oral

Case Report

Fence Technique: Reconstruction on the Aesthetic Zone after Cyst Enucleation—Case Report

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Abstract: Odontogenic cysts can lead to bone destruction that can hamper the dental implant placement in the ideal 3D position. Different biomaterials and techniques that allow bone regeneration are described in the literature, each with its advantages and disadvantages. This clinical case with 18 months of follow-up aims to show the enucleation of an odontogenic cyst following the guided bone regeneration with the fence technique, which allows the placement of the dental implants in the ideal 3D position, reducing morbidity and the number of surgeries. It involved a fifty-year-old male patient with a cyst in the second sextant who needed implant rehabilitation. During the first surgery, the odontogenic cyst (proven by histological analysis where there was reported a non-keratinized stratified squamous epithelium) was enucleated and a guided bone regeneration using the fence technique was performed. The fence technique combines the xenograft, the collagen membrane and an osteosynthesis plate that is molded and fixed to the intervention area to ensure sufficient space for bone tissue regeneration. After six months, two dental implants were placed in the region of tooth 11 and 21, then rehabilitated nine weeks later. The fence technique guaranteed the recovery of the bone morphology and the placement of the dental implants in the ideal 3D position. This technique allows for the handling of complex cases, avoiding the need of autologous bone.

Keywords: cysts; bone regeneration; dental implants; bone substitutes; case reports

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1. Introduction

Odontogenic cysts are a unique disorder characterized by an epithelial lined pathological cavity [1]. This condition appears as a result of inflammatory occurrence or of the pathogenic causes associated with the epithelium development of a tooth-forming apparatus [2]. Thus, the epithelial lining of these cysts can derive from the odontogenic epithelium, which includes reduced enamel epithelium, the epithelial cell rests of Serres and the epithelial cell rests of Malassez [3].

The most common odontogenic cysts are radicular cysts, comprising 52–68% of the cysts affecting the jawbone [4], and mostly localized at the anterior region of the maxilla and premolar region of the mandible [5]. Originated from an inflammatory process, these cysts evolve at the root apex of a non-vital tooth typically due to dental caries or associated trauma. The inflammatory process spreads into the tissues that envelop the tooth, including the periodontal ligament—containing the epithelial rests of Malassez cells—and the bone [6]. The release of inflammatory mediators is thought to stimulate the proliferation of the epithelial rests [7].

Usually asymptomatic, these lesions can be firstly discovered radiographically, manifesting as a well-demarcated radiolucency directly associated with the apex of the tooth [4]. Although typically small, at less than 1 cm, they can enlarge to many times that size with destructive capabilities because of their expansion potential [8]. A complete and final diagnosis can only be achieved through histological confirmation. [9] The cyst lining consists of non-keratinized stratified squamous epithelium, while the lumen may contain not only inflammatory cells, but also cholesterol crystals [4].

The treatment of radicular cysts can be accomplished through non-surgical and root canal surgical root canal therapy or with extraction. After excision, the entire cyst should be histologically examined because other lesions, including tumors, can appear to be radiographically similar [6].

After the complete removal of a radicular cyst, patients can be left with insufficient bone volume for implant placement in the ideal 3D position. Due to this, bone augmentation procedures have been studied by many authors and can be broadly divided into horizontal (increase in width) or vertical bone augmentation (increase in height) [10]. In many cases, a combination of both is needed. Non-resorbable membranes or titanium meshes can be used to predictably augment bone in alveolar bone deficiencies. In Guided Bone Regeneration (GBR), these barrier membranes can be used in combination with graft materials [11].

Through the years, GBR techniques have been developed and improved. The "fence technique" was described in 2013 by Merli et al. as a technique in which a space is created by molding an osteosynthesis plate, based on the volume of the bone graft that is planned ahead. The molded plate, or the "fence", not only provides a retaining space for the bone graft but also serves as a support for the collagen membranes covering the grafted material [11,12].

The "fence technique" can be applied in osseous defects localized to a portion of the maxillary or mandibular arch when anatomic prosthodontic requirements do not permit the use of short or tilted implants [11].

This two-stage technique is described to cause limited discomfort to the patient and has been proposed for cases of extreme bone atrophy due to the capacity for the formation of large quantities of regenerated bone in both vertical and horizontal dimensions [11].

The aim of this article is to report the possibility and advantages of using the "fence technique" as a GBR technique simultaneously to the enucleation of an odontogenic cystic lesion that allows the recovery of the bone arch and the placement of the dental implants in the ideal position.

2. Case Report

A Caucasian male patient, 50 years old, attended a private clinic complaining of pain, swelling and a feeling of discomfort in the second sextant. The patient wished to resolve this problem and replace the missing tooth (21) with a fixed rehabilitation.

The patient's medical history reported no systematic diseases and that he was a non-smoker; a clinical evaluation was performed and a computer tomography was requested.

