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CLINICAL CASE

Pterygoid Implant Anchorage in Full-Arch Rehabilitation:

A Two-Case Report with 60-Month Follow-Up

NEODENT

Pterygoid Implant Anchorage in Full-Arch Rehabilitation: A Two-Case Report with 60-Month Follow-Up

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Introduction

Successful implant-supported rehabilitation of complete maxillary arches with conventional implants requires sufficient bone quantity and quality to achieve primary stability and long-term osseointegration.[1] Prolonged edentulism frequently results in resorption of the maxillary alveolar ridge.[2] This scenario associated with a progressive maxillary sinus pneumatization lead to a severe atrophic alveolar bone, posing different clinical challenges for the clinician, such as primary stability, loading protocols and management of posterior cantilever.[3-4] Moreover, such conditions often lead to longer healing period, postoperative morbidity, and higher overall treatment costs.[5-6]

Several graftless strategies have been proposed for implant-supported rehabilitation in patients with severe maxillary atrophy. In poorly alveolar bone conditions for conventional implants placement, alternative anatomical sites can achieve primary stability and osseointegration, including zygomatic, pterygomaxillary, paranasal, and midline basal bone regions.[7-8] All these sites offer potentially cortical anchorage beyond the resorbed alveolar ridge. According to Adell, the cortical linings of the midface, including the canine, zygomatic, and pterygoid areas, contribute to primary implant stability.[9] Since the mid-80s, literature has been described reports regarding these approaches, including the All-on-four protocol, zygomatic and pterygoid implant placement.[10-14] Some of these approaches are introduced in a concept of remote anchorage, that refers to the strategic engagement of distant cortical bone to enhance primary stability and load distribution, particularly in atrophic maxilla.[1]

The pterygoid region was first described as an implant anchorage site by Tulasne and Tessier.[13] Anatomically, this region is located posterior to the maxillary tuberosity, bounded medially by the pterygoid process of the sphenoid bone and superiorly by the pterygopalatine fossa.[7,15] Pterygoid implants traverse the maxillary tuberosity and are anchored in the cortical bone of the medial pterygoid plate, bypassing the pneumatized posterior maxillary sinus.[8] This configuration provides stable bone support, allowing posterior implant placement without the need for bone grafting and contributing to a favorable anterior–posterior spread of the prosthetic framework.[16] In terms of implant number, incorporating pterygoid implants enhances biomechanical stability in the atrophic maxilla, reducing stress and strain concentrations in both bone and prosthetic components and offer a less invasive alternative to bone grafting procedures.[17]

High survival rates of pterygoid implants have been consistently reported in the literature. A retrospective study reported data of 66 pterygoid implants of 99% in a 3-year follow-up period.[18] A systematic review including retrospective studies reported a survival rate of approximately 96%.[19] More recent investigations have reported cumulative survival rates of 95.5% with up to 6 years of follow-up and 94.7% with follow-up periods extending to 9 years.[20-21]

Several studies have suggested that implant lengths between 13 and 20 mm are sufficient to achieve stable anchorage in the pterygoid region.[13,18,22-23] Implant positioning typically involves a vertical angulation of approximately 45° to 75° relative to the Frankfurt plane, or a trajectory directed between the maxillary first and second molars.[22,24-25] Nevertheless, individual anatomical variability and population-related differences may influence these parameters, supporting the need for individualized planning based on cone-beam computed tomography (CBCT) assessment.[24]

This report presents two cases of full-arch maxillary rehabilitation using remote anchorage in the pterygoid region, performed according to different implant placement protocols, with clinical and radiographic follow-up of up to 5 years.

Case Report 1

A 59-year-old female patient, classified as ASA II (controlled hypertension), non-smoker, presenting with fully edentulism in the maxillary arch. The patient first presented to the ILAPEO College in 2018, when rehabilitation of the mandible arch was performed. In 2020, the patient requested rehabilitation of the maxillary arch due to functional and comfort limitations associated with a removable complete denture. No history of hypersensitivity or adverse reactions to titanium was reported.

For diagnostic purposes, clinical examination, panoramic radiography, CBCT, and clinical photographs were obtained (Figure 1). After diagnostic evaluation, an implant-supported rehabilitation with a complete-arch, screw-retained prosthesis was planned as the treatment option for maxillary arch, considering the patient's needs and clinical findings.

