Annals of Stomatology
ISSN 2975-1276

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Case report

PTERYGOID IMPLANTS: TWO CASE REPORTS

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ABSTRACT

Pterygoid dental implants (PDI) are used in cases where traditional implants may not be feasible due to insufficient bone volume in the jaw. Unlike conventional implants placed in the frontal portion of the jawbone, PDI utilize the posterior region, taking advantage of the available bone structure. This can be particularly beneficial for individuals who have experienced significant bone loss in the frontal jaw area or have sinus issues that limit the placement of traditional implants. Placing PDI is a complex procedure requiring careful planning and consideration of anatomical structures. Advanced imaging techniques, such as cone beam computed tomography (CBCT), are used to assess bone density and determine the optimal placement for the implants. PDI can provide a viable solution for individuals with challenging anatomical conditions, offering stability and support for dental restorations. Here, a case series is reported, and pertinent literature is discussed.

KEYWORDS: *implant, fixture, pterygoid, sphenoid, prosthesis*

INTRODUCTION

Traditional dental implants, while highly successful in many cases, face limitations, mainly when dealing with patients who have experienced significant bone loss in the jaw (1-6). The anterior jawbone, a common implant site, may lack sufficient volume or density due to periodontal disease or prolonged tooth absence. Additionally, sinus issues can complicate implant placement in the upper jaw. These challenges spurred the exploration of alternative approaches, leading to the development pterygoid dental implants.

The pterygoid region in the posterior aspect of the upper jaw emerged as a promising alternative for implant placement. At the core of the pterygoid region is the pterygoid bone, a butterfly-shaped structure comprising the lateral and medial pterygoid plates. Anatomical exploration of these plates reveals their connection to the sphenoid bone and their crucial involvement in forming the lateral wall of the nasal cavity. Adjacent structures, such as the greater wing of the sphenoid bone and the posterior wall of the maxillary sinus, further contribute to the complexity of this region. Anatomically, the lateral and medial pterygoid plates provide a robust foundation for implant anchorage.

The advancement of imaging technologies, particularly cone beam computed tomography (CBCT), played a pivotal role in visualizing the pterygoid region in three dimensions. This breakthrough allowed for precise implant placement planning, mitigating risks, and optimizing outcomes (7-10). Real-world applications demonstrate the efficacy of pterygoid implants in restoring oral function and aesthetics for patients who may have been deemed challenging cases with traditional approaches (1-6). Here, a case series is reported, and pertinent literature is discussed.

Received: 7 October 2023
Accepted: 19 November 2023

ISSN 2975-1276 [online]

CASE REPORT

Case 1

The patient presented to our clinic complaining about her smile in 2019. She was 65 years old and was a nonsmoker. At the clinical and radiological evaluation, she had a far-advanced periodontal disease and bone defects following endo-perio failure (Fig. 1).

Fig. 1. *Pre-operative X-ray.*

The patient's main concern was not remaining without teeth, and she asked for immediate and permanent rehabilitation.

Surgically, a vertical GBR with resorbable membranes and a combined 50/50 heterologous/homologous bone graft was done in the canine area. Membranes were fixed with titanium pins, and the emergence profile of implants was adapted with a multi-unit abutment surrounded by bio-guides (Fig. 2).

