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USE OF CONE BEAM TOMOGRAPHY FOR IMMEDIATE LOADING PLANNING IN UPPER protocol: a case report

USO DE LA TOMOGRAFÍA CONE BEAM PARA LA PLANIFICACIÓN DE CARGA INMEDIATA EN PROTOCOLO SUPERIOR: REPORTE DE CASO

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Resumo

Este estudo teve como objetivo relatar o uso de Tomografia Computadorizada do tipo Cone Beam (CBCT), para o planejamento de carga imediata em protocolo superior através de um caso clínico. Uma paciente de 61 anos de idade compareceu a clínica de reabilitação oral com queixa de uma prótese mal adaptada e de dentes ausentes na região da maxila. Após a avaliação clínica e radiográfica, por meio de tomografia computadorizada, o tratamento proposto foi a realização de uma cirurgia para inserção de quatro implantes e a confecção de uma prótese total fixa sobre implantes.

Palavras-chave: Cone Beam; Implantodontia; Tomografia computadorizada.

Abstract

This study aimed to report on the use of Cone Beam Computed Tomography (CBCT), for immediate loading planning in the upper protocol through a clinical case. A 61-year-old patient presented to the oral rehabilitation clinic with a complaint of ill-fitting dentures and missing teeth in the maxillary region. After clinical and radiographic evaluation, including cone beam computed tomography, the proposed treatment involved surgery for the insertion of four implants and the fabrication of a fixed full prosthesis over the implants.

Keywords: Cone Beam; Implantology; Computed tomography.

Resumen

Este estudio tuvo como objetivo reportar el uso de la Tomografía Computarizada de Haz Cónico (CBCT) para la planificación de carga inmediata en protocolo superior mediante un caso clínico. Una paciente de 61 años acudió a la clínica de rehabilitación oral con queja de una prótesis mal adaptada y ausencia de dientes en la región maxilar. Tras la evaluación clínica y radiográfica mediante tomografía computarizada, el tratamiento propuesto fue la realización de una cirugía para la colocación de cuatro implantes y la confección de una prótesis total fija sobre implantes.

Palabras clave: Cone Beam; Implantología; Tomografía computarizada.

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1. Introduction

The use of Cone Beam Computed Tomography (CBCT), and three-dimensional imaging for implant dentistry planning has become an indispensable tool, enabling accurate diagnosis and contributing significantly to the success of oral rehabilitation in partially and completely edentulous patients (Bornstein, et al., 2017; Braut, et al., 2014). The radiation dose associated with CBCT is lower than that of conventional Fan-Beam Computed Tomography (FBCT), ranging from approximately 92–118 μSv for CBCT compared to 680 μSv for FBCT (Ludlow; Ivanovic, 2008; Schulze, et al., 2004). Therefore, CBCT is frequently indicated for dental implant treatment planning.

After selecting implants according to the anatomical dimensions of the surgical site, the patient undergoes implant placement surgery following prosthetically driven planning principles. Two treatment approaches may be adopted: immediate loading, in which the prosthesis can be delivered within up to 48 hours after surgery depending on the insertion torque typically around 30 Ncm (Maló, et al., 2018), or the conventional two-stage surgical protocol.

The two-stage protocol, originally described by Brånemark et al. (1977), involves implant placement followed by a healing period of 4 to 6 months to allow osseointegration before prosthetic rehabilitation (Erkapers, et al., 2017; Strub, et al., 2012). During this healing phase, patients typically continue wearing a removable full denture. Due to the reduced treatment time associated with immediate loading protocols, many patients prefer this approach (Khorshid, et al., 2011).

Initially, cumulative survival rates for titanium implants were reported as 81% in the maxilla and 91% in the mandible (Adell, et al., 1981). More recent studies, considering advancements in implant design, surface technology, and surgical techniques, have demonstrated cumulative survival rates ranging from 95.5% to 100% (Salvi, et al., 2020).

The posterior maxilla often presents reduced bone density and limited vertical bone height, which may restrict implant placement (Capelli, et al., 2007).