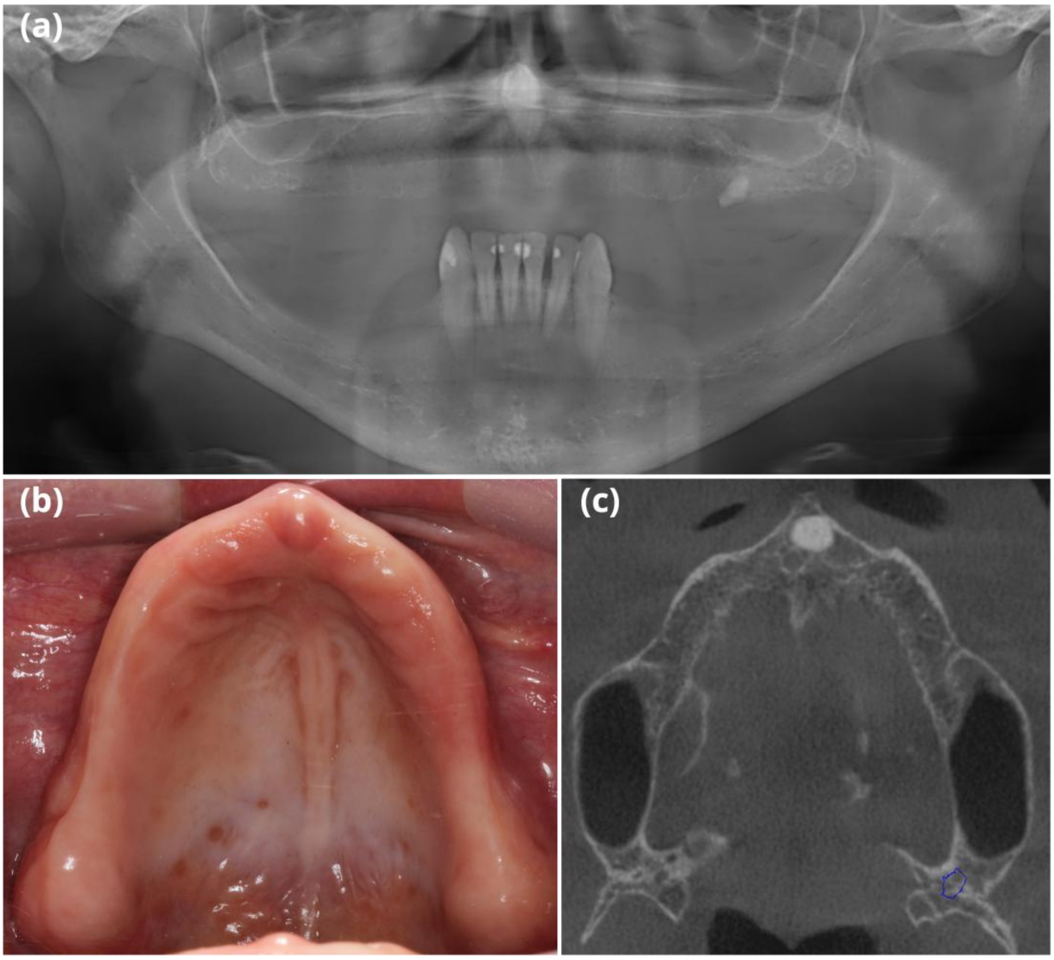

Figure 1. Initial condition case report 1. Panoramic radiographic (a). Clinical condition (b). Treatment planning of the implant in the pterygoid region (c).

A guided surgical protocol was applied for implant placement in the pterygoid region to ensure optimal bone anchorage. The virtual treatment planning was performed using CoDiagnostiX® software (Figure 2). A conventional approach was used for the remaining implants. For the prosthetic phase, reference parameters from the patient's existing removable complete denture were initially used and subsequently adjusted to establish the new prosthetic references. Based on this planning, a multifunctional surgical guide was designed to enable immediate impression taking.

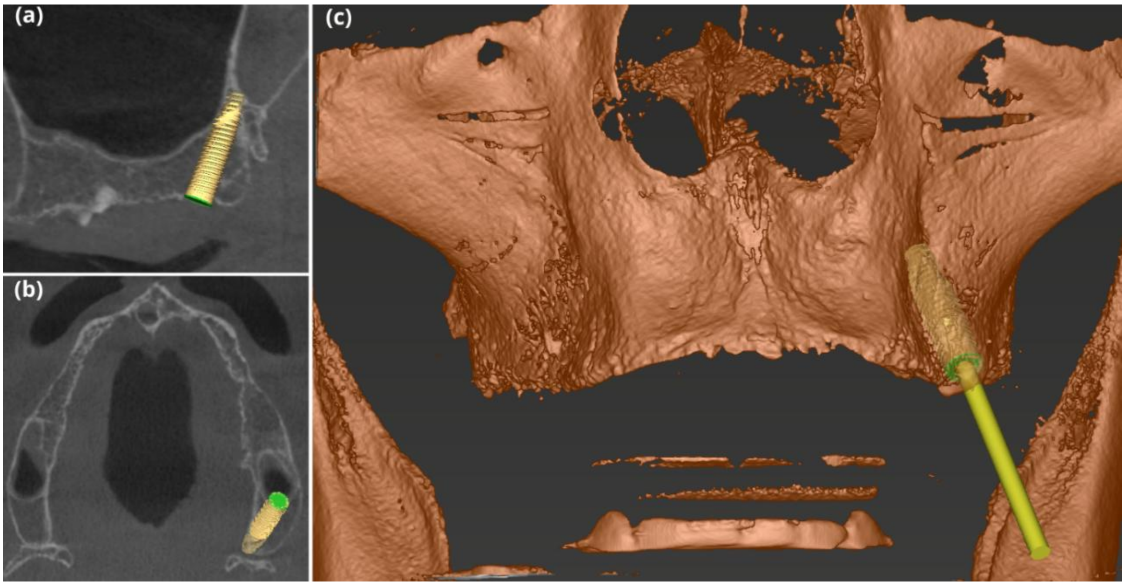

Figure 2. Digital planning of the pterygoid implant. Longitudinal (a) and axial (b) CBCT sections showing the planned implant position. Three-dimensional reconstruction illustrating the virtual implant placement (c).

