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Improving Digital Workflow: Overlapping Guides and Immediate Prostheses for Implant-Supported Rehabilitation

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ABSTRACT

The overlapping of guides allows for precise implant placement, optimizing the surgical process and reducing intervention time. Additionally, using immediate prostheses provides patients with immediate functional restoration, improving their quality of life during the healing period. These combined approaches increase clinical efficiency and promote superior aesthetic and functional outcomes for dental implant rehabilitation patients. This study aims to describe a clinical case in which prior prosthetic planning facilitated guided implant placement in the jaw. Subsequently, a partial arch rehabilitation, previously milled in PMMA, was installed using a fitting system within a fully digital workflow.

KEYWORDS

Aesthetic zone, Dental implants; Dental materials; PMMA

INTRODUCTION

The placement of osseointegrated implants, while a common practice in dentistry, continues to be a subject of study in pursuit of aesthetic and functional excellence. In this context, guided surgery has emerged as an excellent option, enabling detailed pre-planning of aesthetic

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outcomes and implant positioning relative to the ideal prosthesis [1].

With a growing demand for faster and more precise rehabilitation treatments, CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) technology has gained prominence [2]. This innovation integrates computer-assisted design with manufacturing, widely utilized across industries, including dentistry [3]. Initially employed for producing dental prostheses and prototypes from DICOM files derived from tomography, CAD/CAM offers significant benefits such as speed, accuracy, predictability, and longevity of prosthetic restorations [4]. Advancements in scanners, milling machines, and printers have fueled substantial growth in the digital manufacturing of dental prosthetics and implants [5].

Among these advancements, intraoral scanners have revolutionized dental workflows by enabling fully digital processes, thereby reducing clinical preparation time. Additionally, new materials with enhanced physical and mechanical properties, like pre-polymerized PMMA discs for milling prosthesis bases, have emerged [6]. These materials undergo polymerization through high-temperature, high-pressure injection, eliminating shrinkage and transforming the production of provisional prostheses [7].

Currently, most implant-guided surgeries utilize static guides produced by printing or milling CAD designs from planning software, representing the predominant method. Static-guided surgery involves aligning 3D data from computerized conical beam tomography (CBCT) with optical surface scanning files to generate STL files [8-11]. Virtual tooth mounting software or duplication of wax-based mounts approved before tomography can facilitate this process [12-14]. Despite the reliability and advantages of guided surgery over manual techniques, angular and horizontal deviations can occur during in vivo surgeries, particularly in total and partial arch cases using mucosa-supported guides [15]. This necessitates additional steps like molding or scanning final implant positions for subsequent rehabilitation in total, partial, and previously manufactured cases [16-20].

Efforts persist to introduce prefabricated temporary prostheses into surgical settings. Although CAD/CAM prostheses are described in new guides with proposed overlaps, a method to incorporate prefabricated prostheses directly into surgical guides remains elusive. Addressing this gap, this study aims to describe a clinical case where prior prosthetic planning facilitated guided implant placement in the jaw, followed by immediate installation of a partial arch rehabilitation previously milled in PMMA, using a fitting system within a fully digital workflow.

CASE DESCRIPTION

Patient M.R.R., male, 39-years-old, sought care for dental rehabilitation in the anterior region of the mandible. Clinical and radiographic examination revealed significant dental wear in both arches, with greater involvement in the anterior region of the lower arch. Photographic documentation, impressions, and assembly of the models were carried out in a semi-adjustable articulator (SAA) for study, using a modified JIG to record the position of the planned vertical dimension of occlusion (VDO), with the condyles in a centric relationship position (CR).

In the laboratory, the maxillary teeth were removed in plaster and a first provisional mucous-supported prosthesis was created in the VDO established during the assembly of the SAA. After the extractions and installation of the immediate complete prosthesis, healing was awaited before obtaining a new partial model of the lower anterior region, mounted in SAA. Aesthetic factors were then defined, including plane length, incisal curvature, buccal corridors, the vertical dimension of occlusion (VDO), and the relationship between the arches in the centric occlusion relationship position. In the second stage of treatment, the lower anterior teeth were extracted, and two implants were installed (B-fix Profile Ø 4.0 mm × 10 mm, Titaniumfix, São José dos Campos, SP, Brazil). All presented primary stability of 45Ncm or higher, and metallic links (Ø 4.5 mm × 5.5 mm, Universal Abutment, Titaniumfix, São José dos Campos, SP, Brazil) were selected and installed to enable digital oral rehabilitation.