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However, tilted implants have been proposed as a predictable alternative, providing favorable masticatory function provided that excessive cantilever length is avoided (Shackleton, et al., 1994).

Documented techniques involving posterior tilted implants can eliminate the need for bone grafting procedures while providing adequate anchorage and bone support for full-arch rehabilitations (Durkan, et al., 2020; Ozan; Kurtulmus-Yilmaz, 2018). This approach allows the use of longer implants, increasing the bone-to-implant contact area and enhancing primary stability. Additionally, it increases the anteroposterior spread, promoting improved stress distribution along the alveolar ridge and often eliminating the need for distal cantilevers (Capelli, et al., 2007).

The aim of this study was to report the case of a 61-year-old systemically healthy female patient who underwent rehabilitation with four maxillary implants supporting a full-arch fixed prosthesis under an immediate loading protocol.

2. Case Report

A 61-year-old female patient (MALP) presented to the postgraduate dental clinic complaining of poor prosthetic esthetics and difficulty chewing. A comprehensive clinical examination was performed, followed by panoramic radiography (Figure 1) and Cone Beam Computed Tomography (CBCT) (Figure 2).

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Figure 1 – Initial panoramic radiograph.

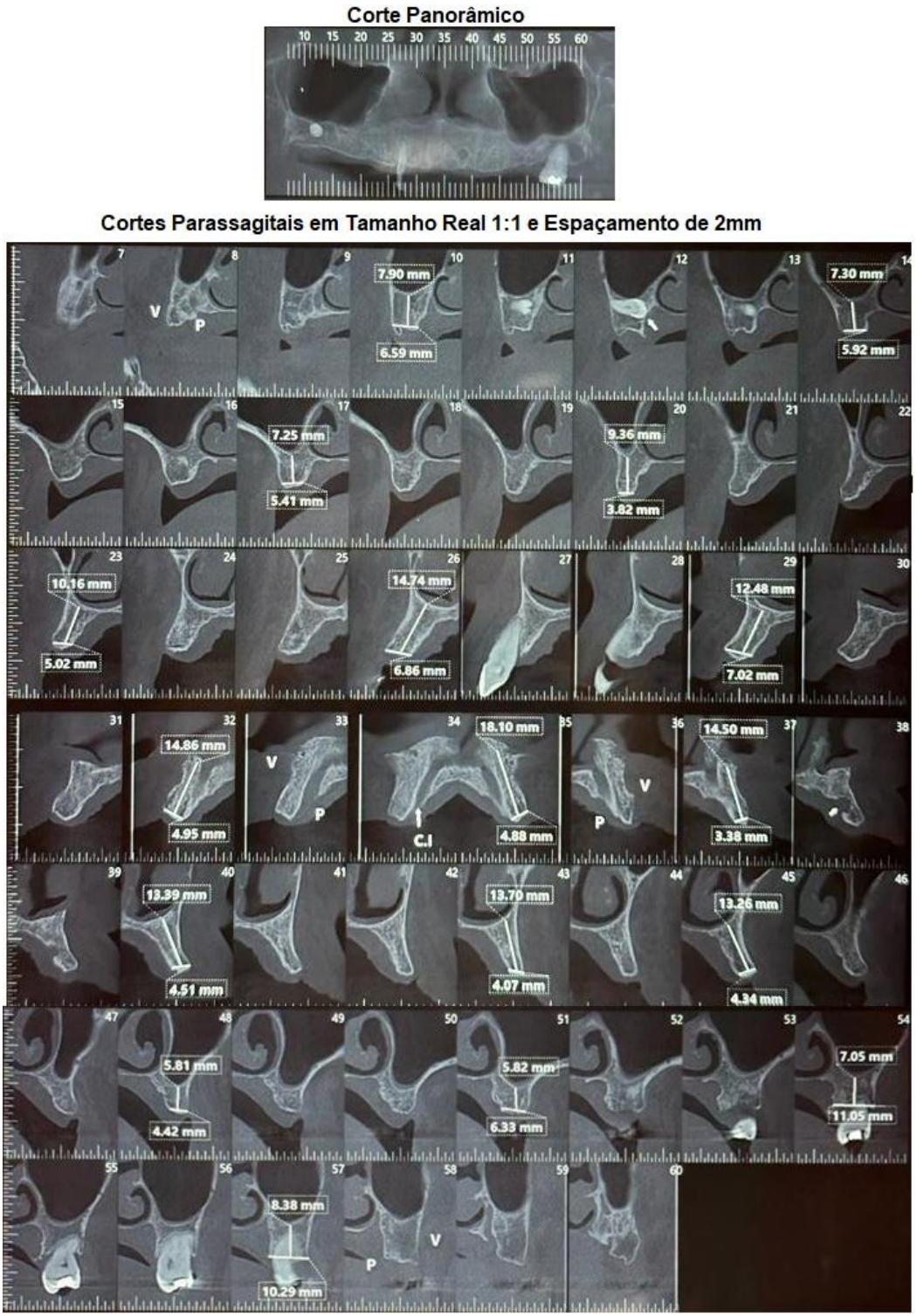


Caption: R indicates the patient's right side and L indicates the left side.

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Figure 2 – Cone Beam Computed Tomography.