The surgical procedure for maxillary arch was conducted under intravenous sedation and local anesthesia with 4% articaine containing 1:100,000 epinephrine, following preoperative administration of Blue®M mouthwash, diazepam 5 mg, and betamethasone 2 mg. The surgical guide was fixed using a palatal setter and additonal Guide Stabilizers (Neodent® Guided Surgery Kit for Grand Morse). For the left posterior maxillary region, a Ø4.0 × 16 mm Neodent GM Helix implant (Acqua surface) was planned for placement in the pterygoid region as a strategy to reduce cantilever length. Osteotomy preparation was performed through the guide sleeve according to the manufacturer's instructions, under dual irrigation. A sequential drilling protocol using 2.0 mm and 3.5 mm tapered guided surgery drills was applied, considering that the bone quality in the region was classified as type IV (Figure 3). An insertion torque of 45 N.cm was achieved. For the implants placed using a conventional surgical approach, a full-thickness flap was elevated, and osteotomy preparation was performed according to the manufacturer's recommendations, under dual irrigation. In the right posterior maxillary region, a Ø4.0 × 42.5 mm Neodent GM Zygomatic implant (Neodent, Curitiba, Brazil) was selected based on anatomical considerations, and an insertion torque of 60 N.cm was achieved. At the remaining implant sites, a Ø3.5 x 18 mm Neodent GM Helix implant was placed at position #12, a Ø 5.0 x 13 mm Neodent GM Drive at position #22, a Ø3.75 x 16 mm Neodent GM Helix at position #25, all implants presenting an Acqua surface. Insertion torque values of 60 N.cm (#12) and 20 N.cm (#22 and #25) were achieved. Bone quality was classified as type IV in all implant sites. Wound closure was completed with simple sutures.

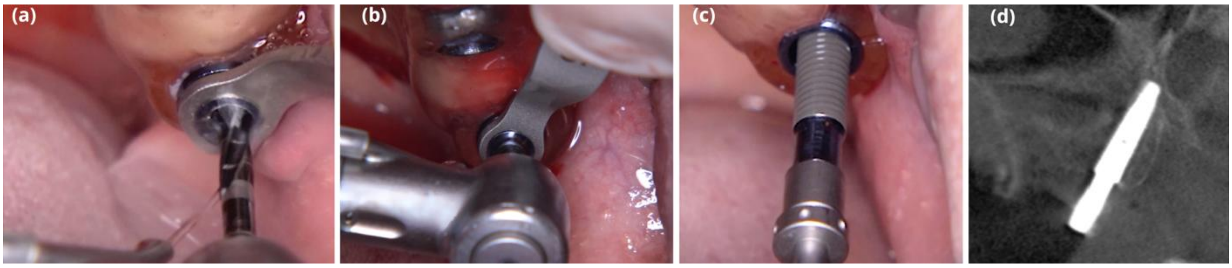

Figure 3. Surgical procedure - Left maxillary posterior region with the surgical guide in position. Sequential osteotomy for the implant placement in the pterygoid region (2.0 mm and 3.5 mm tapered drills) (a–c). Immediate postoperative longitudinal CBCT section showing the final implant position in the pterygoid region (d).

Following the implant placement, the prosthetic phase was initiated. GM Mini Conical Abutments (MUA) (Neodent, Curitiba, Brazil) were selected according to implant position and soft tissue height. For the implant placed in the pterygoid region, a GM Micro Abutment with a gingival height (GH) of 5.5 mm was selected due to the limited prosthetic space in the posterior maxilla. The following MUA were selected for the remaining implants: a 45° GM MUA (1.5 mm GH) for the zygomatic implant, and straight GM MUA (1.5 mm and 3.5 mm GH) for implants at positions #12, #22, and #25. All abutments were torqued according to the manufacturer's instructions. Subsequently, the MUA impression copings were attached to the multifunctional surgical guide using self-curing acrylic resin (GC Pattern resin LS, USA). The interocclusal record was refined using three reference points with the same material. After verification of the established vertical dimension of occlusion, impression material was injected to allow immediate loading (Figure 4).

Figure 4. Prosthetic phase. MUA impression copings connected to the surgical guide with self-curing acrylic resin (a-b). Final impression for immediate loading (c).

The postoperative medications included amoxicillin (500 mg) and ibuprofen (600 mg). The patient received instructions regarding oral hygiene, dietary recommendations, and postoperative care.

The final prosthesis was delivered within 96 hours (Figure 5). The patient was instructed on oral hygiene and prosthetic care.

