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Case Report

Immediate Implant Placement at an Inflammatory Periapical Cyst Site in the Aesthetic Area

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Abstract: A healthy 47-year-old woman consulted the Oral Surgery and Implantology Unit of the University Hospitals of Geneva with a request to treat her painful tooth 11 and replace the missing tooth 21. The dental history revealed that the patient had lost teeth 21 and 22 due to advanced caries. On clinical examination, tooth 11 showed an ill-fitting prosthetic crown with overhanging margins, an increased localized probing depth of 8 mm in the disto-vestibular area, and sensitivity to percussion. The edentulous site 21 showed horizontal bone atrophy. Radiological examination revealed a well-defined unilocular radiotransparent lesion surrounded by a thin radiolucent border, located at the apex of tooth 11 and measuring 10 × 8 mm. The treatment consisted of extraction of 11, enucleation of the apical lesion, and insertion of implants at sites 11 and 21 with simultaneous bone augmentation in a single surgical procedure, with aesthetic and functional results at 3-year follow-up without any complications. Our case highlights that immediate implant placement in cases of cystic periapical lesions represents a good valid alternative to standard treatment.

Keywords: dental implants; radicular cyst

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1. Introduction

For many years, the standard procedure for dental implant treatment has been to place the dental implant in healed sockets [1]. With the changes observed in implant surgery over time, immediate placement of dental implants in extraction sockets has proven to be a safe and viable treatment option [2–4]. This procedure became a strategy favored by clinicians owing to the associated advantages, such as reducing the number of surgical procedures, stress on the patient, and morbidity; shortening treatment duration; and better management of soft tissue and alveolar morphology [5,6].

During the early years of dental implantology, the Branemark protocol based on the concept of osseointegration [1] required excellent primary stability [7] and recommended a healing period of 6 months after dental extraction for complete bone recovery [1]. Initially used to rehabilitate cases of total edentulism [1,4], implant placement therapy was gradually used to restore partially edentulous areas and even missing single teeth [8,9] from the 1990s onwards. In this context, understanding the dimensional changes of the ridge and the biological principles of bone healing after extraction, determining the appropriate time for implant placement after extraction has become paramount, and other implant timing such as early implantation and immediate implantation have been investigated [2–5]. It is essential to point out that this treatment option requires selection of appropriate cases and correct execution of the technique.

In the anterior region where the aesthetic result is very important, numerous studies have demonstrated the need for both an intact socket to optimize primary stability and a buccal bone wall thickness of 1 mm to guarantee the stability of bone and soft tissues in

order to limit the risk of recession [4–6]. In recent years, some studies showed high success rates for immediate implant placement in sockets with chronic periapical pathologies or infected sites [8,9]. In these cases, pathogenic bacteria may be present in the extraction sites [9,10], and complete curettage of the granulation tissues and all soft tissue remnants in the sockets is required to reduce the inflammatory response and allow osseointegration. However, the risks related to this treatment option continue to be a matter of debate in clinical practice [9–12].

Radicular cyst is the most common inflammatory odontogenic cyst, representing 52–68% of all maxillary cysts [13–15] that occur after the development of periapical granuloma. It predominantly affects the upper jaw, in patients between 30 and 40 years, and seems to be more common in men [15]. Its origin is inflammatory: in most cases, it is associated with a decayed tooth with necrotic pulp [16] which causes inflammation of the periapical tissues and stimulation of the epithelial rests of Malassez. Radicular cysts are chronic lesions that grow slowly and are most often asymptomatic; their discovery can be fortuitous during a radiological examination. Radiologically, they appear as a homogeneous radiolucent lesion, round to oval in shape, well limited, surrounded by a sclerotic border [17], or more rarely multilocular [15], and near the apex of a non-vital tooth. Most radicular cysts are small, ranging from 0.5 to 1.5 cm [17]. However, the radiological size of the lesion does not allow a diagnosis to be made. The possibility of root resorption (of the affected tooth or adjacent teeth) by a radicular cyst has been rarely reported [18] and is probably due to infection or osteoclastic factors produced by the cyst [17]. Histological examination of a radicular cyst shows a central cavity filled with eosinophilic liquid or semi-liquid serosity, with cholesterol crystals derived from the disintegration of erythrocytes, lymphocytes, plasma cells, and macrophages. The cyst is lined by a non-keratinized stratified squamous epithelium, occasionally containing mucus and exceptionally ciliated cells. The epithelium is often irregular and spongiotic, has polynuclear neutrophils in exocytosis, and is acanthotic or even shows the presence of atrophic or eroded areas concomitant with the inflammatory process. In some cases, the epithelial proliferation may resemble that of a squamous odontogenic tumor. Rushton bodies, or hyaline bodies, exhibiting a wide variety of shapes, including linear, round, lamellar, or amorphous structures, can be seen in the epithelium as well as the wall of radicular cysts. The epithelium is surrounded by a capsule made up of fibrous connective tissue, containing a chronic inflammatory infiltrate usually dense with numerous silhouettes of cholesterol crystals often associated with foreign-type giant cell granulomas and deposits of hemosiderin [19]. Aspiration of an uninfected radicular cyst reveals serohematic fluid, usually containing an abundance of cholesterol granules that impart a shimmering straw or golden color to the fluid.