At the computer tomography (Figures 1 and 2), a large cyst was observed, extending from tooth 12 to the mesial of tooth 22. At the apical portion of the region of tooth 11 and 21, it was possible to observe an invasion of the nasal floor, with a destruction of the bone cortical of the vestibular of tooth 11 and 21, and in some locations of the same region, a destruction of the palatal cortical, too. The nasopalatine nerve canal was also invaded. It was observed that, in tooth 11, there was a reabsorption of the root.

With this evaluation, tooth 11 was endodontically prognosticated as a hopeless tooth [13,14] with an extraction indication. Since the patient wished for a fixed rehabilitation, the different parts of a complex treatment plan were performed as described in detail below.

A new endodontic treatment was performed at tooth 12, and tooth 11 was extracted.

The extraction of the tooth 11 was carried out under local anesthesia with articaine (artinibsa® 40 mg/mL + 0.01 mg/mL, Inibsa®, Llissá De Vall, Spain), a 15 blade was used to perform the syndesmotomy and forceps were used to perform the extraction. No sutures were used and a new partial removable prothesis was placed. As follow-up, the following prescription was recommended: ibuprofen 600 mg, 12/12 h for four days, chlorhexidine mouthwash 0.12%, 3 times/day for 10 days and a new control appointment after 8 days.

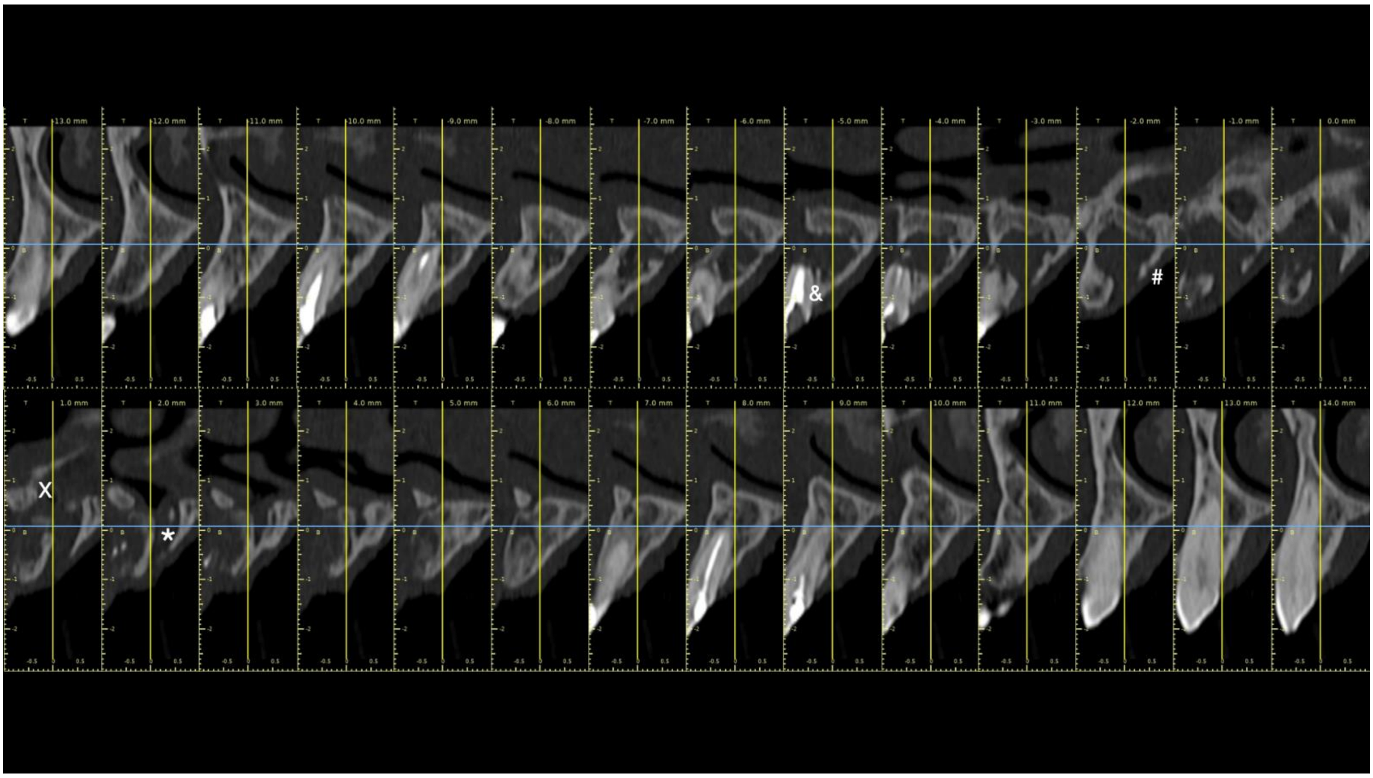

Figure 1. Initial computer tomography (sagittal views). Legend: &—root reabsorption of the tooth 11; *—Nasopalatine Duct; #—reabsorption of the palatal bone wall; X—nasal floor.