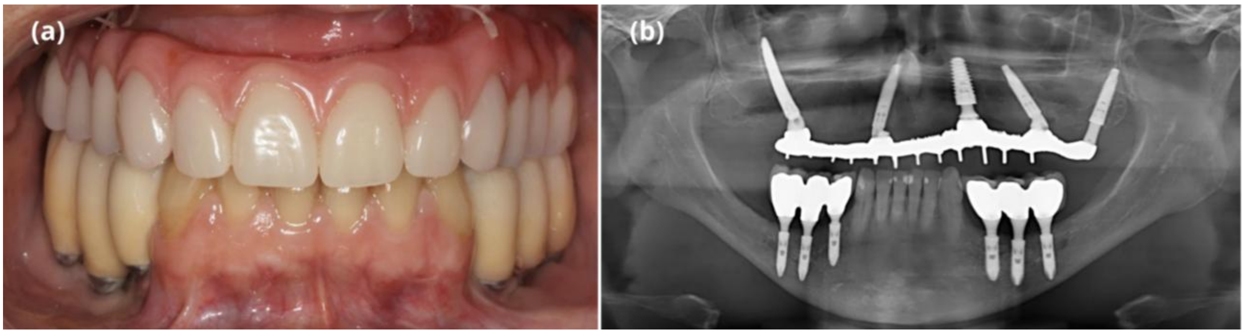

Figure 5. Placement of the final prosthesis. Frontal view (a) and panoramic radiograph (b).

Clinical and radiographic follow-up were conducted at 1, 4, and 12 months postoperatively. Subsequently, follow-up visits were conducted at least once per year. Figures 6 and 7 present the one-, twelve-, and sixty-month postoperative follow-up.

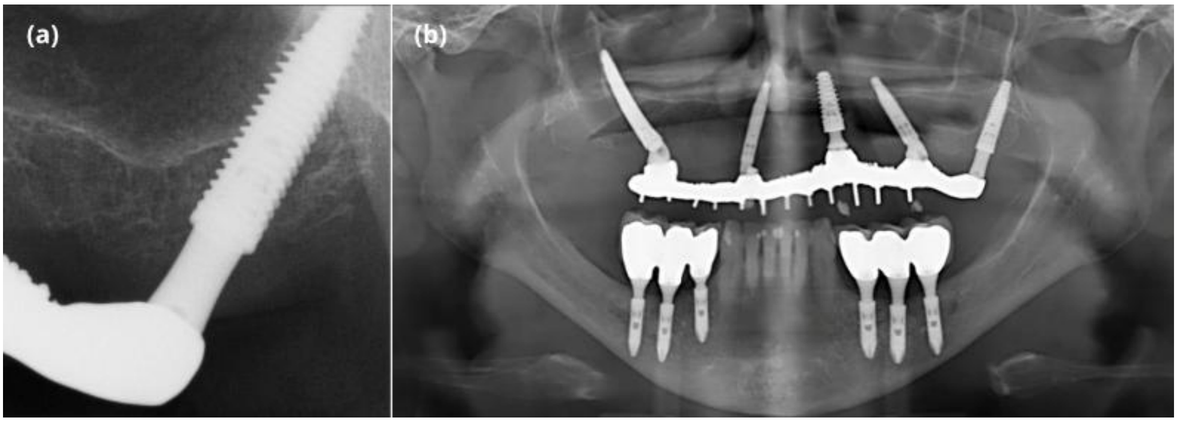

Figure 6. Follow-up radiographs. One-month periapical radiograph (pterygoid region) (a). Twelve-month panoramic radiograph (b).

Figure 7. Sixty-month follow-up. Occlusal view (a). Buccal view of the prosthesis (b). Periapical radiograph (pterygoid region) (c).

Case Report 2

A 76-year-old male patient, classified as ASA I and a non-smoker, was referred to ILAPEO College in 2021 for rehabilitation of partial edentulism due to masticatory difficulties, functional limitations associated with a maxillary removable prosthesis, and occlusal instability. No history of hypersensitivity or adverse reactions to titanium was identified.

For diagnostic purposes, clinical examination, panoramic radiography, CBCT, and clinical photographs were obtained (Figure 8). Based on clinical and radiographic findings, a full-arch implant-supported rehabilitations with screw-retained prostheses were planned.

A guided surgical workflow was used for the maxillary arch, while a conventional approach was employed for the mandible arch. Surgical planning was carried out using CoDiagnostiX® software (Figure 9), and a surgical guide was fabricated. For the prosthetic phase, maxillomandibular relationships and esthetic parameters were planned, and multifunctional surgical guides were designed to ensure ideal implant positioning and allow for immediate impression taking.

