ORIGINAL ARTICLE

PARTICULARITIES OF PLACING THE CERVICAL LIMITS OF PROSTHETIC CROWNS WITH IMPLANT SUPPORT – CASE SERIES

Andreea Stănuşi[1,*], Daniel Adrian Târtea[2], Horia Octavian Manolea[3], Orwah Gharra[4]

[1] Department of Dental Prosthetics, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
[2] Department of Oral Rehabilitation, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
[3] Department of Dental Materials, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
[4] Dentist with private practice

All authors contributed equally to this work.

[*] Corresponding author: **Andreea Stănuşi**, Department of Dental Prosthetics, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania
Email: *andreea.stanusi@umfcv.ro*

Abstract: In implant-prosthetics, individualized implant abutments have become a popular subject of interest. Their position, height and shape can be individualized. Abutments can be made of materials such as zirconium oxide, lithium disilicate or hybrid materials. The purpose of this research was to exemplify, through a series of cases, various particularities of the placement of the cervical limits of prosthetic restorations with implant support. Materials and method This study is retrospective and was carried out by analyzing the images belonging to the cases from the archive of the Faculty of Dental Medicine of the University of Medicine and Pharmacy in Craiova. The selected cases belonged to partially edentulous patients who benefited from fixed implant-prosthetic treatment performed through the digital protocol. Results After applying the inclusion and exclusion criteria, 23 cases were selected. For this article, images belonging to several cases were used to exemplify the particularities of the cervical limits of prosthetic crowns with implant support. Conclusions If in the lateral area or on the oral surfaces it is recommended to place the cervical limit as close as possible to the gingival margin or even supragingival to favor the maintenance of peri-implant health, in the frontal area the aesthetic requirements demand a deeper subgingival placement of the cervical limit of the implant abutment.

Keywords: implant-supported crowns, cervical limit, CAD-CAM technology.

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1. Introduction

The technology of implant-supported prostheses derives from the technology of classic prostheses with dental support, having a series of particularities, related to the fact that the abutment is a prosthetic piece obtained outside the oral cavity, in the dental laboratory or in the factory of the implant manufacturer.

In making implant-supported prosthesis, special attention is paid to the meso-structure, part of the prosthesis located on top of the implant, bearing the prosthesis and the super-structure, the final prosthesis itself [1].

The prosthetic field impression stage marks the beginning of the realization of the prosthetic super-structure. The impression technique differs depending on the super-structure chosen, its support and the implant system used. In implant prosthetics, the direct impression technique and the indirect impression technique have become common. The appearance of intraoral scanners determined the development of digital impression [2]. By developing scannable transfer devices, whose image can be perfectly matched with their standard image from the manufacturer's virtual library, this technique has become increasingly used in current practice as a component of the CAD-CAM protocol [3].

The CAD-CAM protocol involves three consecutive steps: scanning, CAD modeling and CAM production. Scanning refers to the 3D recording of the data of a classic model or an impression and transforming it into a virtual working model. The CAD component refers to the 3D modeling or design of the future prosthesis or a final component on the implant. The CAM system physically produces that 3D designed component, by milling it in precision milling machines, using biocompatible metals, especially titanium [4].

One of the most important aspects of using the CAD-CAM system in the creation of implant-supported prosthetic components is the fact that there is the possibility of custom design for each case, thus being able to modify a series of parameters, such as the emergence profile, thickness, line package and the external outline of the component [5].

In the fabrication of a super-structure within a prosthetic restoration on implants, several principles and rules must be respected. In most cases, it is preffered to place the limits of the super-structure supragingivally, especially in the lateral area.

The design of the super-structure must facilitate, through the presence of embrasures, the possibility of perfect hygiene and good gingival stimulation [6]. Some of the new implant systems launched in order to satisfy aesthetic demands, allow the juxtagingival or even intratissue placement of the gingival margins of the prosthesis [7].

In the field of implant-supported prosthetics, individualized implant abutments have become a subject of interest. The position, height and shape, especially in the emergence area, can be individualized. The abutments can be made of materials such as zirconium oxide, lithium disilicate or hybrid materials. For the lateral area, there are alternatives of bicomponent abutments from a prefabricated titanium base and a bonded ceramic post [8].

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Classically, standard abutments supplied by the manufacturer are used, which are individualized by milling by the dental technician in the dental laboratory. Modern, individualized abutments are made that are obtained by classical casting methods or are milled by CAD CAM techniques after their design is digitally created [9, 10].

