a higher number of the prosthetic potential spaces situated in the posterior mandibular area (Figure 2).

The last step of the analysis was to evaluate the modifications of the prosthetic potential spaces, more specifically whether the spaces were increased in dimensions or decreased.

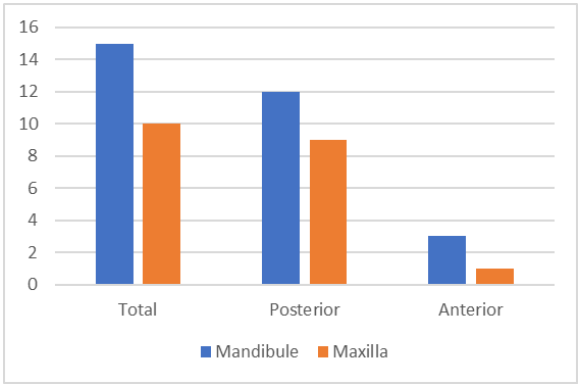

Figure 2. Exemplification of the position of the prosthetic potential spaces.

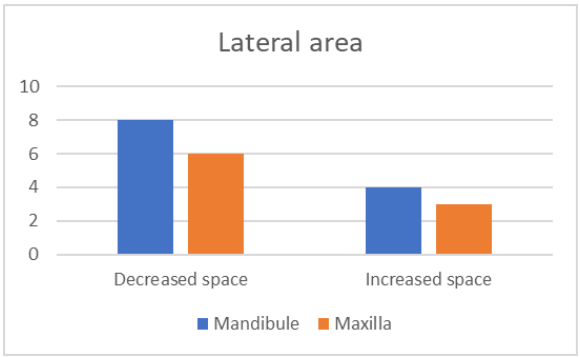

Figure 3. The exemplification of the changes of the prosthetic potential spaces in the lateral area.

We noticed a higher percentage of decreased potential spaces in both jaws. In the lateral area, there was a higher number of decreased prosthetic potential spaces both in the maxilla and the mandible (Figure 3).

Regarding the anterior area, from the number of our selected pacients, we only noticed increased spaces.

Using the EXOCAD programme, we were able to individualise the treatment plans, which were different and specific for each patient. We selected 4 representative cases in which we detailed the design

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procedure for the dental bridges in EXOCAD.

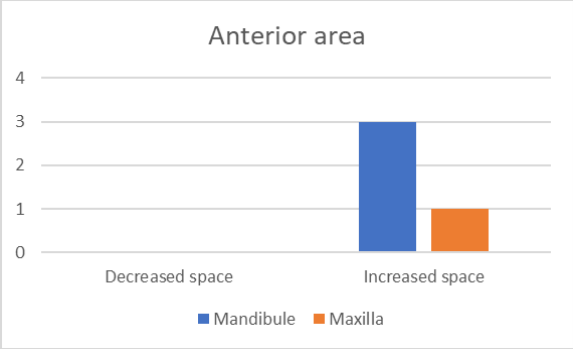

Figure 4. The exemplification of the changes of the prosthetic potential spaces in the lateral area.

Case 1

Using the EXOCAD programme, we designed a temporary dental bridge in the frontal region of the upper jaw to replace the missing tooth 2.1. and resting on teeth 1.3, 1.2, 1.1, 2.2 and 2.3, which were used as abutments.

The particular prosthetic feature of this case was the increased of the prosthetic space due to periodontal which resulted in excessive vestibularisation left upper central incisor and finally necessitated his extraction.

To solve this situation, a central incisor was first placed in the pontic and the coronal third of the root was shaped, partially simulating the pre-extraction situation but leaving a space for post-extraction hygiene.

Another design option that was simulated was the creation of an ovoid pontic. ovoid bridge to aesthetically guide post-extraction healing.