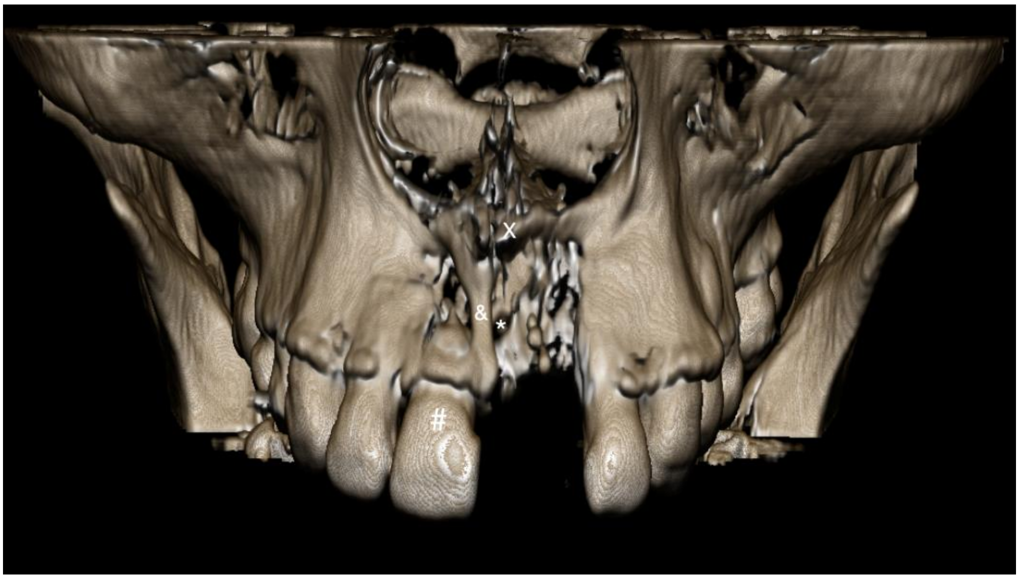

Figure 2. Initial computer tomography—3D reconstruction. Legend: &—anterior nasal spine; *—Nasopalatine Duct; #—tooth 11; X—nasal floor.

After 6 weeks for the healing of the soft tissue (Figure 3), the surgery of cyst enucleation and guided bone regeneration with the fence technique [12] was performed.

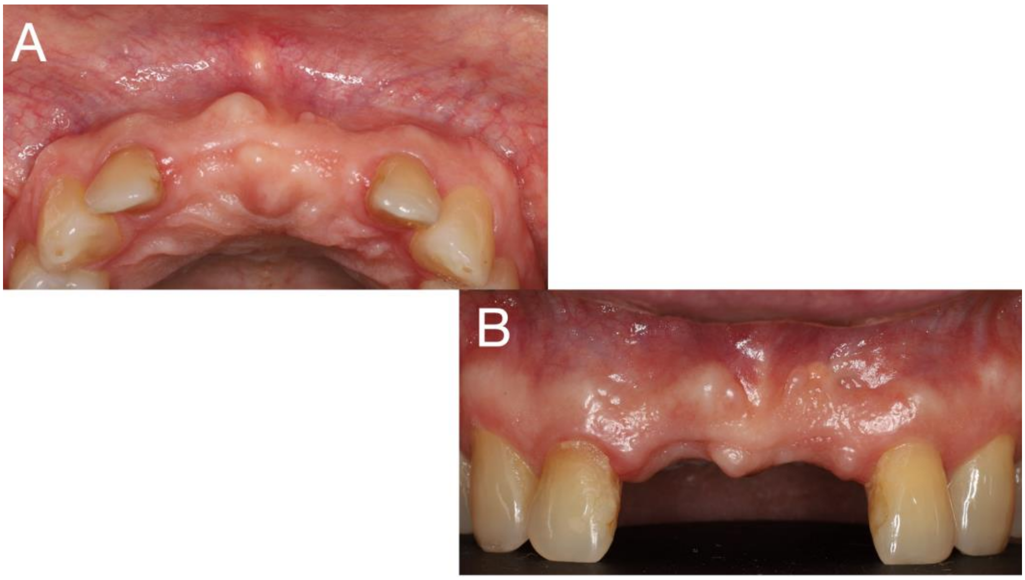

Figure 3. Six weeks after tooth extraction with healed of soft tissue—(**A**)—frontal view; (**B**)—occlusal view.

Local anesthesia with articaine (artinibsa® 40 mg/mL + 0.01 mg/mL, Inibsa®, Spain) was given. A linear incision with a 15 blade was performed from the distal aspect of tooth 13 to the mesial of tooth 23, where a releasing incision that crossed the mucogingival line was performed. A full thickness flap was elevated, and the cyst was enucleated (Figure 4). During odontogenic of the cyst enucleation (histologically established), special attention was paid to maintain the integrity of the anterior nasal spine. Even with the careful enucleation, a communication with the nasal floor occurred and a loss of the palatine bone plate was observed (Figure 4).