To the best of our knowledge, this study describes for the first time an immediate implant placement in the anterior region of the maxilla following cyst enucleation, with good aesthetic and functional results after a follow-up period of 3 years.

2. Case Presentation

A 47-year-old female patient in good general health, who was a non-smoker without allergies and did not take medication, consulted the Oral Surgery and Implantology Unit of the University Hospitals of Geneva, seeking treatment for her painful tooth 11 and for replacing missing tooth 21. The patient had lost teeth 21 and 22 due to advanced carious lesions. Tooth 22 was replaced by a dental implant, and tooth 21 had been replaced several months earlier by a removable prosthesis. Clinical examination of the oral cavity was within normal limits. Dental examination revealed fair oral hygiene, with dental plaque on the crown of implant at site 22; composite fillings of teeth 16, 26, 27, 38, 45, 47, and 48; and a good periodontal status. Particles of bone augmentation materials were visible through the vestibular mucosa. Resin composite filling of tooth 12 was poorly adapted. Tooth 11 presented a poorly adapted prosthetic crown with overhang margins, with an increased localized probing depth of 8 mm in the disto-buccal site and tenderness to percussion. Edentulous site 21 presented horizontal bone atrophy, with a residual thickness of 4 mm.

Attached gingiva and width of keratinized gingiva were measured and were, respectively, 3 and 2 mm. The intraoral radiological examination confirmed the different findings observed clinically for tooth 11: a post-crown, inadequate endodontic treatment and a unilocular, well-defined radiolucency surrounded by a thin radiolucent border, centered around the apex of tooth 11, measuring 10 × 8 mm. The bone deficit was horizontal at site 21 and at the apical part of site 11; however, there was no bone vertical deficit. The residual distance between the roof of the cystic lesion and the nasal cavity measured 2.5 mm (Figure 1a–d).