The classic method of obtaining customized abutments consists in using a castable abutment composed of a prefabricated titanium interface to which a castable plastic tube is attached. On this castable tube, the technician customizes the abutment by adding wax, giving it a shape specific to that case. It follows the classical procedure of investing, calcination and casting, thus obtaining a single common body after the fusion between the titanium interface and the cast metal [11].

Personalized abutments obtained by the digital protocol are the most suitable solution for any case, regardless of its complexity. Once the working digital model is obtained, the design of a customized prosthetic abutment (custom abutment) is not at all difficult, but the way it will be physically produced by a milling machine will be taken into account when designing it [12].

The purpose of this research was to exemplify, through a series of cases, various particularities of the placement of the cervical limits of prosthetic restorations with implant support.

2. Materials and method

This study is retrospective and was carried out by analyzing the images from cases treated at the Faculty of Dental Medicine of the University of Medicine and Pharmacy in Craiova. This research was approved by the Ethics Commission of the University of Medicine and Pharmacy in Craiova (no. 58/29.01.2024).

Inclusion criteria were: (1) patient with maxillary or mandibular partial edentulism, who benefited from fixed implant-prosthetic treatment; (2) two-component implants were inserted; (3) the digital implanto-prosthetic restoration protocol was done; (4) prosthetic crowns with implant support were made.

Exclusion criteria were: (1) patient with partial/total maxillary/mandibular edentulism who did not benefit from fixed implant-prosthetic treatment; (2) monocomponent implants were inserted; (3) the conventional implanto-prosthetic restoration protocol was done; (4) bridges with implant support were made.

The digital stages of obtaining prosthetic abutments began with the scanning of the prosthetic field on the working model/directly in the oral cavity. The scan included gingival registration and digital transfer abutments. Next came the alignment of the components and the preparation of the files necessary for the design. Then the project of the future customized abutment was defined in EXOCAD, the scanned files were loaded, the implant model used was identified from the digital library, the emergence profile was drawn according to the scanned gingiva, the appearance of the abutment was defined by drawing the Bottom and Top lines/points, then the project was saved. Figure 1 shows some of

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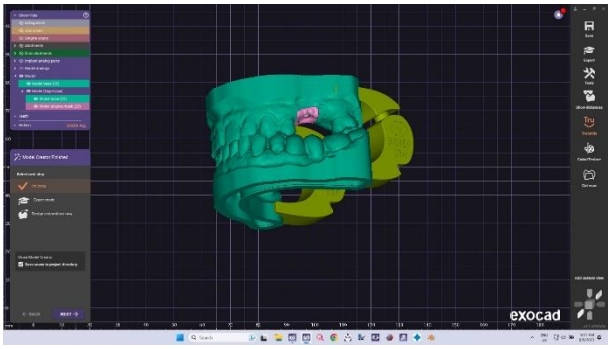
the working stages of the digital protocol for obtaining the personalized abutment of a case selected for this study.

3. Results

After applying the inclusion and exclusion criteria, 23 cases were selected. For this article, we will exemplify through images from several cases, the particularities of the cervical limits of prosthetic crowns with implant support to achieve the proposed objective.

The first case presented is of a patient with maxillary partial edentulism who had a Bredent implant inserted in the position corresponding to tooth 2.5. It was decided to create an individualized prosthetic abutment.



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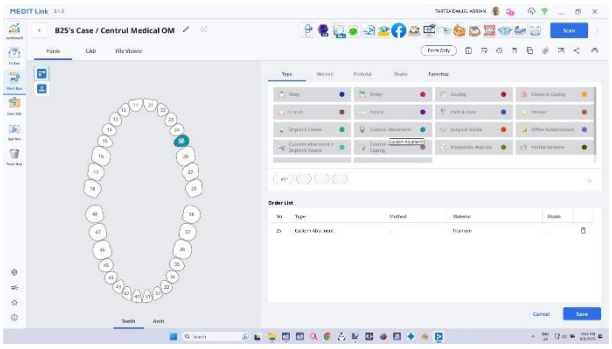