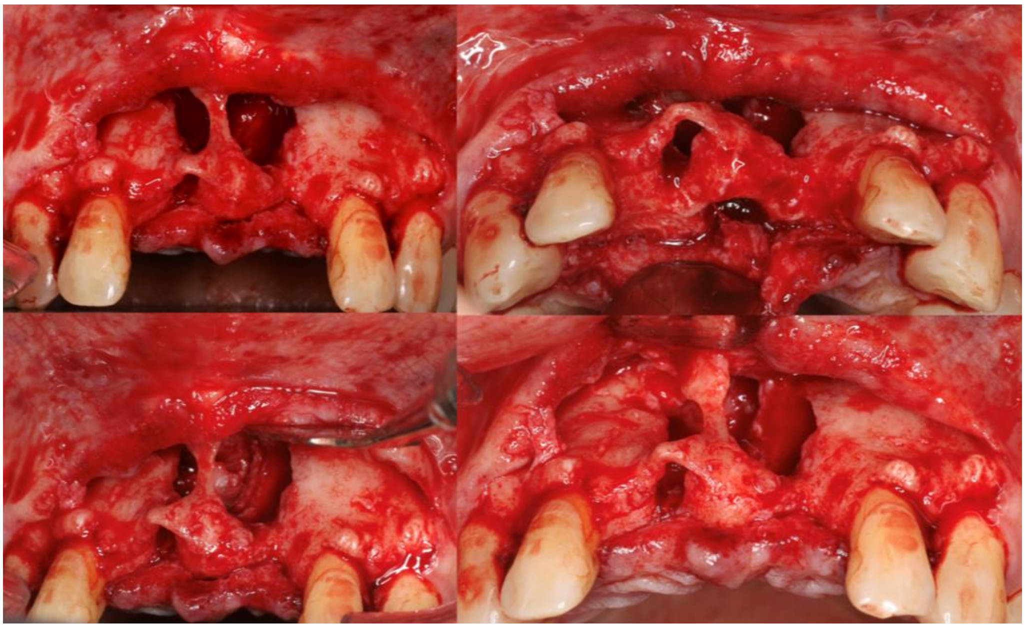

Figure 4. Different view after cyst enucleation.

A collagen membrane (Bio-Gide®, Geistlich®, Wolhusen, Switzerland) was placed (Figure 5) to seal the nasal floor communication and palatine bone plate was positioned prior to the placement of the particulate xenograft (Bio-Oss® S, Geistlich®, Switzerland).

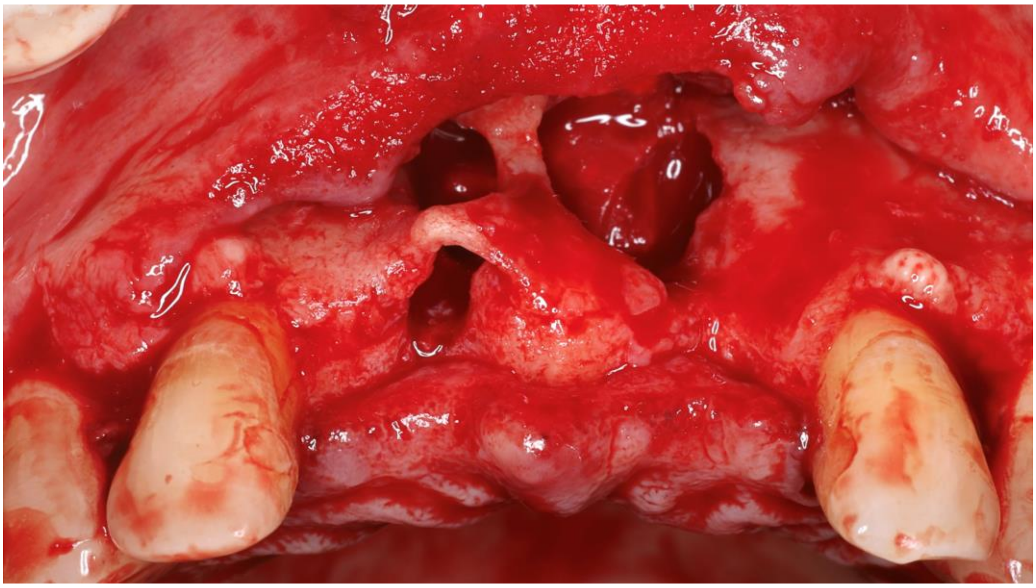

Figure 5. The collagen membrane placed to seal the nasal floor communication and palatine bone—occlusal view.

A titanium straight plate with 0.8 mm of thickness (Global D, Brignais®, Brignais, France) was molded to give the shape of the alveolar ridge and fixed with two screws (Figure 6), and the released periosteous incisions was performed with a 15 blade.