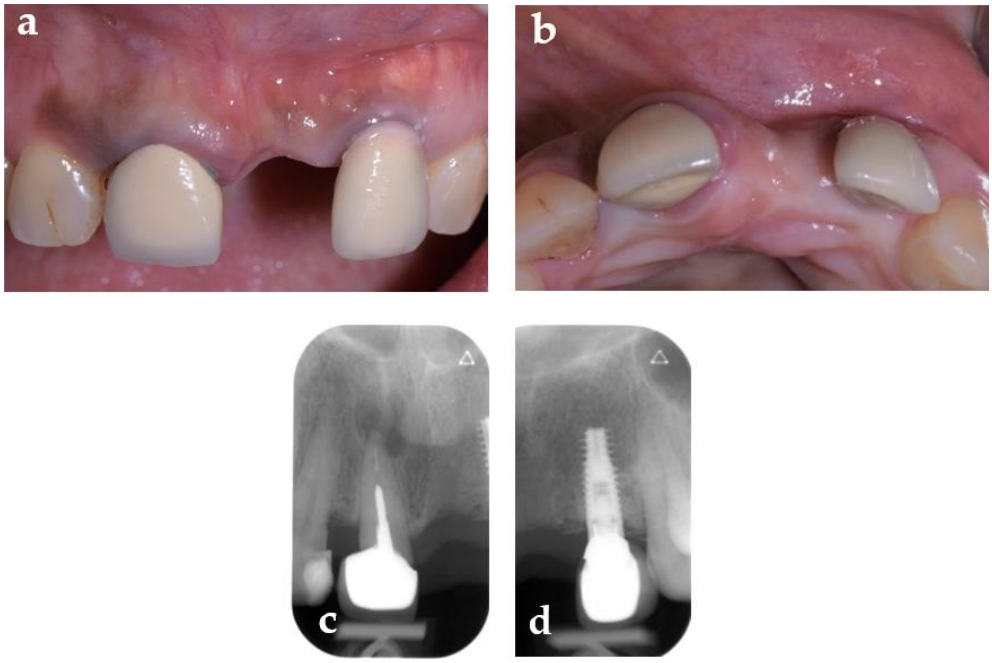


Figure 1. (**a**–**d**) Clinical view and intraoral radiographs showing the initial clinical status of anterior maxillary area.

The presumptive diagnosis of an odontogenic radicular cyst on tooth 11 was made. A root fracture was also suspected. The prognosis for tooth 11 was considered hopeless. The patient asked to restore the 2 anterior teeth while maintaining the diastema that she had previously. Extraction of tooth 11 and enucleation of the apical lesion were proposed and accepted by the patient, who requested immediate implant placement at sites 11 and 21 at the same time. A preoperative prophylactic antibiotic Co-amoxicillin (Co-amoxi mepha, Mepha Pharma, Basel, Switzerland) was taken one hour prior to surgery (2 g). A mucoperiosteal flap was raised on the facial and lingual aspects to obtain a clear view of site 11, the underlying resorbed alveolar ridge, and site 21, under local anesthesia (4% articaine with 1:100,000 adrenaline—Ubistesin™ Forte—3M ESPE, North Ryde, Australia). The cystic lesion was enucleated in toto using surgical curettes, and root 11 was removed carefully to preserve intact buccal wall (Figure 2a–d). Cyst cavity was irrigated after enucleation with sterile saline.

Implant bed preparation was carried out freehand at the future implant position to its final diameter under constant irrigation with sterile saline according to the manufacturer's instructions for placing BLT implants (Straumann, Switzerland). The existing removable prosthesis from site 21 was used for the drilling axis at site 11. Gauges were used to control preparation depth and implant axis orientation after each drill (Figure 3).

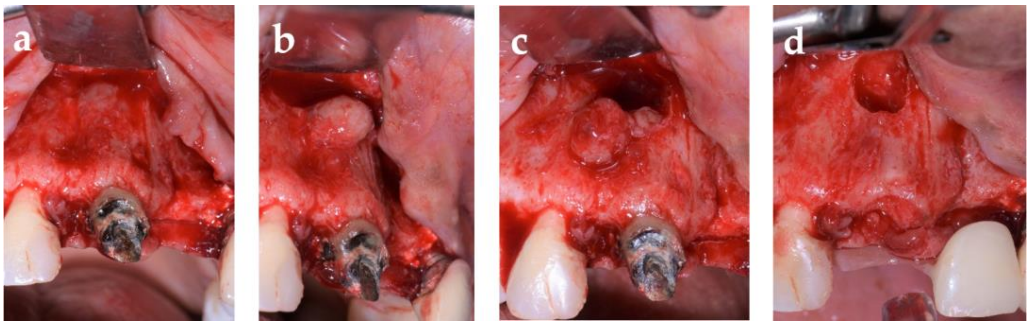


Figure 2. (**a**–**d**) Intraoperative view of buccal mucoperiosteal flap elevation (**a**), during (**b**) and after cystectomy (**c**) and after tooth extraction (**d**).