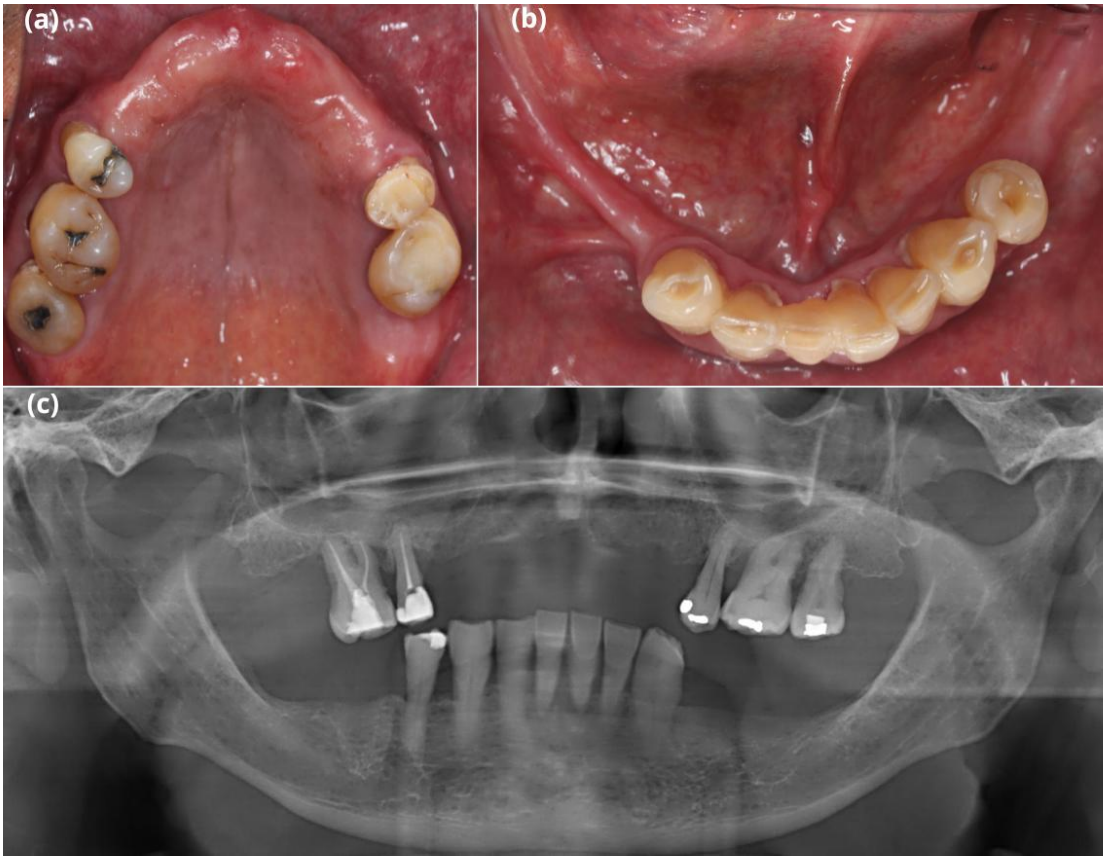

Figure 8. Initial condition case report 2. Clinical occlusal view (a-b). Panoramic radiograph (c).

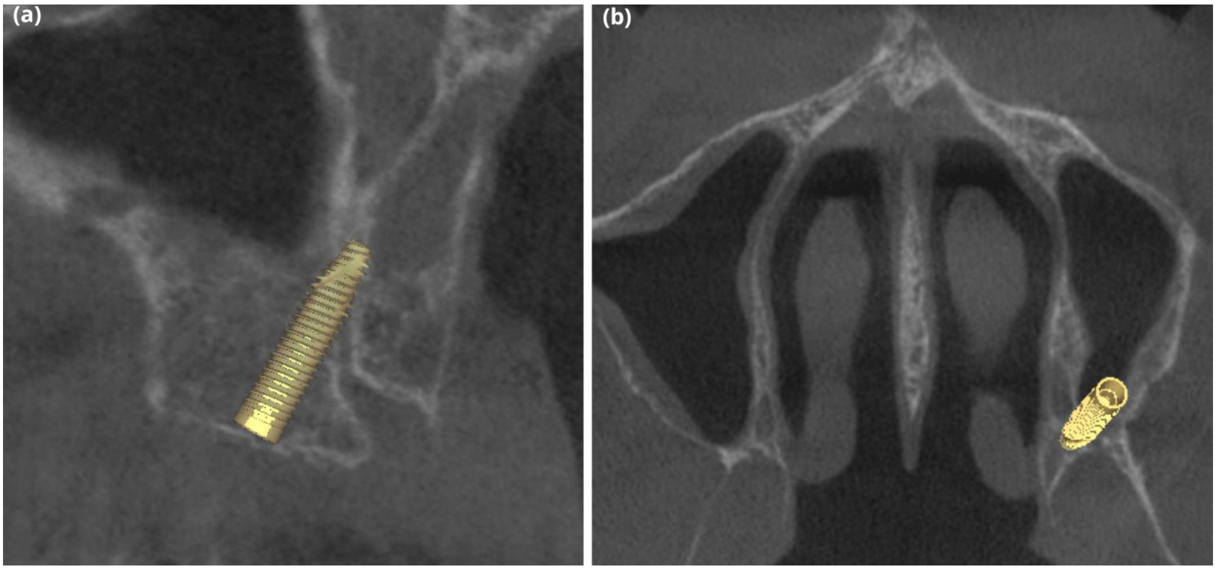

Figure 9. Planning of the implant in the pterygoid region using CoDiagnostiX® software (a-b).

Both surgical procedures were performed on the same day under intravenous sedation and local anesthesia using 4% articaine with 1:100,000 epinephrine, following preoperative administration of Blue®M mouthwash, diazepam 5 mg, and betamethasone 2 mg.