Caption: Panoramic reconstruction with 2-mm slice thickness and spacing of the maxillary region.

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CBCT analysis revealed sufficient bone height and thickness for the placement of two implants in the anterior maxilla and two implants in the posterior region with 30° angulation to avoid the maxillary sinus. Radiographic examination also showed the presence of two remaining teeth (FDI 13 and 27) with reduced bone support, indicating extraction at the time of implant placement.

During treatment planning, a new immediate full denture was fabricated (Figure 3). In case the implants did not achieve a minimum insertion torque of 32 Ncm, the patient would use this denture during the osseointegration period. The denture was duplicated to serve as a multifunctional surgical guide (Figure 4) during implant placement, allowing occlusal registration, vertical dimension transfer, and impression procedures.

Figure 3 – Fabricated full denture.



Caption: Full denture.

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Figure 4 – Multifunctional surgical guide.



Caption: Surgical guide with perforations for impression procedures and prosthetic component pickup.

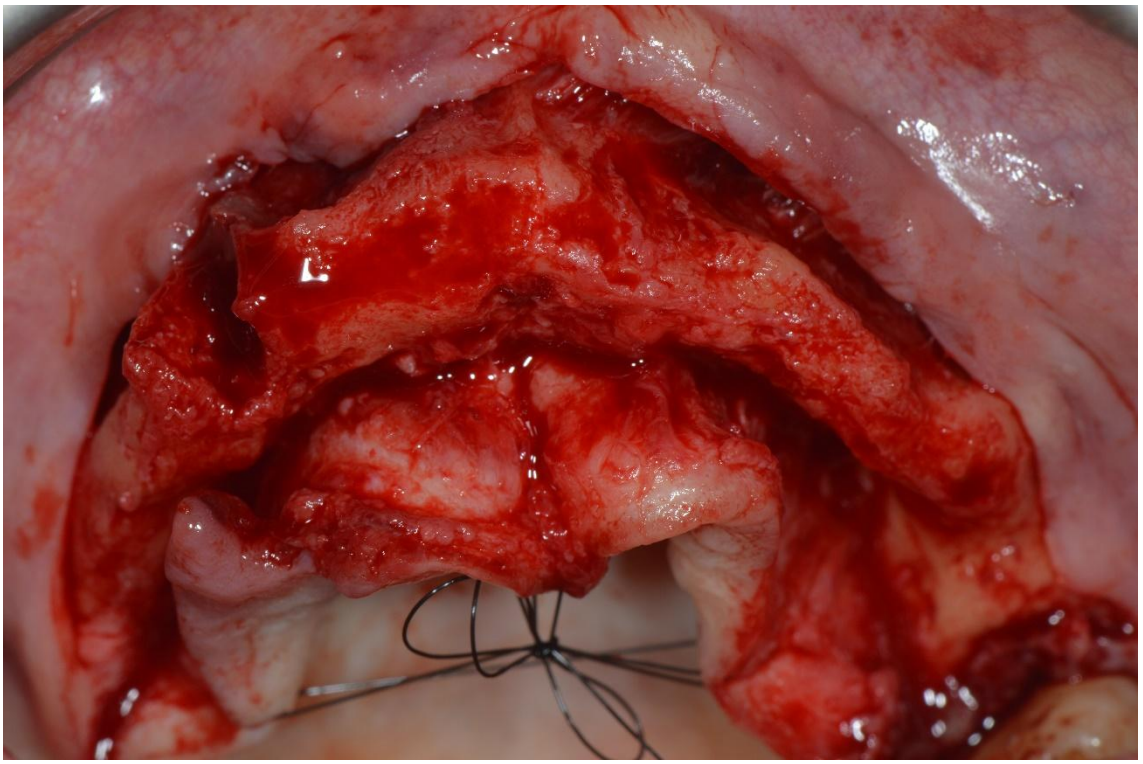
Preoperative medication included 1 g amoxicillin and 8 mg dexamethasone. Local anesthesia was achieved with three cartridges of 4% articaine with epinephrine 1:100,000, anesthetizing the nasopalatine, infraorbital, and greater palatine nerves bilaterally. Additional infiltrative anesthesia was administered in the buccal incisor region and along the alveolar ridge.