The implant-supported prosthesis of the anterior region of the lower arch was manufactured using the guided surgery technique, with prior production of a dentogingival prosthesis milled in PMMA. Initially, intraoral scanning (Virtuo Vivo, Straumann) of the installed partial denture, edentulous ridge, antagonist arch, and occlusion was performed. Subsequently, with the prosthesis prepared in the mouth, cone beam tomography was performed. A second CT scan was done just of the prosthesis outside the mouth. The images in DICOM format and the virtual files in STL format were imported into the co-DiagnostiX software (Dental Wings, Chemnitz, Germany) (Figure 1).

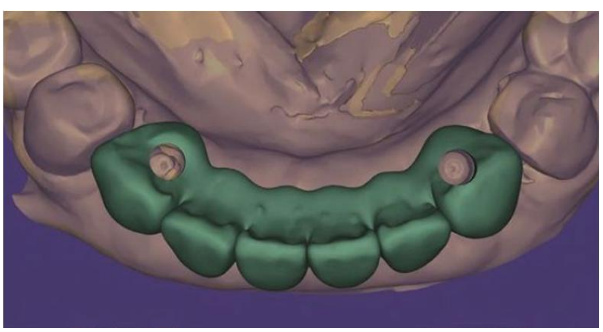

Figure 1: Images in DICOM format of the scanned region, and virtual files in STL format.

In the virtual environment, two implants (B-fix Profile Ø 4.0 mm × 10 mm, Titaniumfix, São José dos Campos, SP, Brazil) were installed according to bone availability, aiming for better anchorage for primary stability. The spatial positioning of the implants was studied based on the prosthetic design, with the vertical positions defined at 2 mm infra-osseous. After approval of the positioning of the implants, the heights of the metallic links were chosen (Ø 4.5 mm × 5.5 mm, Universal Abutment, Titaniumfix, São José dos Campos, SP, Brazil). The approved files were then sent to the planning center (Digital Center Lab, Vitoria, ES, Brazil). The virtual planning with the implant coordinates was exported together with the virtual wax-up to Exocad 3.0 Galway (Darmstadt, Germany) for the design of the surgical guide and the provisional fixed prosthesis.

The design of the prosthesis and the CAD of the base mucosupported surgical guide were performed. On this base guide, the surgical guide containing the design of the prosthesis was designed, allowing the inclusion of some teeth in the design. Meshmixer (Autodesk, United States) was used to design the cutting connections on the digital guide, facilitating the fitting of the milled polymethyl methacrylate (PMMA) prosthesis. The base and surgical guides (Figure 2) were printed with Pro Surgical Guide resin (Titaniumfix, São José dos Campos, SP, Brazil) on the Rapidshape P30 printer (Titaniumfix, São José dos Campos, SP, Brazil), and the provisional prosthesis was milled from a 20 mm PMMA block (Ceramill A-Temp Multilayer, Amann Girrbach AG, Koblach, Austria) on the Ceramil Motion 2 DNA milling machine (Amann Girrbach AG, Koblach, Austria). Using the surgical guide and the surgical kit (Surgical kit, Profile, Titaniumfix, São José dos Campos, SP, Brazil), the base guide was positioned, and the fixation pins were milled and installed, followed by adaptation of the surgical guide and execution of the surgical instrumentation, following the progressive sequence of drills with abundant irrigation.

Figure 2: Base and surgical guides printed with pro surgical guide resin.

Two implants (B-fix Profile Ø 4.0 mm × 10 mm, Titaniumfix, São José dos Campos, SP, Brazil) were installed in regions 33 and 43, with an installation torque equal to or greater than 35 Ncm (Figure 3). The heights of the metallic links (Ø 4.5 mm × 5.5 mm, Universal Abutment, Titaniumfix, São José dos Campos, SP, Brazil) were previously selected in the software, using the prosthetic selection kit (Universal Abutment, Titaniumfix, São José dos Campos, SP, Brazil). After installing the components, the torques recommended by the manufacturer were applied. The metallic links (Ø 4.5 mm × 5.5 mm, Universal Abutment, Titaniumfix, São José dos Campos, SP, Brazil) were then installed using the passive cementation technique, and the prosthesis, previously milled in PMMA, was positioned (Figure 3 and figure 4).