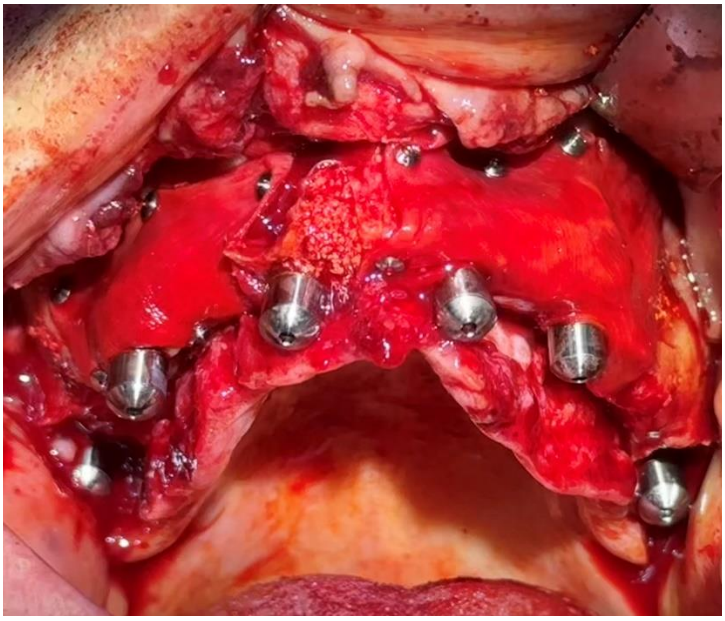

Fig. 2. *Horizontal-gbr-with-titanium-pins.*

The fixtures were anchored to the canine recesses and the nasal bone in the premaxilla, elevating the sinus membrane in the two distal sites and grafting the sub-sinus area. In the molar area, two pterygoid implants were inserted, which anchor the region between the pterygoid plates and the pyramidal process of the palatine bone. The positioning of implants in this way allows excellent stability even if the tuberal bone is soft (i.e., bone quality D3-D4).

Both bone primary stability and insertion torque are related to bone quality at the implant's apex. In this area, bone quality is of basal type (i.e., D1) surrounded by the insertions of pterygoid muscles. Here, pterygoid implants must be inclined 7-10 degrees towards the palate and 20-25 degrees towards the mesial side, thus emerging in the tuberal area. (Fig. 3).

Fig. 3. *Post operative X-Ray.*

It should be noted that soft tissue in this area is very dense, making it a suitable site for free gingival graft sampling and optimal for sealing the collar transmucosal devices. Thus, the characteristic of soft tissue makes pterygoid implants well-maintainable over time. The patient then carried out immediate loading at the end of the surgery and the definitive rehabilitation in composite metal after 6 months. The follow-up was uneventful; after 45 months, the patient had no complications (Fig. 4, 5).

Fig. 4. *Fixed-temporary-full-arch.*

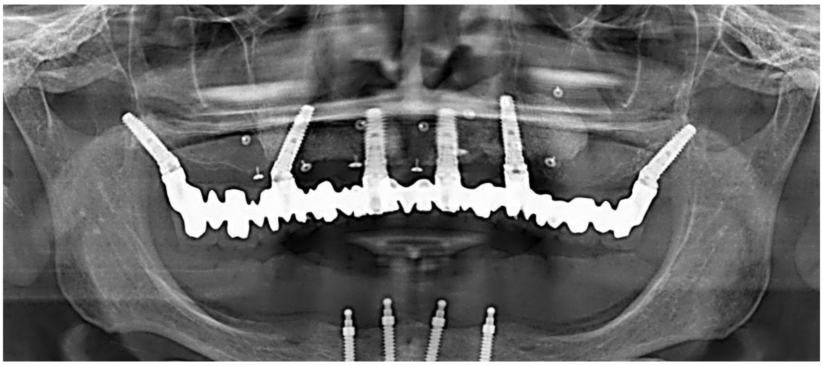

Fig. 5. *Final X Ray*.

Case 2

The patient presented to our clinic complaining about his chewing in 2019. He was 60 years old and was a nonsmoker. At the clinical and radiological evaluation, he has oro-antral communication in the right sinus due to infection affecting the implants in the 1st quadrant, bone defects extending to the entire arch, and non-recoverable anterior dental elements (Fig. 6).

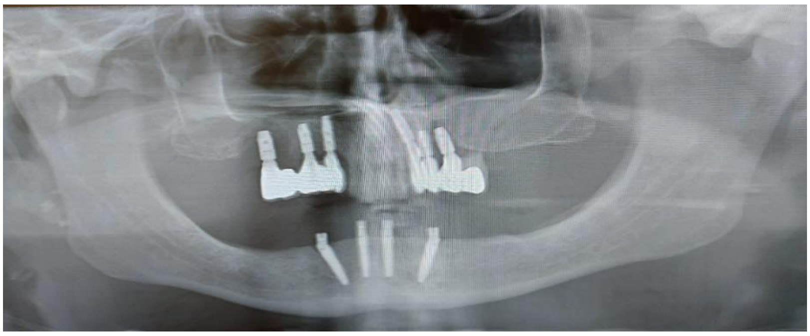

Fig. 6. *Pre-operative X-ray.*

The patient’s chief concern was not to be left without teeth and asked for immediate and permanent rehabilitation. The program was to remove compromised teeth and implants and to perform a Toronto bridge.