Teeth 13 and 27 were extracted, followed by a uniform supracrestal incision extending from tooth 17 to 27. A full-thickness mucoperiosteal flap was elevated, and a palatal suture was placed to improve surgical field visualization (Figure 5).

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Figure 5 – Flap elevation.



Caption: Alveolar ridge exposed after flap elevation, with palatal suture placed to improve surgical field visibility.

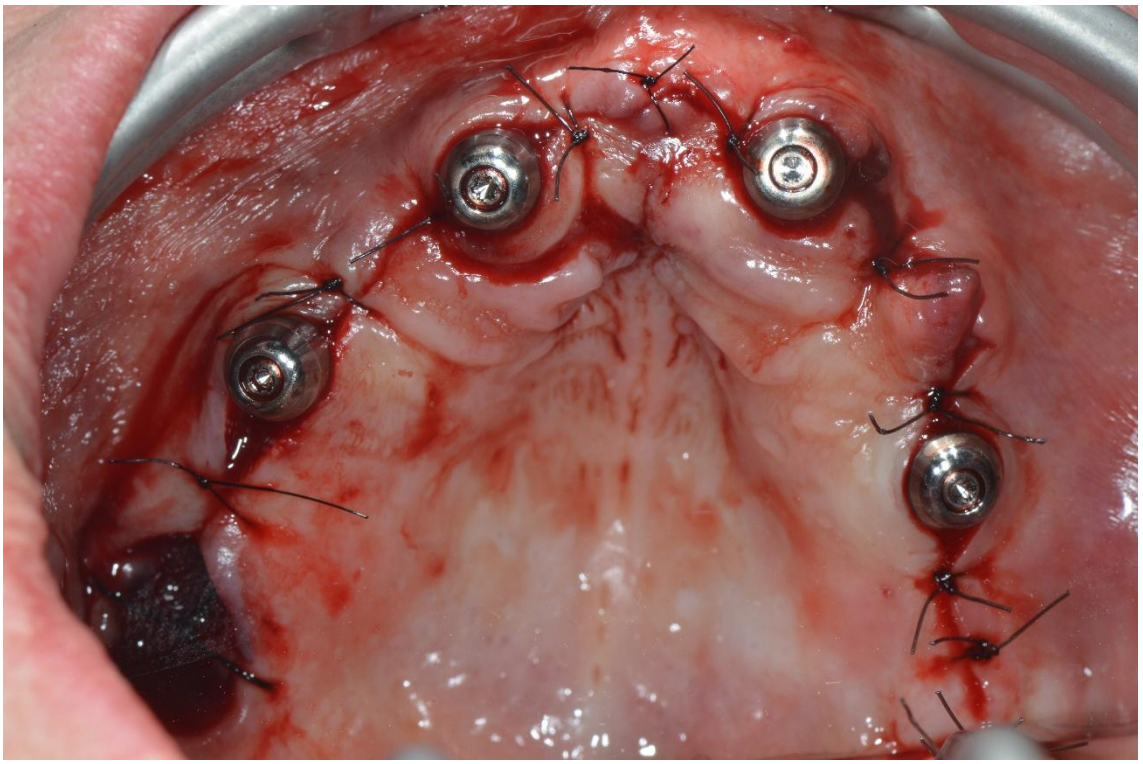
Alveolar ridge regularization was performed to provide adequate prosthetic space for the implant-supported fixed prosthesis. Osteotomy preparation was carried out using Helix drills in the sequence 2.0, 3.5, and 3.75 mm, followed by insertion using a torque wrench.