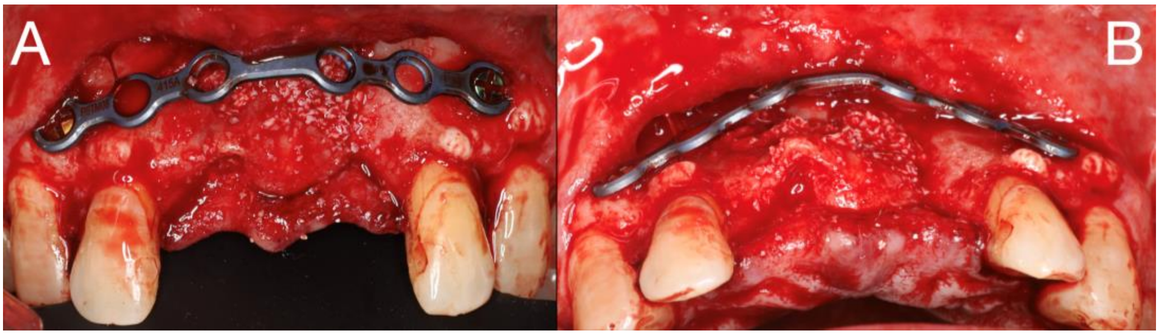

Figure 6. The titanium plate mold to give the shape of the alveolar ridge and fixed with two screws; xenograft placed at the cyst cavity—(**A**)—frontal view; (**B**)—occlusal view.

The gap between the bone and the plate was filled with particulate xenograft (Bio-Oss® S, Geistlich®, Switzerland) and covered with a collagen membrane (Bio-Gide®, Geistlich®, Switzerland) fixed with pins (Figure 7). The flap was sutured with PTFE 5.0 (Polytetrafluoroethylene polymer, Medipac®, Kilkis, Greece) with a horizontal mattress suture and simple stiches (Figure 8).

The prescription comprised of an antibiotic (amoxicillin and clavulanic acid 875 + 125 mg) 12/12 h for 8 days; corticoid (glucocorticoid) 60 mg/day for 3 days; a pain killer (paracetamol 500 mg + Codeine hemihydrate phosphate 30 mg) 12/12 h for 3 days; and chlorhexidine mouthwash 0.12%, 3 times/day for 10 days. The suture was removed after 10 days.

The report of the histological cyst analysis described a fibrous tissue affected by a cavity lesion lined by adjacent non-keratinized stratified squamous epithelium, with a presence of moderate inflammatory infiltrate with lymphocytic predominance. Permeation of the epithelium by inflammatory elements with a focal outline of erosion was observed. No signs of malignancy were detected. This histological report confirmed the clinical hypothesis of odontogenic cyst.

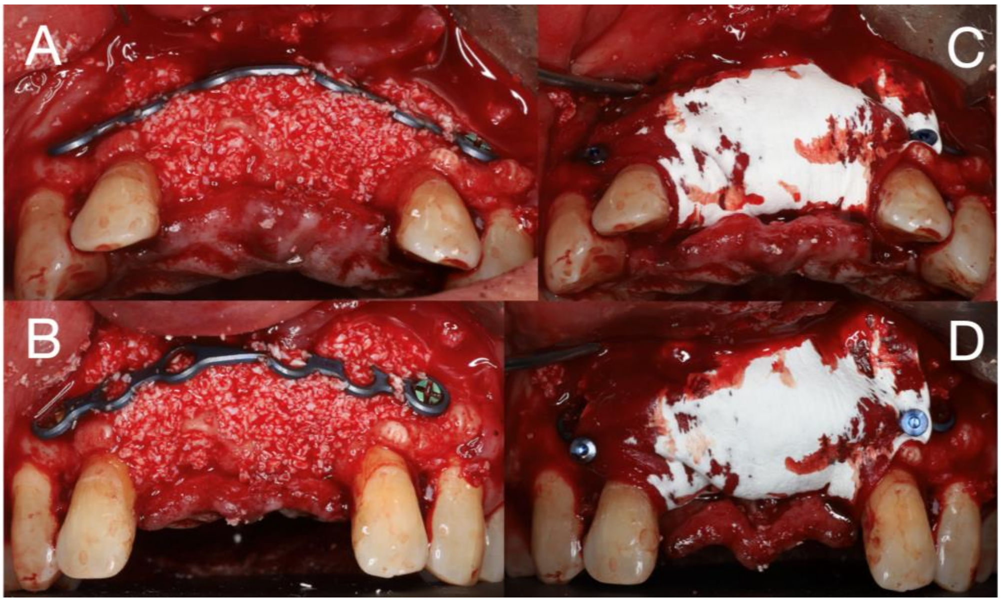

Figure 7. The gap between the bone and the plate filled with particulate xenograft—(**A**)—occlusal view; (**B**)—frontal view; the xenograft covered with a collagen membrane fixed with pins—(**C**)—occlusal view; (**D**)—frontal view.