Teeth #16, #15, #25, and #26 were extracted, and the surgical guide stabilized on tooth #27 with the aid of a palatal setter. Osteotomy preparation was initiated with soft tissue removal using a mucosal punch and subsequently performed through the guide sleeves according to the manufacturer's instructions under dual irrigation. For the left posterior maxillary region, a Ø3.75 x 16 mm Neodent GM Helix implant was placed in the pterygoid region. Osteotomy preparation was performed using a sequential drilling protocol with 2.0 mm, 3.5 mm, and 3.75 mm tapered guided surgery drills (Figure 10). In the right posterior maxillary region, a Ø4.0 × 13 mm Neodent GM Helix implant was placed on the tuberosity region. In these regions, bone quality was classified as type III, with an insertion torque of 32 and 60 N.cm respectively. Both implants were placed as a strategy to reduce cantilever length. At the additional implant sites, the following implants were placed: a Ø3.75 x 11.5 mm Neodent GM Helix implant (Acqua surface) at position #12, Ø3.75 x 25 mm Neodent GM Helix Long implant (NeoPoros surface) at position #14 (placed using a conventional surgical protocol), Ø3.75 x 13 mm Neodent GM Helix implant (Acqua surface) at position #22, and a Ø3.75 x 18 mm Neodent GM Helix implant (Acqua surface) at position #25. Insertion torque values of 60 N.cm were achieved. Bone quality was classified as type III in all implant sites.

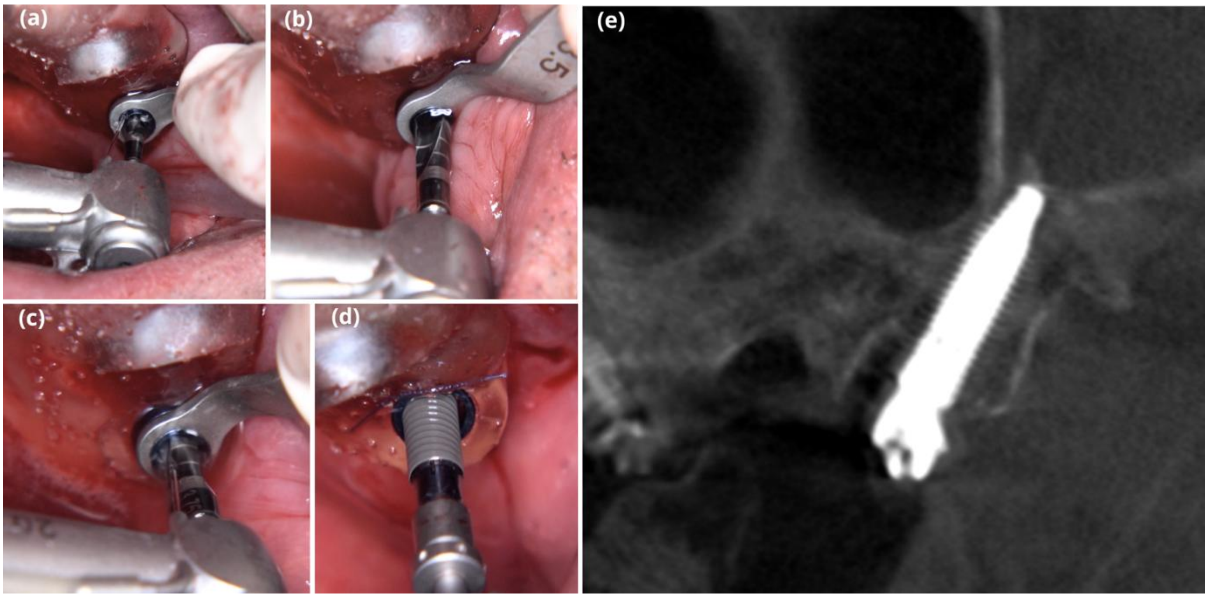

Figure 10. Surgical procedure – Left maxillary posterior region with the surgical guide in position. Pterygoid implant osteotomy performed using a sequential drilling protocol (2.0 mm, 3.5 mm, and 3.75 mm tapered drills) (a–d). Immediate postoperative longitudinal CBCT section showing the final implant position in the pterygoid region (e).

A conventional surgical approach was used for the mandible arch. The remaining teeth were extracted. Four Neodent GM Helix implants were placed, with osteotomy preparation performed according to the manufacturer's recommendations, under dual irrigation. All implants were presented with an Acqua surface. The following implants were inserted interforaminally: two 3.75 × 13 mm implants (bone type II), one Ø3.75 × 18 mm implant (bone type II), and one Ø4.0 × 20 mm implant (bone type III). Subsequently, two 17º MUA with GH of 1.5 mm and 2.5 mm, and two straight MUA with GH of 2.5 mm and 3.5 mm were seated. All implants achieved a torque of 60 N.cm. All MUA were torqued according to the manufacturer's instructions. Wound closure was completed with simple sutures.

After implant placement, angled and straight GM MUAs (Neodent®) were selected according to implant position and peri-implant soft tissue height. The following MUA were used: 30º MUA with a GH of 3.5 mm at position #17, a 30º MUA with a GH of 2.5mm at position #27, a 30° MUA with a GHs of 2.5 mm and 1.5 mm at positions #12 and #25, respectively, and a 17° MUA with GHs of 2.5 mm and 3.5 mm at positions #14 and #22, respectively.

MUA impression copings were secured to the multifunctional surgical guides with self-curing acrylic resin (GC Pattern Resin LS, USA). Interocclusal records were refined using three reference points fabricated with the same material. After confirmation of the vertical dimension of occlusion, the impression material was injected for immediate loading (Figure 11).