Surgically, after extraction, the Schneiderian membrane was turned inside and sutured with 5.0 resorbable stitches to repair it and restore the anatomical separation between the antrum and the oral cavity. It should be done before grafting the area of oral communication with xenograft.

A resorbable membrane was placed over the Schneiderian membrane to prevent possible lacerations due to implant pressure or the patient's respiratory movements in the postoperative period. No sinus lift was performed in this patient since sutures were sufficient to prevent sinus complications. Subsequently, four implants were inserted in the premaxilla. The GBR was done using resorbable membranes stabilized by periosteal sutures. GBR of the residual alveolar crest was done by using bovine bone mixed with autologous bone collected from the zygomatic processes with a bone scraper. This procedure was necessary since the alveolar ridge was thick (Cawood class IV). It should be noted that pure autologous bone must be placed to cover the implant surface, whereas the remaining reconstruction can be made 50/50 autologous/xenograft mix. Then, a covering membrane was placed stably. To stabilize membrane pins, screws, and sutures fixed to the periosteum can be used. Fixing the membrane is the key point to having a successful surgical procedure. Finally, two pterygoid implants were inserted to stabilize chewing and reduce distal cantilever stress (Fig. 7-10).

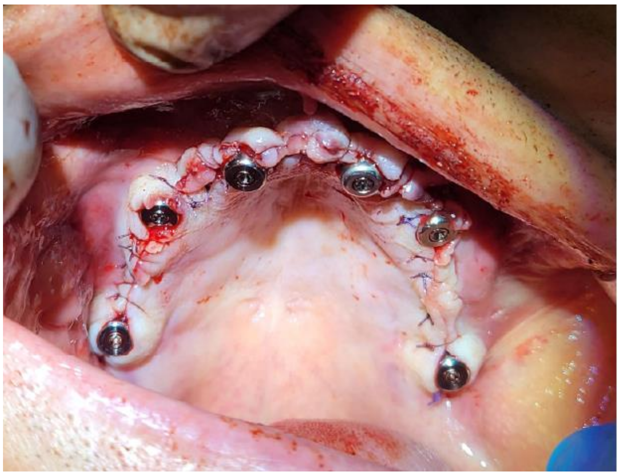

Fig. 7. *Suture.*

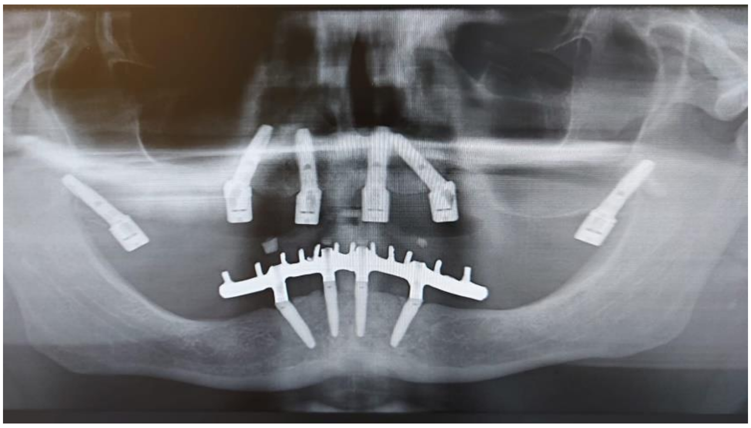

Fig. 8. *Post-operative X-ray.*

Fig. 9. *Post operative CBCT pterigoid check.*

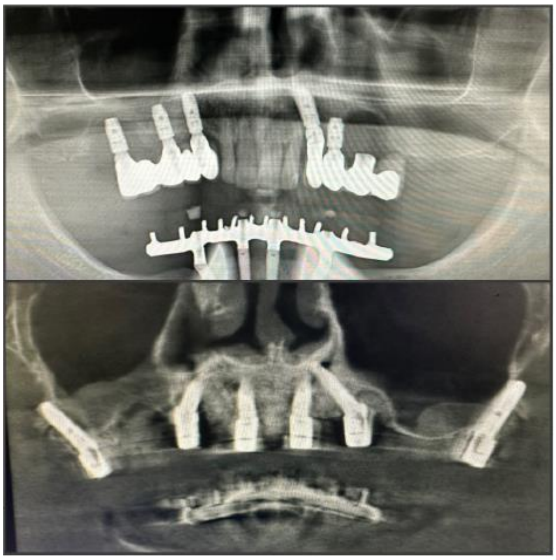

Fig. 10. *X-Ray comparison.*

Finally, an immediate prosthesis was delivered (Fig. 11). The follow-up was uneventful; after 51 months, the patient had no complications (Fig. 12).