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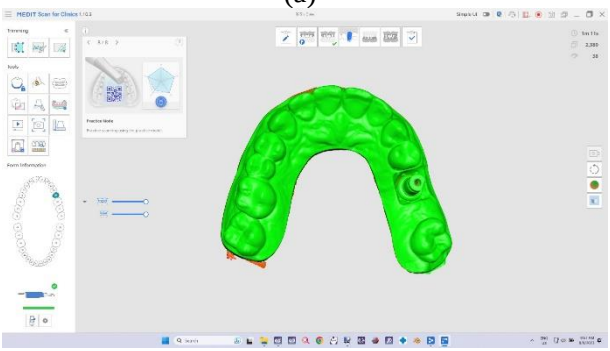

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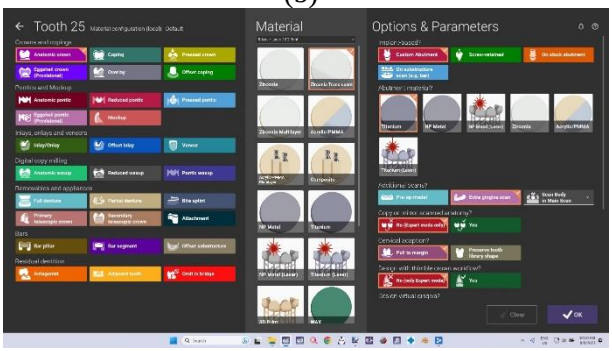

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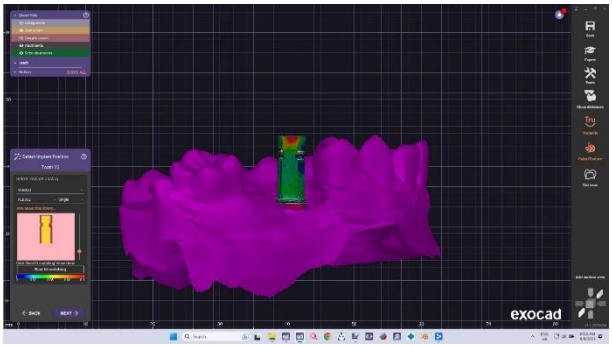

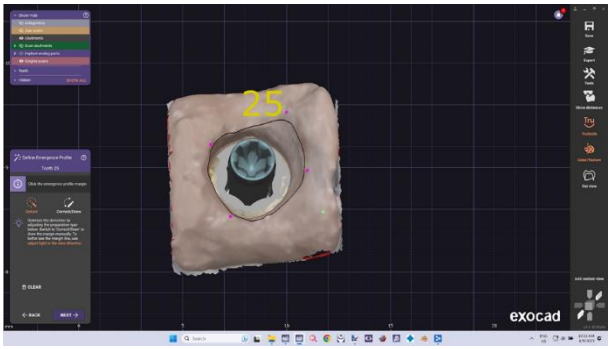

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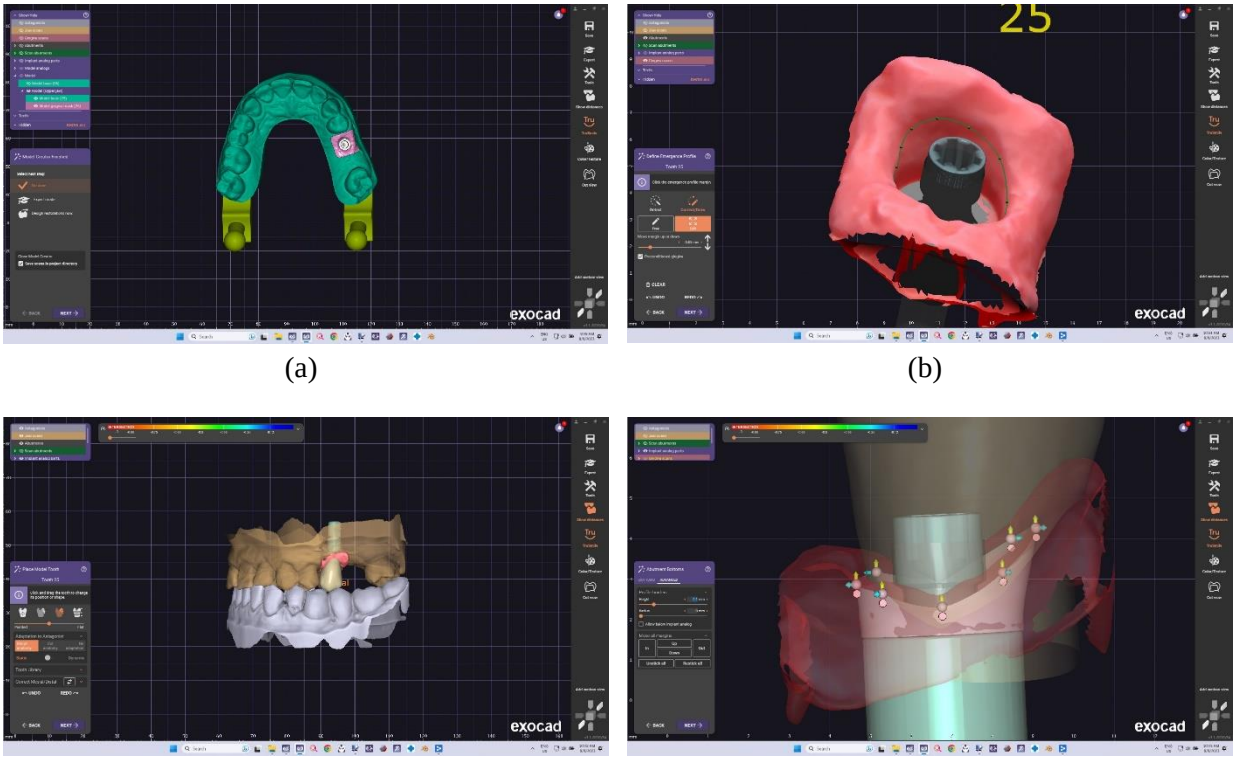
(e) (f)