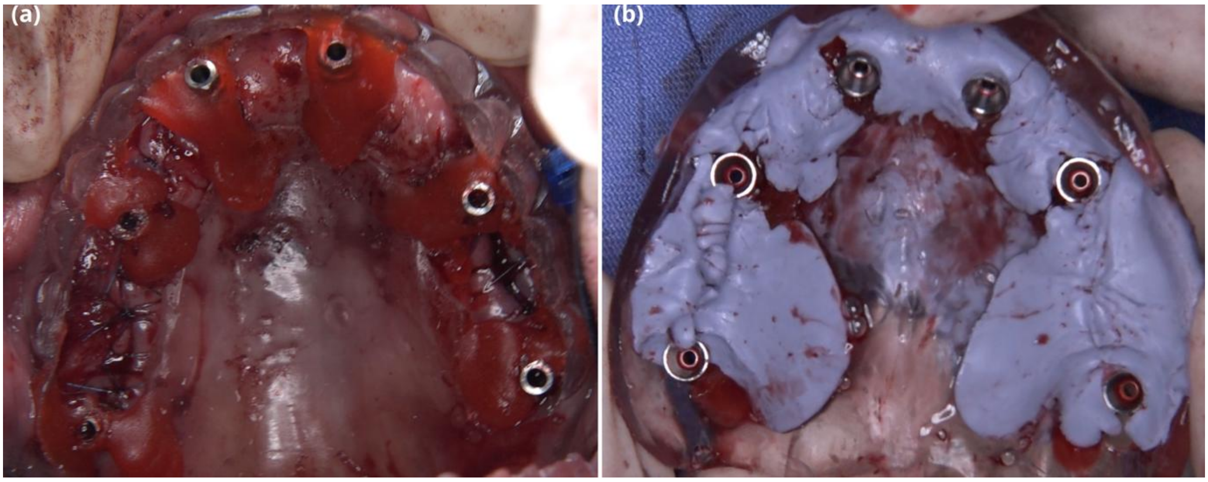

Figure 11. Prosthetic phase. MUA impression copings connected to the surgical guide with self-curing acrylic resin (a). Final impression for immediate loading (b).

The postoperative medications included amoxicillin (500 mg) and ibuprofen (600 mg). The patient received instructions regarding oral hygiene, dietary recommendations, and postoperative care.

A postoperative panoramic radiograph was obtained after prosthesis delivery (Figure 12). Final prostheses were delivered within 48 hours. Due to the patient's motor difficulties, movement occurred during radiographic acquisition, compromising the image sharpness. The patient was instructed on oral hygiene and prosthetic care.

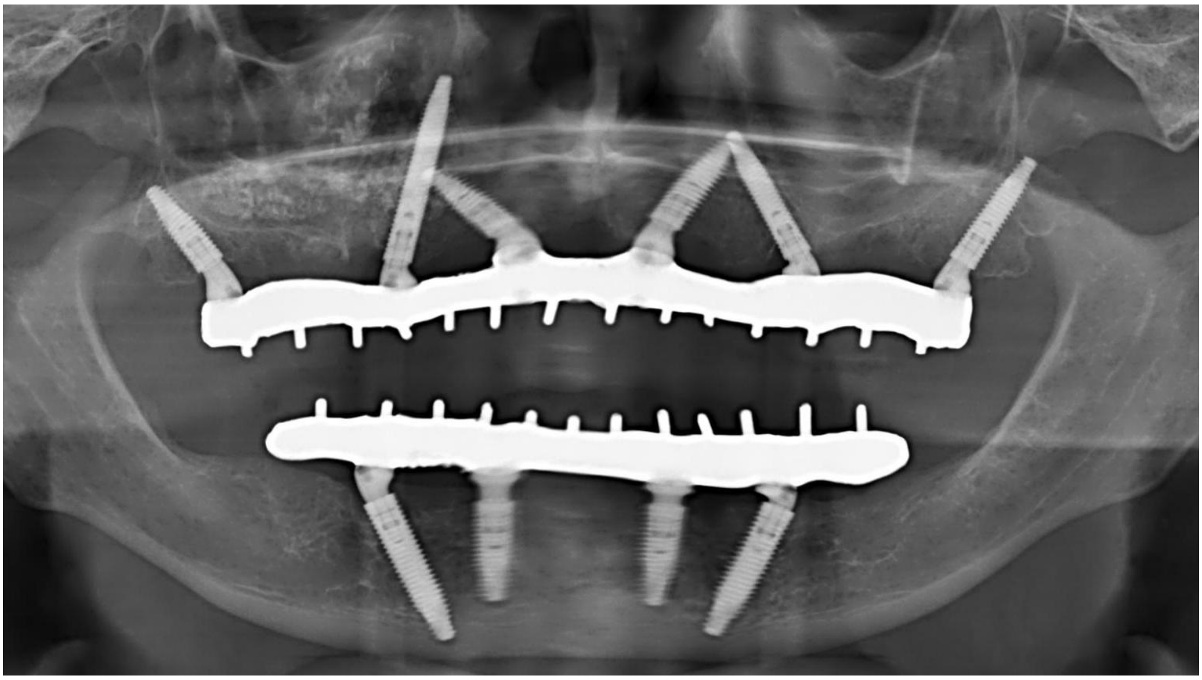

Figure 12. Postoperative panoramic radiograph obtained at prosthesis delivery.