Four Helix GM (Gran Morse) implants (Neodent, Curitiba, Brazil) were placed: two measuring 3.75 × 13 mm in the posterior region and two measuring 3.75 × 10 mm in the anterior region. All implants achieved insertion torque values greater than 40 Ncm. Two straight mini abutments were placed in the anterior region, and two 30° angled mini abutments were placed in the distal regions, along with four mini abutment protectors (Figure 6).

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Figure 6 – Implants installed with abutments in position.



Caption: Implants placed with mini abutments and protective caps in position, followed by suturing.

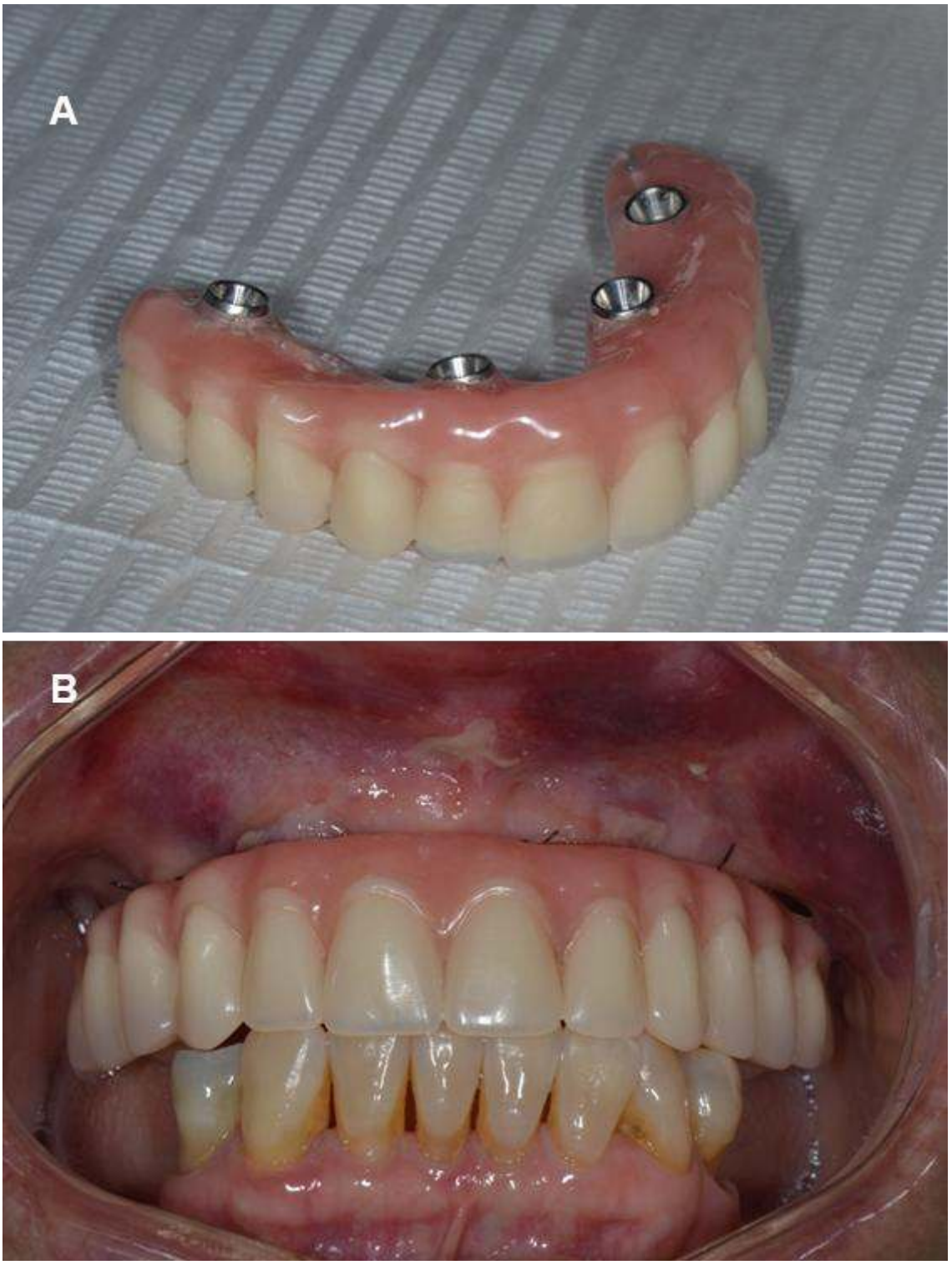
Postoperative medication included amoxicillin 500 mg (every 8 hours for 7 days), nimesulide 100 mg (every 12 hours for 2 days), and 0.12% chlorhexidine gluconate mouth rinse (initiated 48 hours after surgery and used for 7 days).