Figure 1. Working stages. (a) ExoCAD software interface; (b) interface of the scanning software used; (c) the digital appearance obtained after scanning the printed model; (d) the interface of the design software used highlighting the parameters used; (e) identifying the digital transfer device mounted on the implant analog and pairing it with the one in the software's digital library; (f) the gingival emergence profile definition menu and a first line suggested by the software.

With the help of the EXOCAD-Bredent implant library, the position and shape of the future prosthetic crown was established, depending on the potential prosthetic space available. The design of the abutment was made according to the desired shape for the prosthetic crown in position 2.5. Some of the working steps, most relevant for the purpose of this article, are shown in Figure 2.



(a) (b)

(c) (d)

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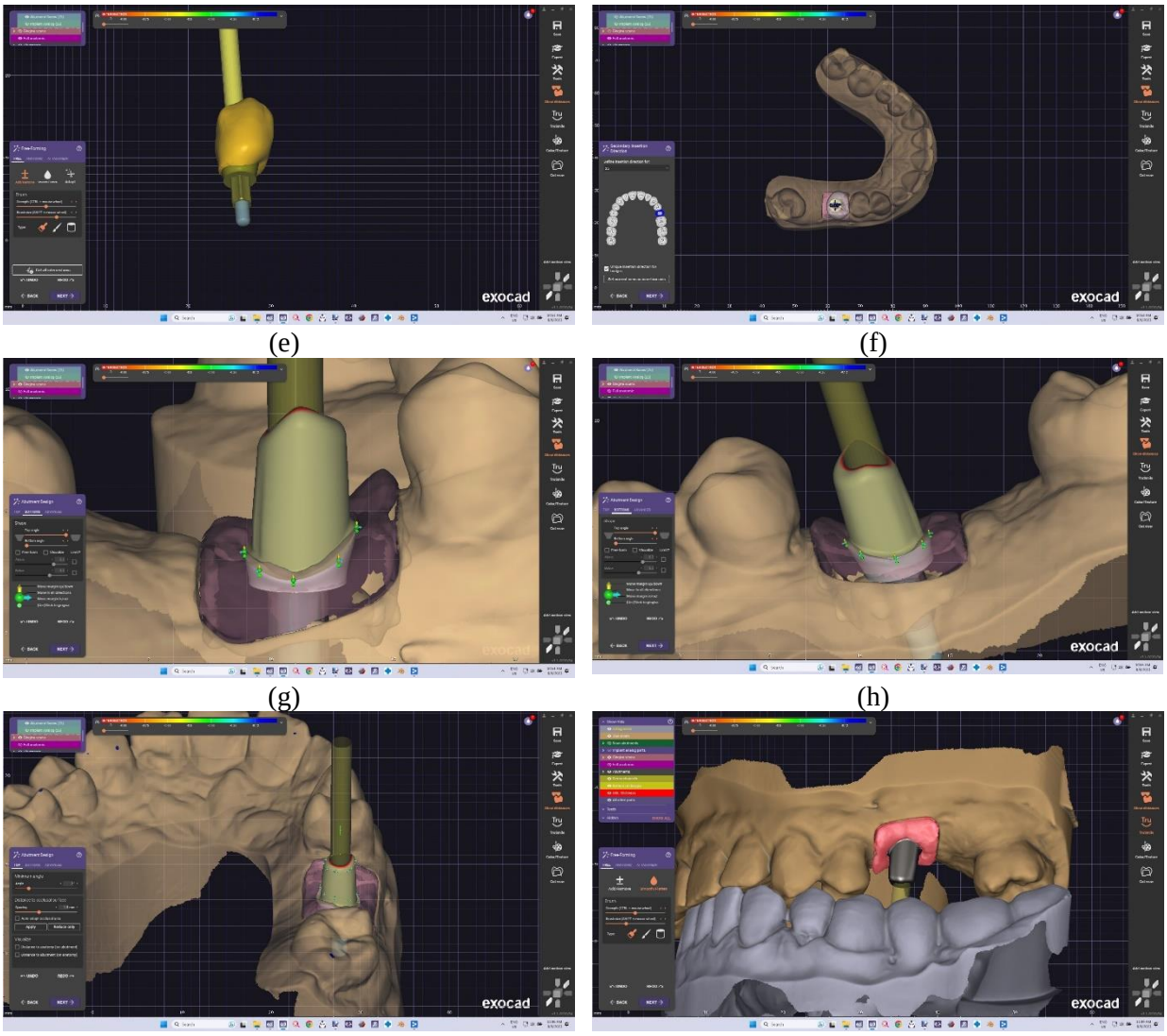