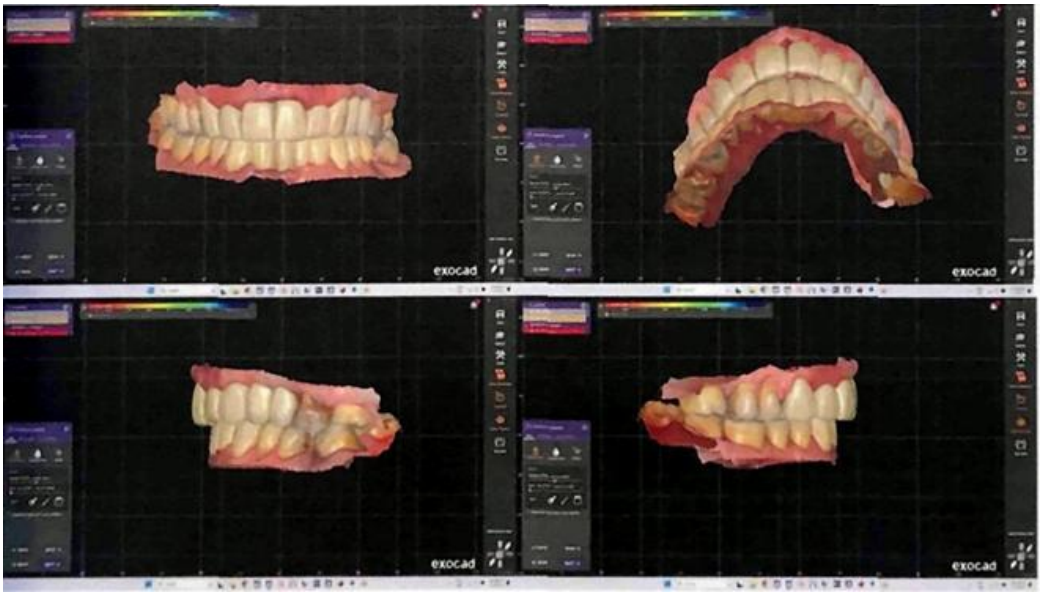

Figure 5. Final prosthetic restoration design.

Case 2

With the help of EXOCAD software, we designed a temporary dental bridge immediately post-extraction in the anterior mandible to replace the missing teeth 3.1 and 4.1, resting on teeth 3.3, 3.2 and 4.2, 4.3, which were used as abutments. The prosthetic particularity of this case was the vertical increase of the prosthetic space due to the atrophy of the edentulous ridge caused by periodontal disease, which necessitated the extraction of the central incisors.

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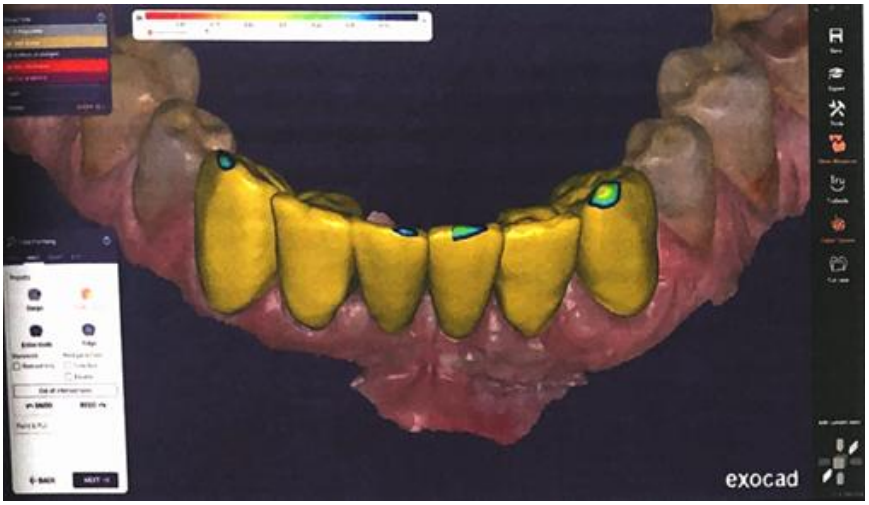

Figure 6. Final aspect of the temporary bridge design.