On the following day, the full-arch fixed prosthesis (protocol-type prosthesis) was installed, and occlusion was adjusted (Figure 7). A postoperative panoramic radiograph was obtained to confirm implant positioning (Figure 8).

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Figure 7 – Full-arch fixed (protocol-type) prosthesis.

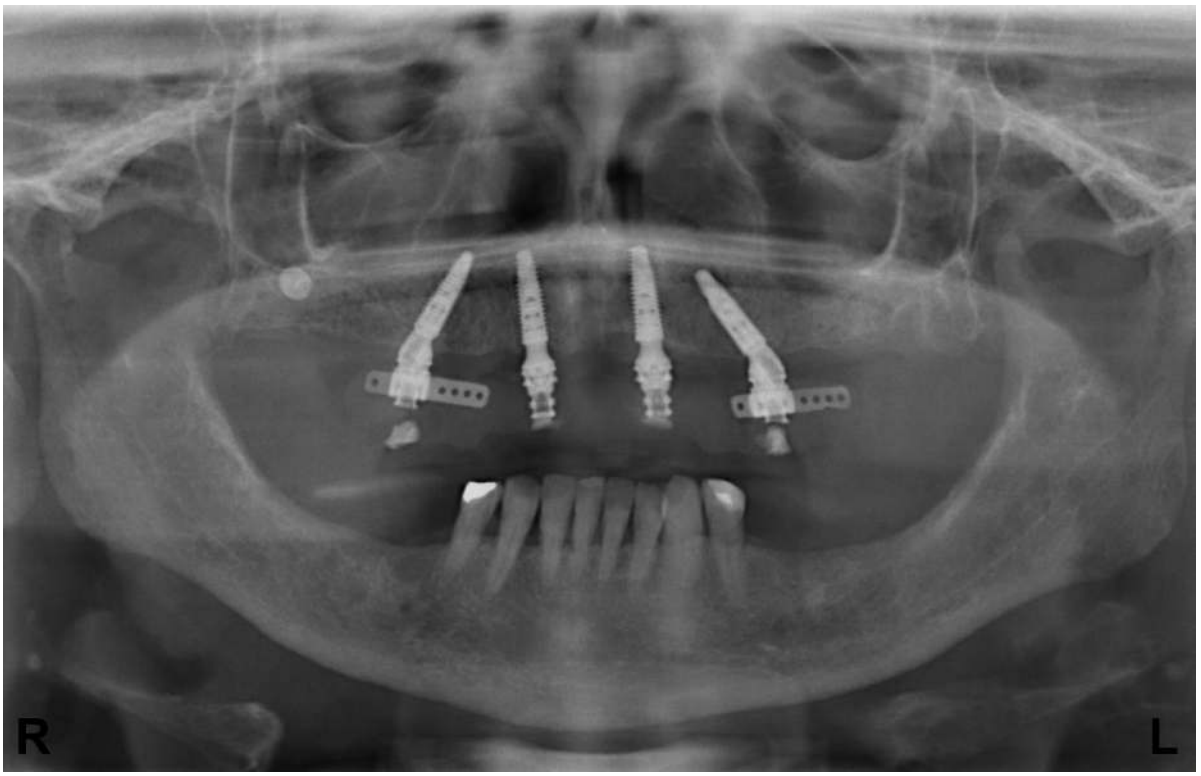


Caption: (A) Prosthesis image; **(B)** After prosthesis installation.

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Figure 8 – Postoperative radiograph.



Caption: Panoramic radiograph confirming implant positioning after prosthesis installation.

3. Discussion

Computed tomography is composed of multiple image slices that are reconstructed to generate a three-dimensional (3D) dataset. This imaging modality provides detailed information regarding patient-specific anatomy and pathological findings, producing high-resolution images that facilitate accurate diagnosis and improve precision in treatment planning (Bornstein et al., 2014; Omani & Yafi, 2019).

Implant placement in atrophic mandibles or maxillae represents a clinical challenge for implantologists; however, this procedure has increasingly become routine in contemporary practice. For adequate planning and improved

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prognosis—whether in single-tooth cases or complex full-arch rehabilitations—the use of three-dimensional radiographic imaging is considered essential and is regarded as the gold standard in implant dentistry (Jacobs et al., 2018).

In the present case, CBCT data allowed the selection of two posterior implants measuring 3.75 × 13 mm placed at a 30° angulation, and two anterior implants measuring 3.75 × 10 mm. The use of tilted implants enabled effective avoidance of the maxillary sinus, reducing the risk of complications such as maxillary sinusitis, infection, facial pain, and nasal congestion (De Oliveira & Paraguassu, 2022). An additional advantage was the possibility of performing surgery without sinus grafting procedures, which would have increased treatment time and morbidity. Thus, the combination of axial and tilted implants may provide predictable clinical outcomes. These findings are consistent with those reported by Maló et al. (2003) in their retrospective clinical study describing the “All-on-Four” technique.