(e) (f) (g) (h) (i) (j)

Figure 2. (a) digital appearance of the printed model; (b) gingival emergence profile editing menu; (c) crown appearance; (d) editing the position of the cervical limit of the abutment; (e) visualization of the cervical profile of the abutment; (f) view of abutment insertion axis; (g) visualization of the cervical profile of the abutment; (h) oral view of the cervical profile of the abutment; (i) distal view of the ratio of the cervical border of the abutment; (j) the final digital appearance of the abutment.

The second case presented is of a partially edentulous patient who was inserted a Bredent implant in the position corresponding to tooth 3.6. It was decided to create an individualized prosthetic abutment, on which a prosthetic crown with implant support was applied. Obtaining digital information was done by performing an intraoral scan for which a scan transfer device placed at the level of the implant was also used. Figure 3 shows some of the work stages.

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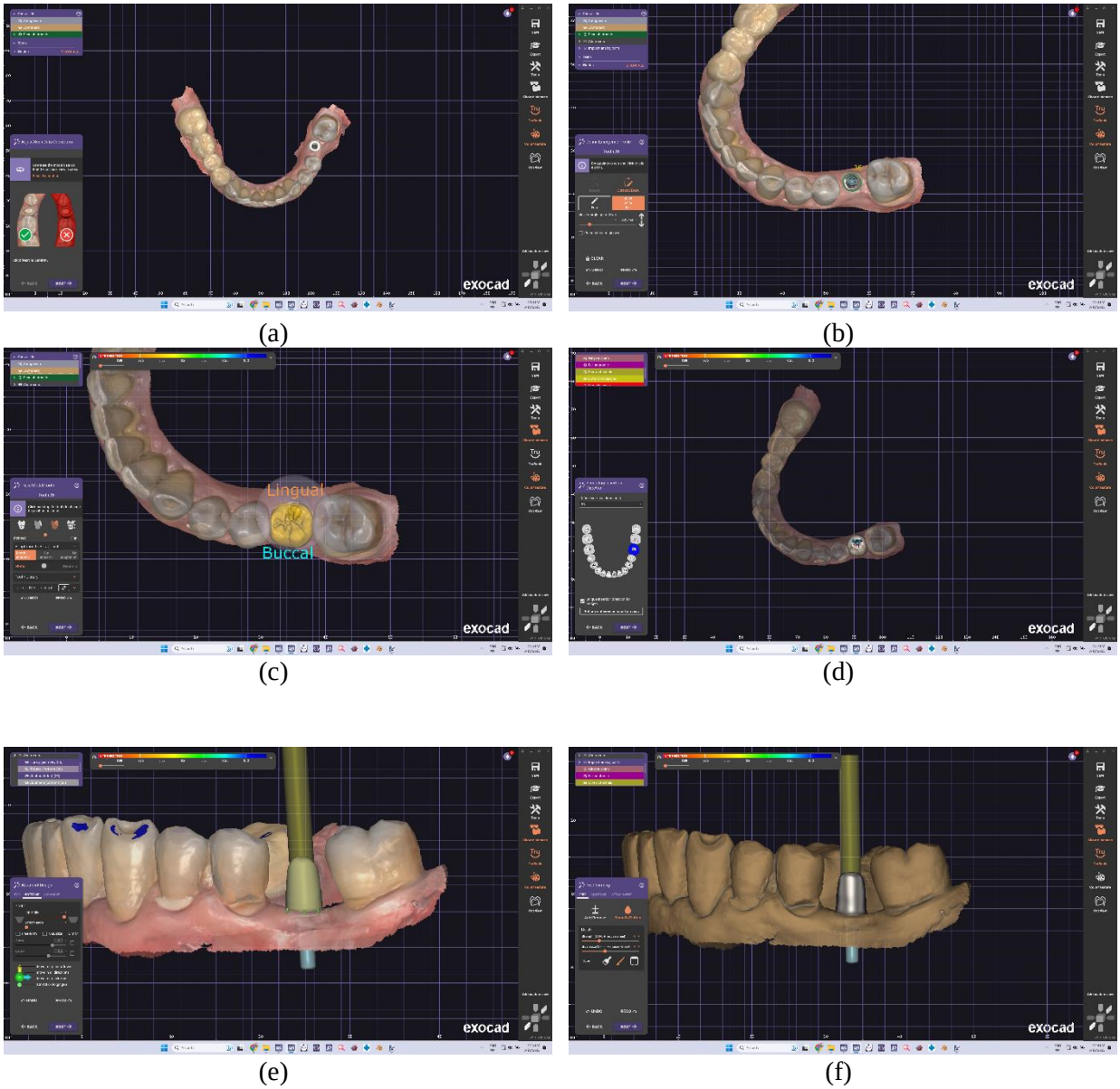