Case 3

With the help of EXOCAD software we designed a dental bridge in the area left mandibular side, which will replace the missing teeth 3.6 and 3.7 and will rest on the teeth 3.5 and 3.8, which were used as abutment teeth. The prosthetic feature of this case was was the horizontal reduction of the potential prosthetic space by the migration of the adjacent teeth. of the teeth adjacent to the edentulous gap, especially the wisdom molar. To solve this situation, it was decided to place a small secondary molar in the pontic.

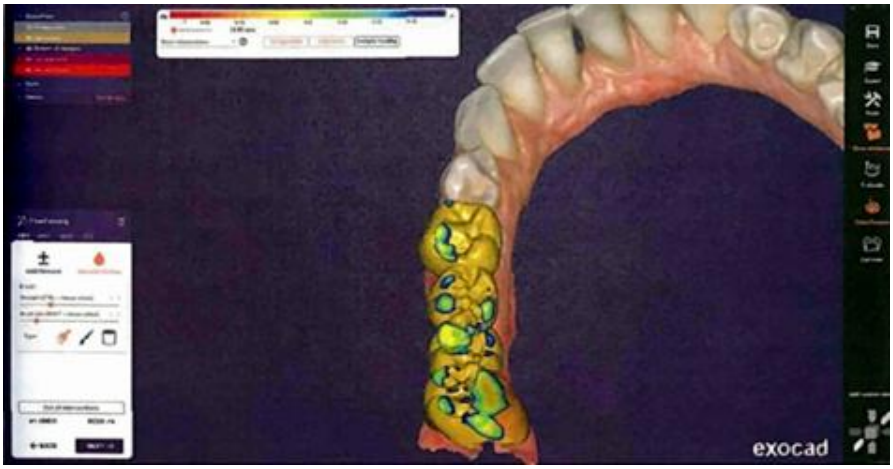

Figure 7. Manual adjustment of occlusal relationships, final result.

Case 4.

Using the EXOCAD software, we designed a dental bridge in the area of the left lateral mandibular region to replace the missing tooth 3.6 and to rest on teeth 3.5 and 3.7, which were used as abutment teeth. The prosthetic feature of this case was the vertical reduction of the potential prosthetic space by extrusion of the antagonist by extrusion of the antagonist molar of the edentulous gap.

The results obtained using EXOCAD software have been very good; this

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programme has allowed us to create prosthetic parts that meet the requirements of the dentist and also of the patient, and is excellent in terms of reducing the time needed to make a restoration and in terms of communication between the doctor and the dental technician.

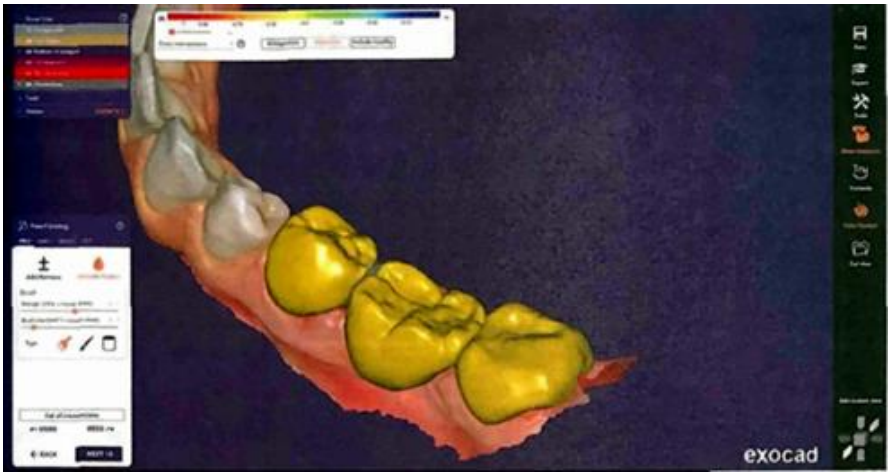

Figure 8. Final prosthetic restoration design.