Tilted implants placed in the posterior maxilla can achieve outcomes comparable to those of axially placed implants, which may be explained by biomechanical advantages. In this case, the approach reduced distal cantilever extension and improved load distribution along the maxillary ridge. The literature reports high success rates for full-arch rehabilitations supported by four or six implants (Brånemark et al., 1995).

In the present case, a multifunctional surgical guide was used to assist implant positioning during surgery, enable impression procedures for prosthetic transfer, and record the intermaxillary relationship. This approach represents a valuable planning tool that enhances predictability in implant-supported prosthetic rehabilitations (Galvão et al., 2023).

All implants achieved insertion torque values greater than 40 Ncm, allowing immediate installation of the full-arch fixed prosthesis (De Oliveira et al., 2016; Maló et al., 2018). Studies have reported that immediate and delayed rehabilitation of edentulous maxillae using two axial and two tilted implants demonstrate a cumulative survival rate of 99.3% after one year of function, with no statistically significant difference between immediate and delayed loading protocols (Nijafi et

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al., 2016).

The use of computed tomography for planning oral implant surgeries is therefore fundamental, as it helps prevent intraoperative complications and provides accurate assessment of bone anatomy, contributing to safer and more predictable outcomes.

4. Conclusion

Rehabilitation with an immediately loaded implant-supported full-arch prosthesis provides improved esthetics and restores masticatory function without the need for preliminary bone grafting procedures. However, successful outcomes depend on specific prerequisites, including adequate bone quantity and quality, good oral hygiene, and the absence of parafunctional habits.

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