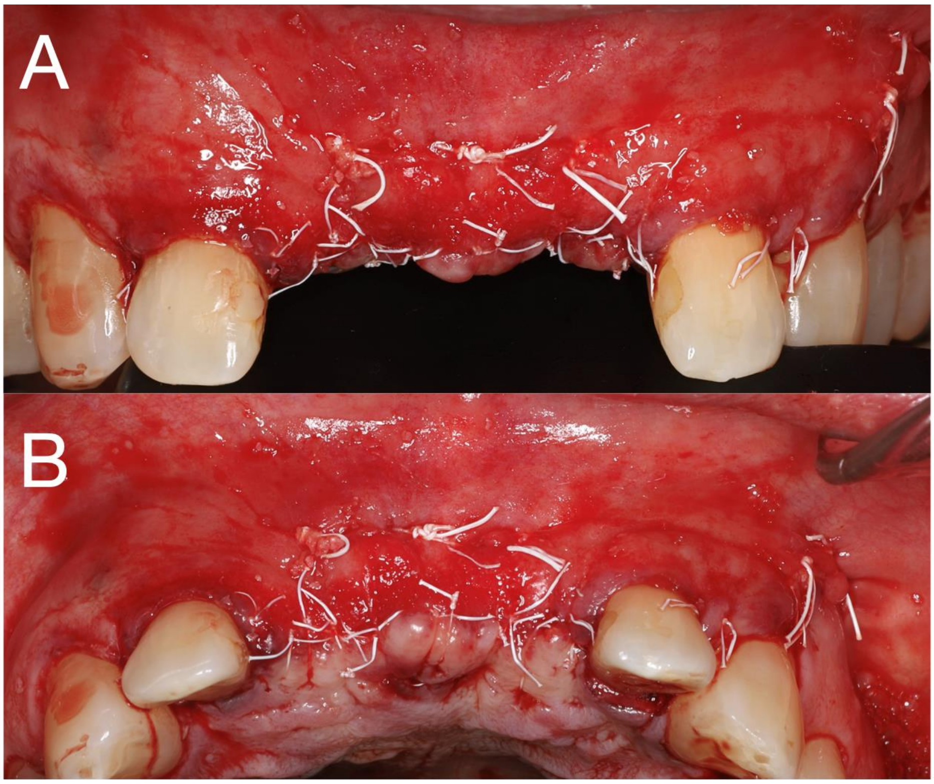

Figure 8. Flap suture—(**A**)—frontal view; (**B**)—occlusal view.

After 6 months of healing without any adverse event, the placement of the two implants was prosthetically planned (Figure 9A,B).