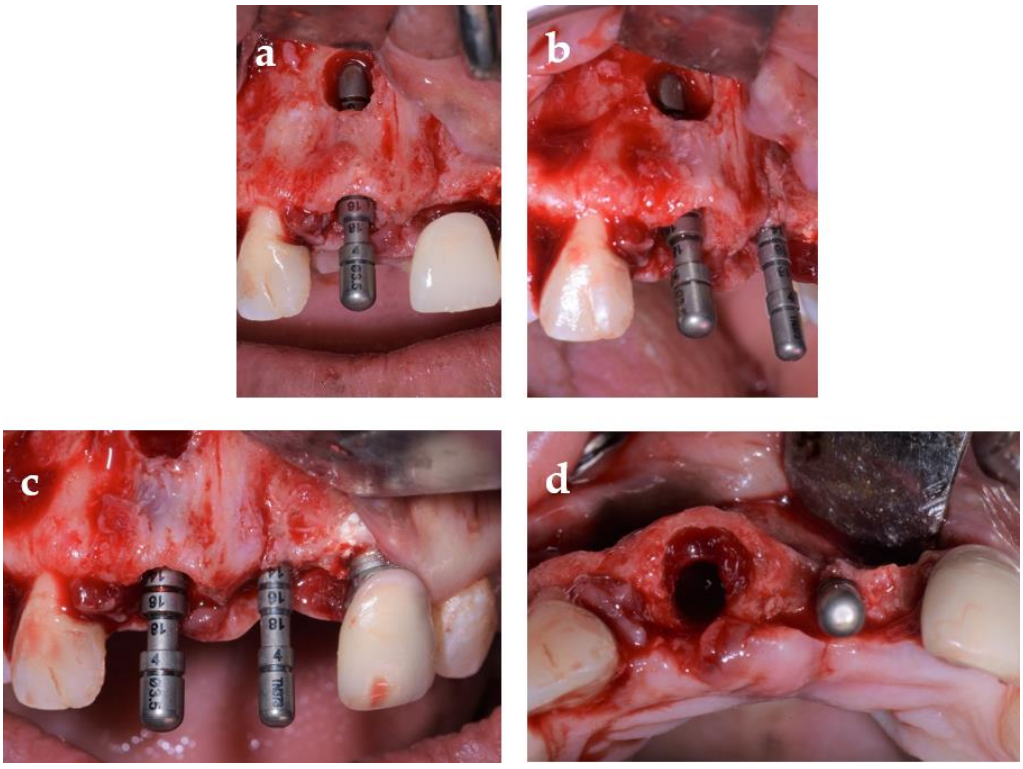


Figure 3. (**a**–**d**) Buccal view showing control of the drilling axes of site 11 (**a**) and 11 and 21 (**b**,**c**), and occlusal view showing implant bed preparation of site 11 (**d**).

A Straumann® BLT implant (Basel, Switzerland) with a diameter of 4.1 mm and a length of 14 mm and a BLT implant with a diameter of 3.3 mm and a length of 12 mm were manually placed at sites 11 and 21, respectively (Figure 4). Primary stability was achieved for both implants, and an insertion torque of 25 and 30 N/cm was obtained at the level of implants 11 and 21, respectively.

The cystic cavity, the gap between the buccal wall and exposed surface of implant at site 11, and the buccal defect of site 21 were filled and augmented using a mixture of autogenous bone chips, retrieved during drilling, and alloplastic bone (bone Ceramic® Straumann, Switzerland) (Figure 5). A collagen membrane (OsteoBiol Evolution, Tecnoss, Milan, Italy) was used to entirely cover the augmented site, and soft tissues were carefully reapproximated and sutured using simple 4-0 Supramid sutures (Figure 5).