(a) (b) (c) (d) (e) (f)

Figure 3. (a) appearance in ExoCad design software of the intraoral scan of the mandibular arch with the scannable transfer device mounted at the implant level; (b) gingival emergence profile definition menu and a first line suggested by the software; (c) crown suggested by software library; (d) view of the insertion axis of the future crown; (e) establishing the design of the basal portion of the prosthetic abutment and its cervical limits; (f) final shape of the prosthetic abutment showing the insertion axis.

The last case presented is that of a patient with partial mandibular edentulism who had a BREDENT implant on the position corresponding to tooth 3.6. It was established, again, the realization in EXOCAD of an individualized prosthetic abutment. The

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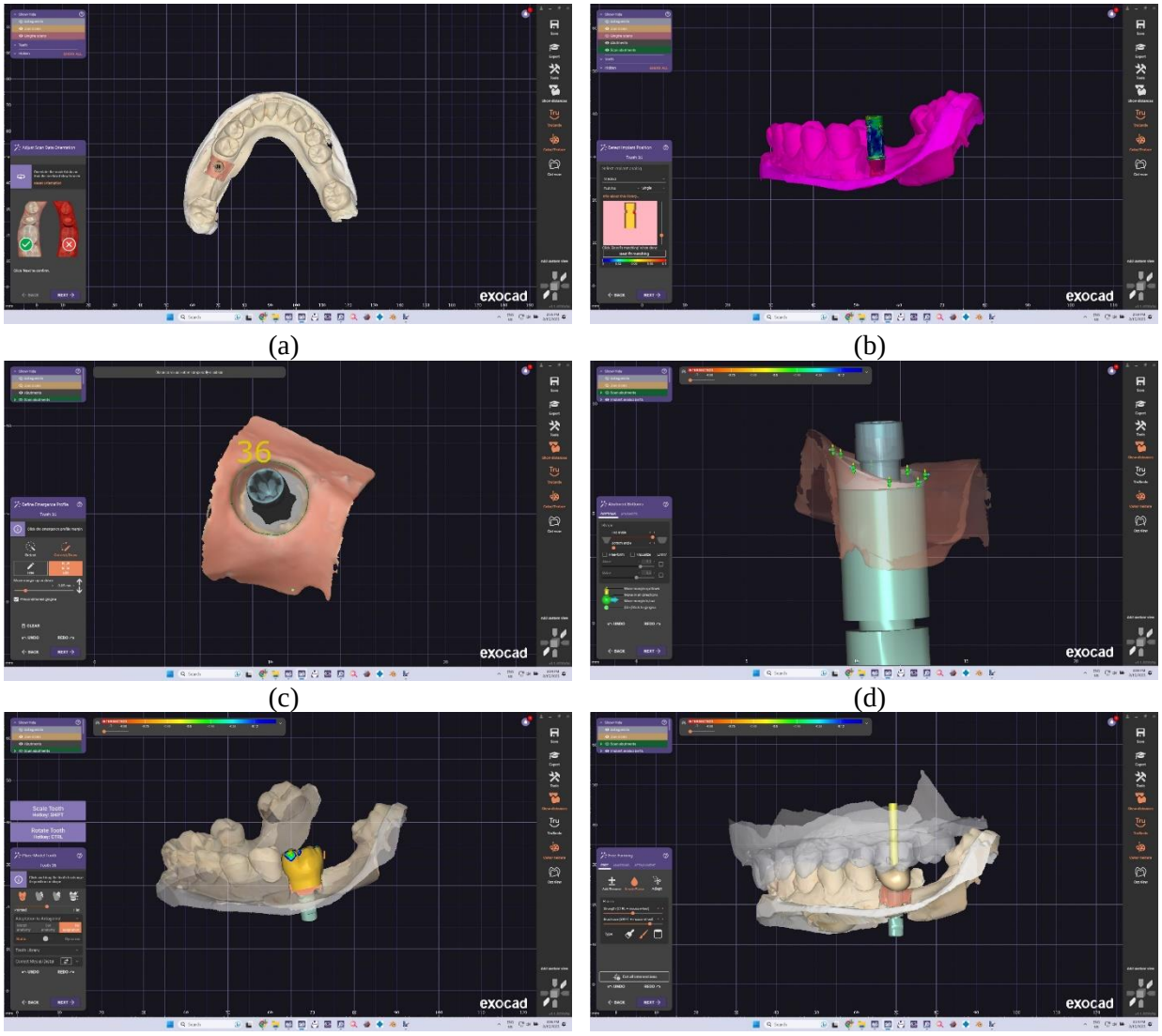
acquisition of digital information was done by scanning the plaster working model and the gingival profile reproduced from the silicone material, together with a scanning marker placed at the level of the implant. Certain working stages, the most relevant for this article, are shown in Figure 4.



(a) (b) (c) (d) (e) (f)

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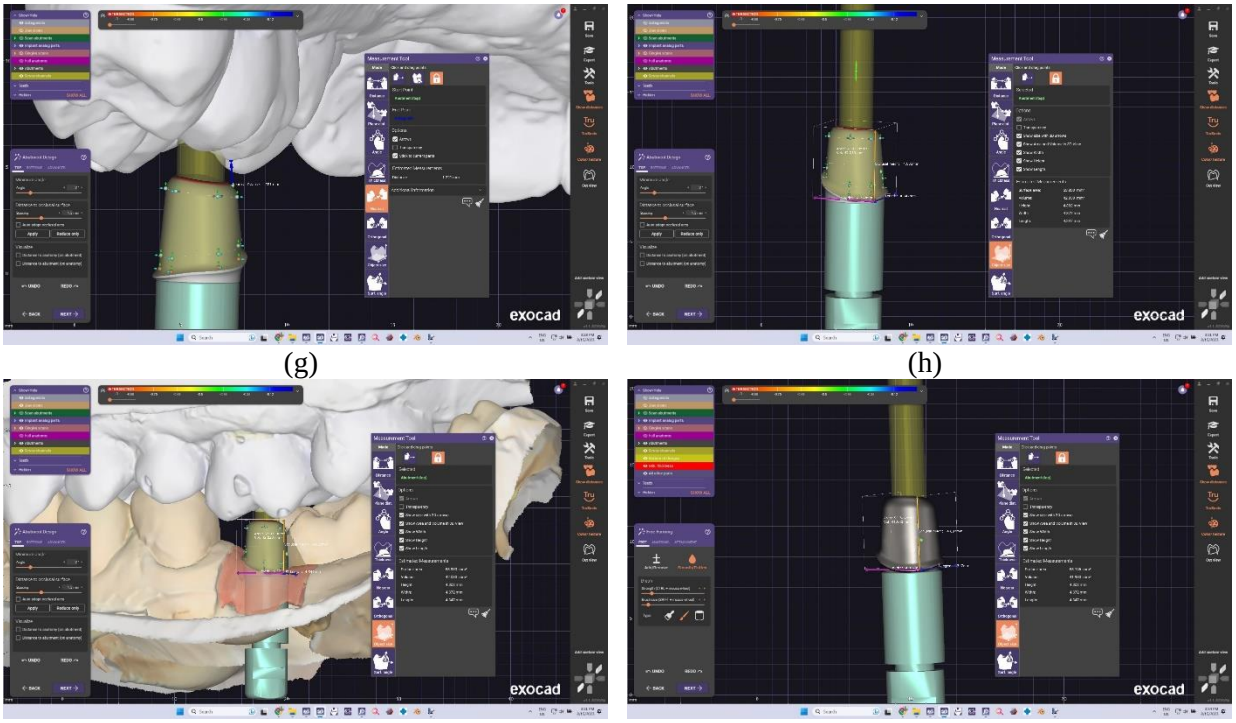