Fig. 11. *Fixed temporary.*

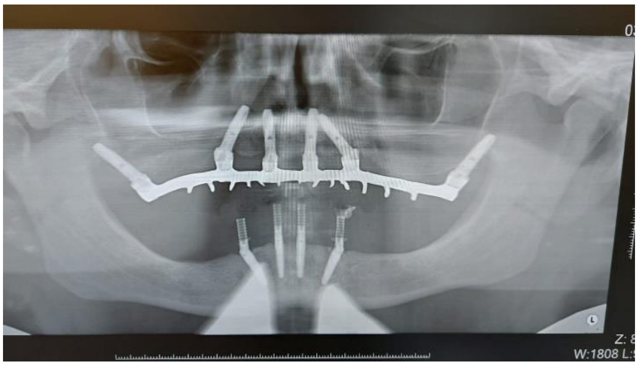

Fig. 12. *Three-year follow up X-ray.*

DISCUSSION

Traditional dental implants are typically placed in the anterior region of the jawbone, relying on adequate bone volume and density. In contrast, pterygoid dental implants (PDI) utilize the posterior pterygoid region, specifically the lateral and medial pterygoid plates (1-6). This distinction is crucial for patients with insufficient bone in the anterior jaw or anatomical challenges that complicate traditional implant placement. The surgical techniques for (PDI) involve accessing the posterior pterygoid region, which demands high precision due to its proximity to critical structures such as the maxillary sinus and major blood vessels. The increased complexity of pterygoid implant surgery requires specialized training for practitioners.

Vrielinck et al. (1) validate a planning system based on preoperative CT imaging on 12 patients for implant insertion. It allows the surgeon to determine the desired position of different kinds of implants. Candel et al. (2) reviewed the published literature to assess the success of treating patients with atrophic posterior maxilla with PDI. Studies from 1992 to 2009 on patients with atrophic posterior maxilla rehabilitated with PDI were reviewed. Thirteen articles were included, reporting 1053 pterygoid implants in 676 patients. The weighted average success of PDI was 90.7%; bone loss evaluated radiographically ranged between 0 and 4.5 mm. No additional complications compared with conventional implants were found, and patient satisfaction level with the prosthesis was high. Curi et al. (3) evaluated success rates of PDI and prostheses in patients treated in the atrophic posterior maxilla. A total of 66 PDI were placed. The mean bone loss around PDI after 3 years of loading was 1.21 mm (range 0.31 to 1.75). Araujo et al. (4) included 6 studies in their systematic review. Six hundred thirty-four patients received 1.893 PDI, with a mean implant survival rate of 94.87%. Ren et al. (5) described the clinical management and good short-term success in treating severe maxillary atrophy with a novel "VIV" design, using a combination of 3 anterior and 2 PDI. Sun et al. (6) studied CBCT to define the virtual valid length of PDI in maxillary atrophic patients from the prosthetic prioritized driven position and measure the implant length engaged in the pterygoid process according to the HU difference of the pterygoid maxillary junction. The authors concluded that PDI achieve adequate bone anchorage length beyond the pterygoid maxillary junction from a prosthetic prioritized driven position with fixed entry and angulation.

While traditional dental implants have a well-established track record of success, PDI have shown promising results in clinical applications. Success rates for PDI are influenced by factors such as patient selection, surgical technique, and anatomical considerations. Complications associated with each type of implant, such as peri-implantitis or implant malposition, need to be considered in the decision-making process (1-6). The choice between PDI and traditional dental implants depends on various factors, including the patient's oral health, anatomical considerations, and treatment goals. PDI are often considered for patients with severe bone loss in the anterior jaw, while traditional implants remain a reliable option for a broad range of cases.