Clinical and radiographic follow-up was conducted at 1, 4, and 12 months postoperatively. Subsequently, follow-up visits were conducted at least once per year. Figures 13 and 14 show the 12-month and 60-month postoperative follow-up, respectively.

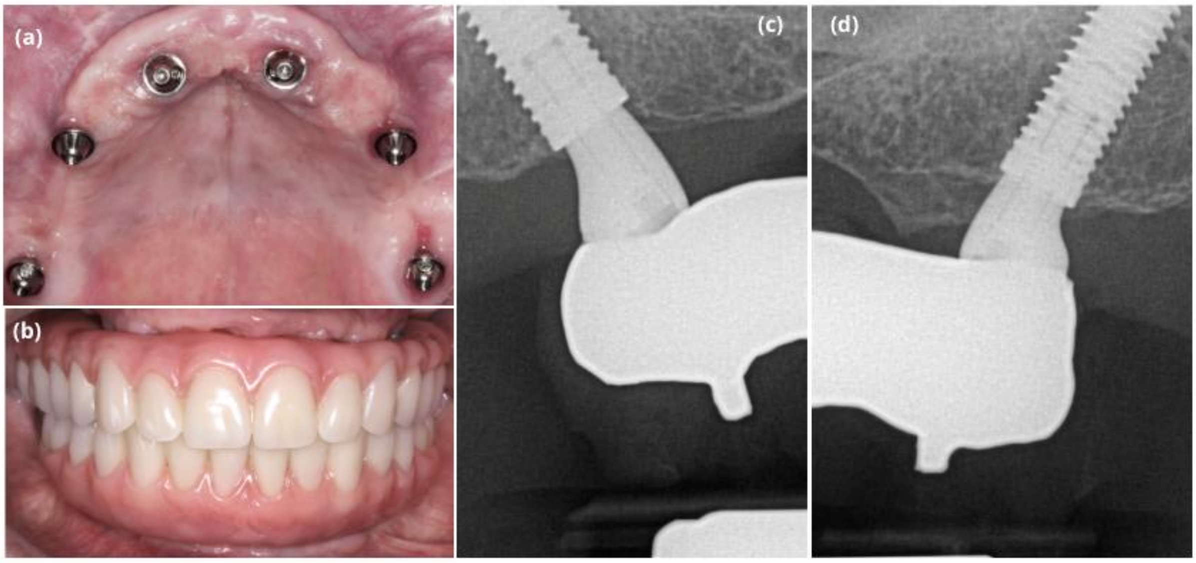

Figure 13. Twelve-month follow-up. Clinical occlusal view (a). Buccal view of the final prostheses (b). Periapical radiographs of the #17 and #27 regions (c-d).

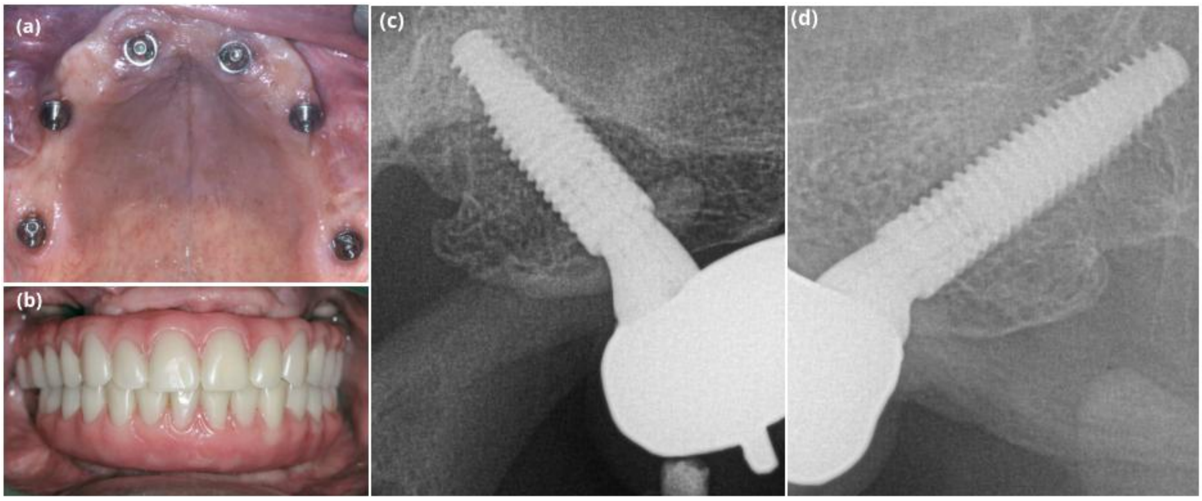

Figure 14. Sixty-month follow-up. Clinical occlusal view (a). Buccal view of the final prostheses (b). Periapical radiographs of the #17 and #27 regions (c-d).

Conclusion

The present report describes two cases using hybrid implants with conical implant to abutment connection for pterygoid anchorage in full-arch rehabilitation. Despite low bone density, this approach allowed adequate remote anchorage and immediate loading, serving as a predictable alternative treatment. At the 60-month follow-up, no biological or mechanical complications were observed, and peri-implant hard and soft tissues remained stable in both cases.

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