4. Discussion

The continuous development of dental technologies offers new possibilities in the field of fixed prosthetic restorations using fully virtual methods without physical steps [6] The management of partial edentulism can be challenging when the interocclusal space is limited. Extrusion of antagonist teeth combined with extrusion of alveolar bone from edentulous areas reduces the space required for a removable or fixed prosthesis when edentulous areas are present in the maxilla [7]. Proper assessment, a multidisciplinary approach and a treatment plan developed in accordance with the patient's wishes are important factors in ensuring successful prosthetic treatment [8]. The prognosis of prosthetic treatment with dental bridges depends on the correct distribution of occlusal forces between the abutment teeth and the bridge body. Although implant-supported dental bridges remain a reliable and predictable rehabilitation option for partial edentulism, fixed dental bridges supported on natural teeth are a more financially acceptable treatment option for a significant number of patients [9].

The study showed that the use of CAD/CAM technology in the cases analyzed provided multiple benefits for both the patient and the dental team, aspects that were noted by other studies from the literature [10].

The relevant aspects reflect the efficiency and accuracy of the CAD/CAM system, which allows the production of individualized prosthetic components that meet the requirements of the professional [11] and the patient. These aspects are consistent with literature data confirming that all patients prefer intraoral scanning to conventional impressions [12].

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In addition, three-dimensional tooth scanning and digital modelling provide accurate restorations without human error and with excellent adaptation to each patient's oral anatomy. Optimal results have also been achieved in terms of maintaining the health of the periodontal tissues, observed through reduced inflammation [13]. The traditional process of making a dental prosthesis can take days or weeks, but with CAD/CAM technology the time required is much shorter, the digital data is processed quickly and the milling unit produces the prosthesis in a few hours or even minutes, significantly reducing the time required.

CAD/CAM technology facilitates direct communication between the dentist and dental technician, digital images and precise specifications are transmitted quickly, eliminating the risk of misinterpretation and ensuring efficient collaboration. The use of intraoral optical scanners reduces patient discomfort, is efficient, simplifies clinical procedures for the dentist, improves the dentist's communication with laboratories and patients, and reduces the use of plaster casts. However, current literature does not support the use of intraoral scanners for long-term restorations on natural teeth or implants [14]. The algorithm for manufacturing fixed prostheses using a CAD/CAM system involves a series of steps from determining the insertion axis for the bridge to saving the design and importing the file into the CAM software [15].

The materials used in CAD/CAM technology are very well tolerated and integrate perfectly into the oral cavity. The restorations are aesthetic, natural and durable, contributing to improved chewing function and aesthetic appearance [16].

We believe that CAD/CAM technology represents the future of dentistry by providing fast, accurate and customized solutions for dental restorations, allowing patients to benefit from painless treatments and very good results in a very short time.

5. Conclusions

CAD/CAM technology is increasingly being used in dental practices. Thanks to advances in CAD/CAM technology, dentists can fabricate a temporary restoration for the patient in the dental office. Using EXOCAD software, the treatment plan can be adapted to the individual wishes and needs of each patient.

Although the design of prosthetic restorations is primarily the domain of the dental technician, the dentist must be involved in this technological step to achieve optimal prosthetic results, especially for dental bridges in clinical situations with altered prosthetic potential space.

In this regard, the dentist's knowledge of the functions and possibilities of the design software is essential in order to carry out this stage in collaboration with the dental laboratory.

Thanks to CAD/CAM technology and EXOCAD software, communication between the dentist and the dental technician is more efficient and faster.

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Author contributions

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There are no potential conflicts of interest concerning this study.

Data availability statement

Data availability at request.

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