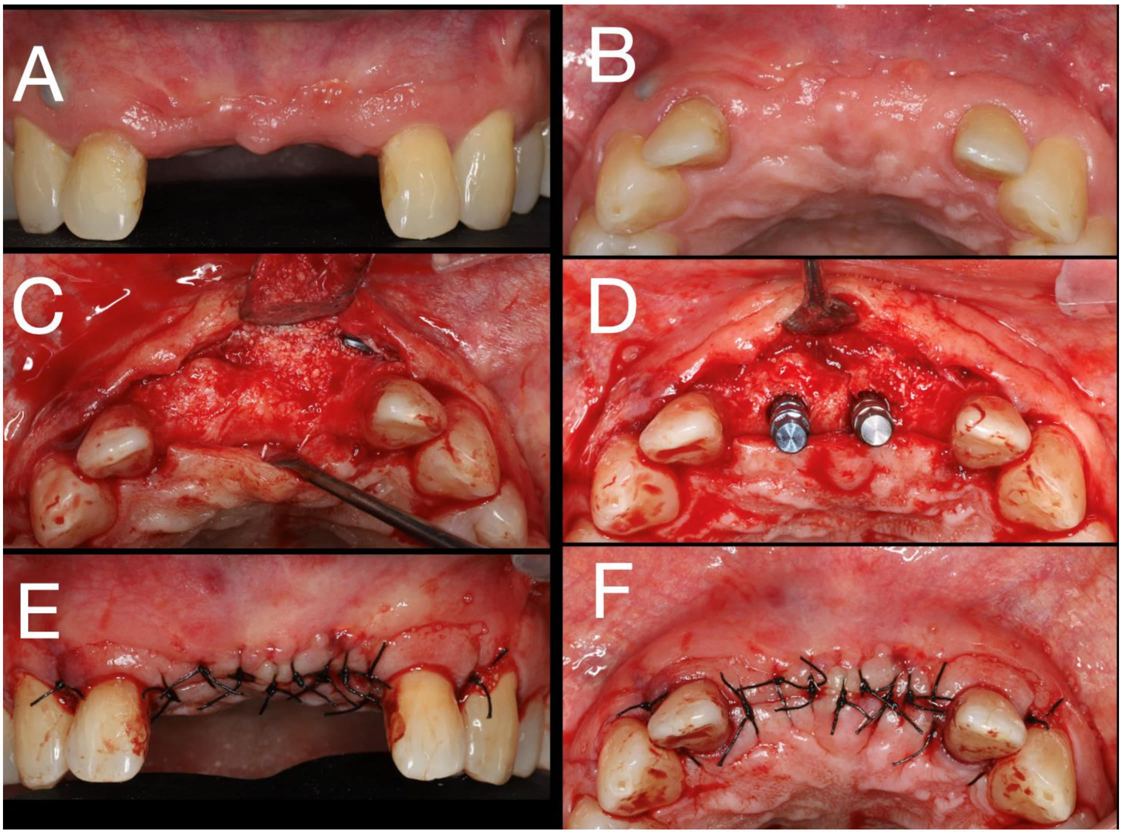

Figure 9. Six months of healing; Surgery of the dental implants placement; (**A**)—frontal view; (**B**)—occlusal view; (**C**)—full-thickness flap—occlusal view; (**D**)—Dental implant placement—occlusal view; (**E**)—Flap suture frontal view; (**F**)—Flap suture—occlusal view.

An incision with a 15 blade between teeth 13 and 23 under local anesthesia with articaine (artinibsa® 40 mg/mL + 0.01 mg/mL, Inibsa®, Spain) was executed and a full-thickness flap was raised (Figure 9C).

The Bone level® (Straumann®, Basel, Switzerland) drilling protocol for the two dental implants 4.1 × 10 RC at the region of tooth 11 and 21 was followed (Figure 9D). The removable prothesis was used as a guide in order to observe the correct dental implant position. The cover screws were placed, and the flap sutured with polyamide 4.0 (Supramida®, B Braun®, Melsungen, Germany)) (Figure 9E,F). As follow-up, the following prescription was recommended: azithromycin 500 mg 1 pill/per day for 3 days, ibuprofen 600 mg, 12/12 h for 4 days, chlorhexidine mouthwash 0.12%, 3 times/day for 10 days and the sutures removed after 8 days.

Nine weeks later, the second phase of implant surgery was performed, and the healing abutments (Straumann®, Switzerland) were placed. Both implants were osteointegrated with no signs of bone loss around them.

Two cad-cam monolithic zirconia implants cemented/screw crows over a 2 mm height abutment (RC Variobase, crown, Straumann®, Switzerland) were placed two months later.

After 18 months, it was possible to observe (Figure 10) an aesthetic pleasant soft tissue architecture, a maintenance of the bone volume and no signs of bone loss or biological complication around the implants. No signs of cyst reoccurrences were observed neither clinically nor radiologically.

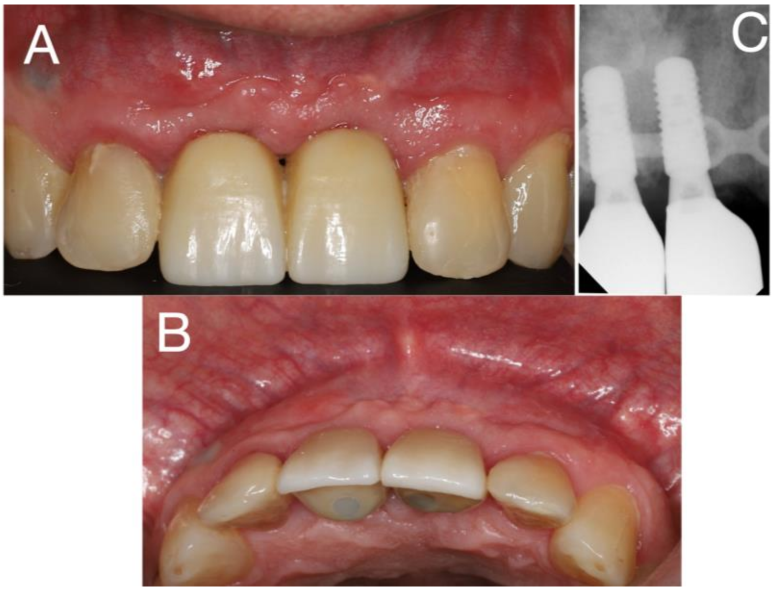

Figure 10. 18 months of follow-up—(**A**)—frontal view, (**B**)—occlusal view; (**C**)—periapical X-ray;.

At the follow-up appointments, the patients reported that he is very satisfied with his smile, confident in eating, with no pain or any discomfort (Figure 11). The plate translucidities do not bother him even when smiling. In his words, "no one can see it and I don't want more surgeries. . . for me it is perfect and it meets my expectations".

Figure 11. 18 months of follow-up—patient smiling.

3. Discussion

This clinical case reports step-by-step the procedure to combine the use of fence technique for bone regeneration simultaneously with odontogenic cyst enucleation in the second sextant. To the best of the authors' knowledge, this combination has not been reported in the literature before.