(g) (h)

(i) (j)

Figure 4. (a) appearance of the scanned plaster model; (b) aligning the scanning marker with the device in the software library; (c) gingival emergence profile editing menu; (d) editing the position of the cervical margin of the abutment; (e) the appearance of the crown suggested by the software library; (f) establishing the shape of the zirconia crown; (g) establishing the shape of the upper portion of the abutment with the measurement of the prosthetic space left for the crown; (h) establishing the final shape of the prosthetic abutment with the measurement of its dimensions; (i) establishing the final shape of the abutment; (j) the final digital appearance of the abutment.

4. Discussions

Implant-supported prostheses are a popular treatment choice for the rehabilitation of patients with missing teeth, particularly those in the anterior region of the maxilla, where esthetics is highly important [13].

Despite its popularity amongst dental practitioners and pacients, one must be aware that after implant restoration, several postoperative complications can appear, including food traps, poor esthetic outcomes, periimplantitis, mucositis [14]. The success of the implant-prosthetic treatment is dependent on the health of the surrounding bone and soft tissues. Prevention and management of mucositis and peri-implantitis are essential for long-term maintenance of the health of these tissues [15].

Dental implantology has seen a significant evolution in recent years, including the implementation of CAD-CAM systems that ensure a high success rate for the prosthetic restoration. Some of the most popular CAD software are Exocad, 3Shape, DentalWings, and referring to the CAM software, the most

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frequently used are hyperDENT, CIMSystem-Millbox and WorkNC [16]. Use of CAD/CAM technology in implantology allowed the fabrication of custom abutments. Nowadays, the realization of individual custom abutments can be done according to the patients' anatomic landmarks and/or with the ideal emergence profile of the absent tooth [13].

Although design software offers a wide range of tools for individualizing the shape of the prosthetic abutments of implant-supported restorations, there is currently no consensus on the design of all prosthetic abutments [17].

Abutment designs may be customized to enhance the emergence profile of the crown in relation to the soft tissue or to increase crown retention [18, 19]. Custom abutments based on CAD-CAM technology can be individualized to each clinical situation, and materials such as titanium may be used, zirconia, ceramic and PEEK [16]. Customized abutments enable the creation of an individualized emergence profile for the prosthesis, simplifying the removal of excess cement compared to standardized abutments [20]. Personalized medicine offers better solutions for various health problems. In implantology, this trend represents the customizing dental abutments for each clinical situation. The patients' and dentists' demands for better esthetics and function of implant-supported restorations have imposed a more personalized variety of prosthetic abutments [21].

5. Conclusions

A good knowledge of the possibilities of realizing the design of prosthetic abutments, as well as the existing limits, is important for both the dental technician and the dentist, in order to ensure a good collaboration between them in order to optimally fulfill the wishes of a successful implanto-prosthetic treatment functionally.

If in the lateral area or on the oral surfaces, it is recommended to place the cervical limit as close as possible to the gingival margin or even supragingival to favor the maintenance of peri-implant health, in the frontal area the aesthetic requirements require a deeper subgingival placement of the cervical border of the implant abutment.

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Author contributions

All authors read and approved the final manuscript. All authors have equally contributed to this work.

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Conflict of interest statement

The authors declare no conflicts of interest concerning this study.

Data availability statement

Will be provided on request.

Ethics statement

Approved by the Scientific Ethics and Deontology Commission of UMF Craiova (no. 58/29.01.2024).

ORCID

Andreea Stănuși: https://orcid.org/0000-0003-2520-7967
Horia Octavian Manolea: https://orcid.org/0000-0002-2710-5537

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