Before embarking on PDI, meticulous preoperative planning is essential. Advanced imaging modalities, such as cone beam computed tomography (CBCT), enable a three-dimensional assessment of the pterygoid region (7-10). Surgeons can analyze bone density, evaluate anatomical structures, and identify potential complications. This thorough assessment forms the foundation for creating a customized surgical plan tailored to each patient's unique anatomy. Salinas-Goodier et al. (7) analyzed three-dimensionally the morphological characteristics of the pterygomaxillary region related to PDI. The authors concluded that due to the significant variation in the morphological characteristics of the pterygomaxillary region among subjects, personalized pre-surgical radiological assessment should always be performed. Zhang et al. (8) conducted a study to identify effective landmarks and establish valid guidelines to determine the ideal PDI placement. Rodríguez et al. (9) investigated the three-dimensional angulation of the pterygomaxillary corridor where PDI should ideally be placed. Based on the results of this study, an implant of at least 15mm long should be used to take advantage of the quantity and quality of the bone in this region. Motiwala et al. (10) analyzed the three-dimensional angulation of PDI using the hamulus as an intraoral guide, showing that when implants are placed along the hamular line, they are more likely to engage the center of the pterygomaxillary junction, resulting in an excellent prognosis of PDI. The surgical procedure begins with the administration of anesthesia, typically a combination of local anesthesia and sedation. Once the patient is adequately anesthetized, the surgeon gains access to the pterygoid region through a carefully planned incision. The core of the surgical process involves the precise placement of implants into the pterygoid bone. This step demands a deep understanding of the anatomical structures, particularly the lateral and medial pterygoid plates.

Surgeons navigate the region's complexities, utilizing specialized instruments and techniques to ensure the implants achieve stable anchorage. Using surgical guides based on preoperative CBCT data enhances accuracy and minimizes the margin for error (11-13). Grecchi et al. (11) performed a human cadaver study to assess the accuracy of zygomatic/pterygoid implant placement using custom-made bone-supported laser-sintered titanium templates. The authors concluded that the surgical guide system allowed acceptable and accurate implant placement regardless of the case complexity. Wilkerson et al. (12) compared the stress and strain distributions in the PDI and surrounding bone using finite element analysis, concluding that PDI decreased the stress and strain level in the surrounding bone for all cases studied. Stefanelli et al. (13) showed that PDI surgery can be a predictable and successful modality for prosthetically directed implant rehabilitation in the atrophic posterior maxilla, is more accurate than free-hand surgery, and takes less time when using dynamic navigation.

Decisions regarding immediate or delayed loading of PDI are critical considerations in the surgical technique. Signorini et al. (14) investigated the 1-year survival and success rates of PDI and prostheses in participants affected by severe atrophy of the posterior maxilla requiring a complete-arch immediate fixed prosthesis. During the 1-year follow-up, high prosthesis stability and no implant loss were observed for all participants. In addition, participants did not report any pain or paresthesia. No peri-implant radiolucency was detected in the panoramic radiographs. Survival and success rates in the follow-up period were 100%. Immediate loading requires careful stability assessment, where prosthetic restorations are attached soon after implant placement. Alternatively, delayed loading allows for osseointegration before attaching the final prosthesis. The choice between these protocols depends on the strength of the implant's primary stability and the surgeon's judgment.

Despite meticulous planning, complications may arise during PDI placement (2-4). These can include vascular injuries, nerve damage, or malpositioning of implants. Surgeons must be equipped with strategies to address these challenges promptly. Preoperative imaging, a thorough understanding of the region, and adherence to a meticulous surgical technique contribute to minimizing the risk of complications. Successful PDI placement extends beyond the operating room. Regular follow-up appointments allow the surgeon to assess the patient's progress, address any concerns, and make necessary adjustments to the treatment plan.

CONCLUSIONS

Pterygoid implant placement has emerged as a sophisticated surgical technique, offering a viable alternative for individuals facing challenges with traditional implant options. The surgical technique of PDI placement requires a careful evaluation of anatomical structures and has to be performed by an expert surgeon. Our case series strengthens the usefulness of PDI in patients with extreme maxillary atrophies.

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