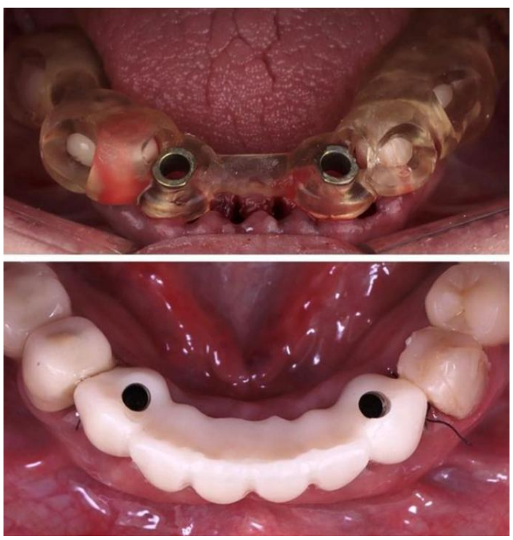

Figure 3: Black-fix profile implants installed in regions 33 and 43 with printed surgical guide.

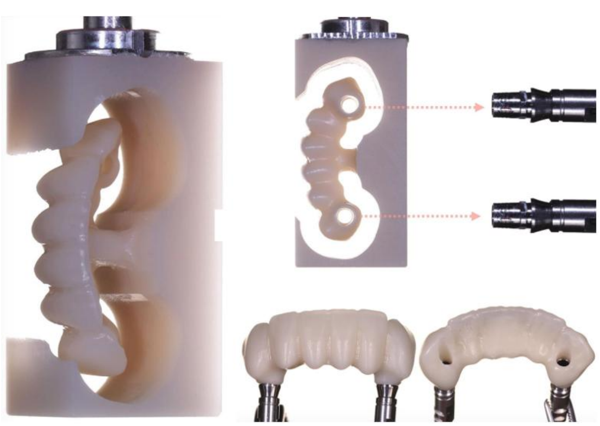

Figure 4: Prosthesis previously milled in PMMA and installed using the passive cementing technique.

DISCUSSION

The technique described provides agility in clinical work and is already fully available for use without special devices. 11 It demonstrates the possibility of implementing the installation of implants and the placement of temporary prostheses completely in the digital stream, allowing the use of a process already described for partial rehabilitation in total arches [12].

An important point for the speed and efficiency of the work was the existence of a pre-total prosthesis with all the characteristics desired for rehabilitation, including the previously studied lip support, as recommended by studies [13-17]. This prosthesis can be scanned, providing a tomographic image, and the resulting files can be aligned. This file also worked as the "standard" for the CAD of the implant-supported prosthesis, speeding up the procedure [18].

The use of intraoral scanning is mentioned as a tool to improve patient comfort and facilitate printing by reducing working time, a fact that can be confirmed in this clinical case [19]. It was possible to scan a pre-prothesis and use the file as a standard for the CAD of the temporary milled-type implant-supported prosthesis, which reduced the number of clinical steps required and allowed the installation of prosthodontics on a more durable material [20].

FINAL CONSIDERATIONS

It is concluded that oral rehabilitation using a digital workflow with immediate superimposed guides and prostheses made from PMMA offers significant benefits to modern dentistry. This method ensures high precision, agility, and efficiency in the dental rehabilitation process. The ability to digitally install implants and temporary prostheses reduces the number of clinical steps and treatment time while enhancing patient comfort. PMMA, known for its biocompatibility and durability, ensures the longevity and functionality of temporary prostheses, providing both aesthetic appeal and functionality. This technological advancement represents a significant evolution, optimizing professionals' workflow and delivering improved outcomes for patients.

DATA AVAILABILITY

All data analyzed during this study are available from the corresponding author upon reasonable request.

DISCLAIMER OF LIABILITY AND DISCLOSURE

All data analyzed during this study are available from the corresponding author upon reasonable request. The authors report no conflicts of interest regarding any of the products or companies discussed in this article.

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