Radicular cysts are the most common inflammatory odontogenic cysts of tooth bearing areas of the jaws [15]. Other lesions, such as nasopalatine cysts—the most common nonodontogenic cyst of the maxilla—or tumors must be discarded when the histological diagnosis is conducted [6,16]. In the maxilla, radicular cysts have a prevalence of 60% [17] and affect mostly the anterior region, due to the predisposition of this area to trauma [18], as was the case in this report. With a typically slow and asymptomatic evolution, it can lead to extensive bone resorption and tooth mobility or loss; thus, a radiographic diagnosis is of major importance [15]. In this case, due to the enlarged dimension of the lesion, most of the root was already reabsorbed and the tooth was lost, preventing a more conservative approach. During cyst enucleation, it is crucial to ensure that the cystic capsule is completely removed, therefore preventing the possibility of recurrence [19]. Recurrence rates can vary from 33% to 44% [20,21].

In the presented case, the cyst expansion resulted in extensive bone loss that led to communication with the nasal floor and left no palatine bone plate after the cyst enucleation. Since insufficient bone was left for adequate implant placement, guided bone regeneration (GBR) arose as an adequate tissue engineering-based reconstruction technique to achieve good bone regeneration. The decision for using the fence technique was bonded with its advantages since it allows the bone far away from the bone crest to be regenerated as the plate prevents the invasion of soft tissue into the defect area and provides stability to the clot and to the xenograft. With the use of a membrane, it provides a microenvironment for osteoprogenitor cells to develop and proliferate to become mature osteoblast cells [22].

Unlike other bone regeneration techniques, such as the use of non-resorbable membranes, if a membrane exposure occurs, immediate intervention is almost always required, as the risk of infection is very high [23–25]. Dealing with resorbable membranes decreases the risk of contamination of the site after exposure of the membrane [25].

Another of the advantages that the fence technique presents compared to the use of other bone regeneration techniques, such as the Kory technique, is the lack of autologous bone harvesting, which is associated with increased morbidity [26,27].

The choice of suture material and technique is also important to allow the patient's successful recovery. The use of PTFE sutures prevents the accumulation of biofilm, while allowing a good tensile strength [28,29]. This, with the use of a horizontal mattress sutures, provides the closure of the flap and a proper healing without further inflammation or even infection [30].

Antibiotics were prescribed in order to reduce the degree of bacterial contamination of the grafted bone particles [31].

A 2020 study by Merli M. et al. [32] compares vertical bone augmentation grafting with 100% autogenous bone vs. 50% deproteinized bovine bone matrix/50% autogenous bone using the fence technique, in a two-stage implant placement, presenting no significant differences in the histomorphometric comparisons 6 months after grafting.

Xenografts have been shown to have valid properties for GBR, such as its biocompatibility, formation of a scaffold (osteoconduction), slow resorption rates and the ability to define and maintain the volume for bone gain [33]. Thus, xenografts are an attractive alternative for not submitting the patient to further procedures [34–36].

In the 2015 meta-analysis by Sanz-Sánches I. et al. [37], the use of bone replacement grafts with barrier membranes and a staged approach presented a mean high survival and success rates (>95%) for the implants placed on the regenerated sites, with the non-exposure of the membranes being an important aim.

In this case, contrary to the described by Merli M. [11], a 100% bovine xenograft (Bio-Oss® S, Geistlich®, Switzerland) was used. No signs of inflammation or infection were visible, as well as no tendency for a decrease in bone volume was observed over time, as described by Mello I. et al. [33]. The patient was pleased with the result; minor complications were associated with the procedure and there was only a slight edema that was self-limiting. Thereby, the use of only xenografts appears to be a viable option for GBR when the patient is not predisposed to further procedures. Nonetheless, at re-entry, xenograft particles were still observed. This is expected since the literature reports a "slow-turnover" for the resorption and replacement of bovine bone xenografts [38]. However, further controls must be put in place over time to guarantee the stability and health of the implants.

Since the patient has a lower smile, he does not have any complaints about the plate translucidities, and, to avoid a more invasive process, it was opted that the titanium plate be left. Since this plate is biocompatible, no major problems are expected to occur. In case we need to remove the osteosynthesis plate, it can be performed simultaneously to the dental implant placement. In order to achievethis, it is necessary to extend the flap and remove the bone eventually covering the screws and the plate.

As reported by Merli M. et al. [32], this two-stage technique allows for the formation of large quantities of regenerated bone in both vertical and horizontal dimensions in cases of extreme bone atrophy, enabling a correct implant placement and pleasant results, resulting in patient satisfaction. Thus, this technique appears as a valid GBR technique [11] to be used simultaneously to a cyst enucleation.

4. Conclusions

In this clinical case with a follow-up of 18 months, it was possible to observe that the reconstructed bone volume was stable and allowed an aesthetics result in terms of soft and hard tissues.

Radiographically, no reoccurrence of the odontogenic cyst was observed, the enucleation being successful.

The fence technique allowed the maintenance of the space that helps to obtain a normal contour of the maxillary arch and allowed the dental implant placement in the ideal 3D position.

With this technique, in contrast to other regenerative technics, the collection of autologous bone is avoided, which reduces the mobility. Moreover, in case of exposition of the non-resorbable membrane, the risk of infection when compared with a non-reabsorbed membrane is lower.

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