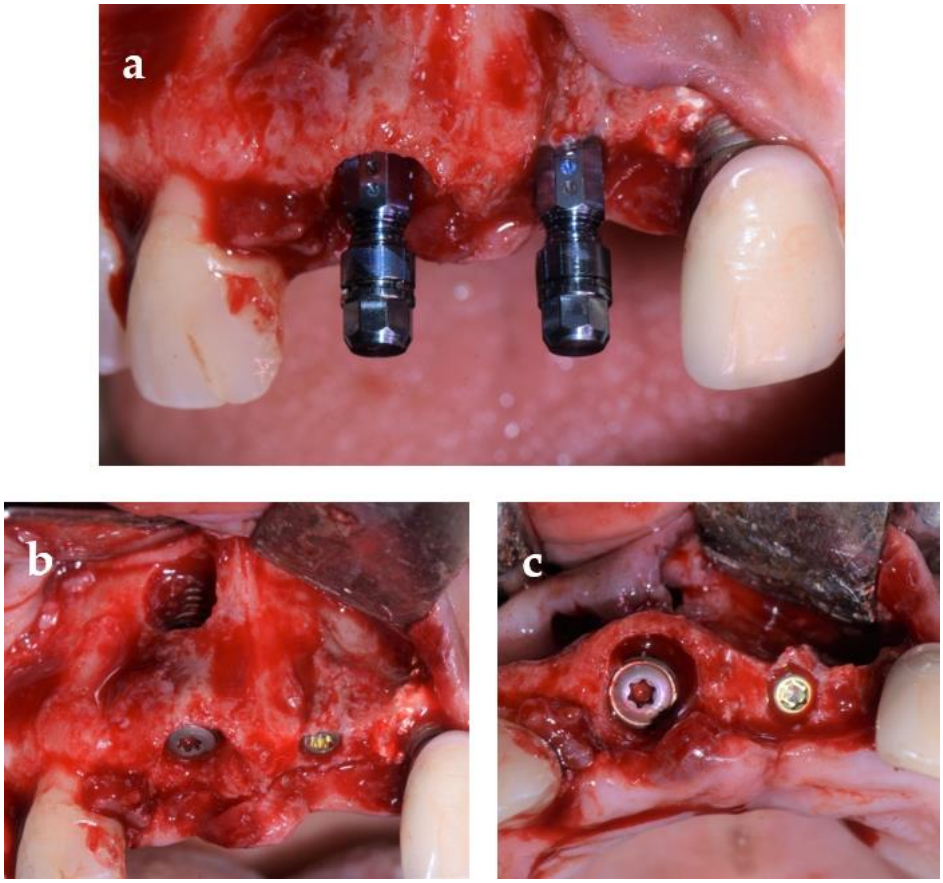


Figure 4. (**a**–**c**) Buccal view after placement of implants at sites 11 and 21 (**a**) and showing bone defect at the cavity after cystectomy (**b**), and occlusal view showing the gap between the intact buccal wall and implant site 11 (**c**).

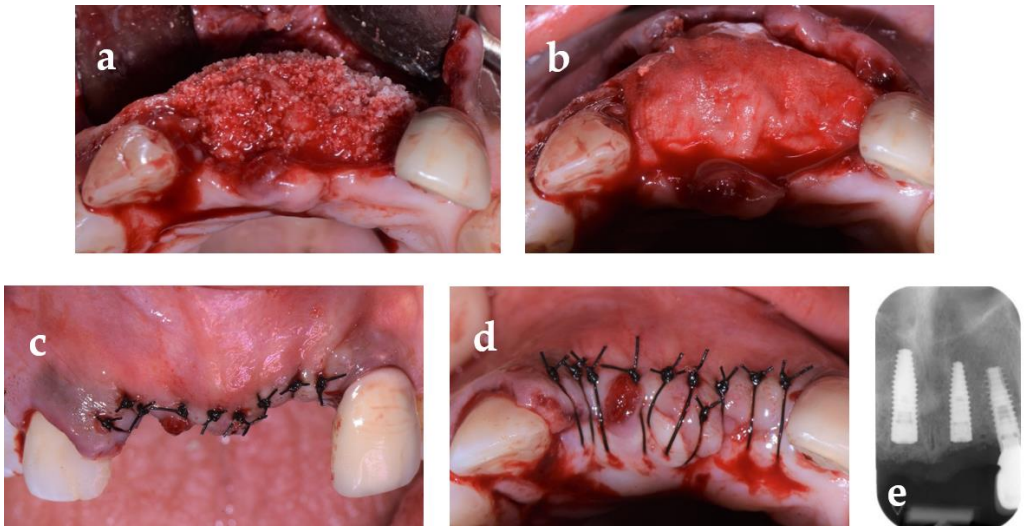


Figure 5. (**a**–**e**) Clinical view showing the augmented sites using autogenous bone chips and alloplastic bone (**a**) covered by collagen membrane (**b**) and after wound closure (**c**,**d**), and periapical 2D radiographs taken immediately after implant placement.

The cystic lesion was sent for histopathological analysis. The latter revealed a largely abraded fibrous wall, partially lined by non-keratinized stratified squamous epithelium. The underlying connective tissue contained numerous chronic inflammatory cells and

rare small birefringent foreign bodies under polarized light. These findings confirmed the diagnosis of radicular cyst (Figure 6a–d).

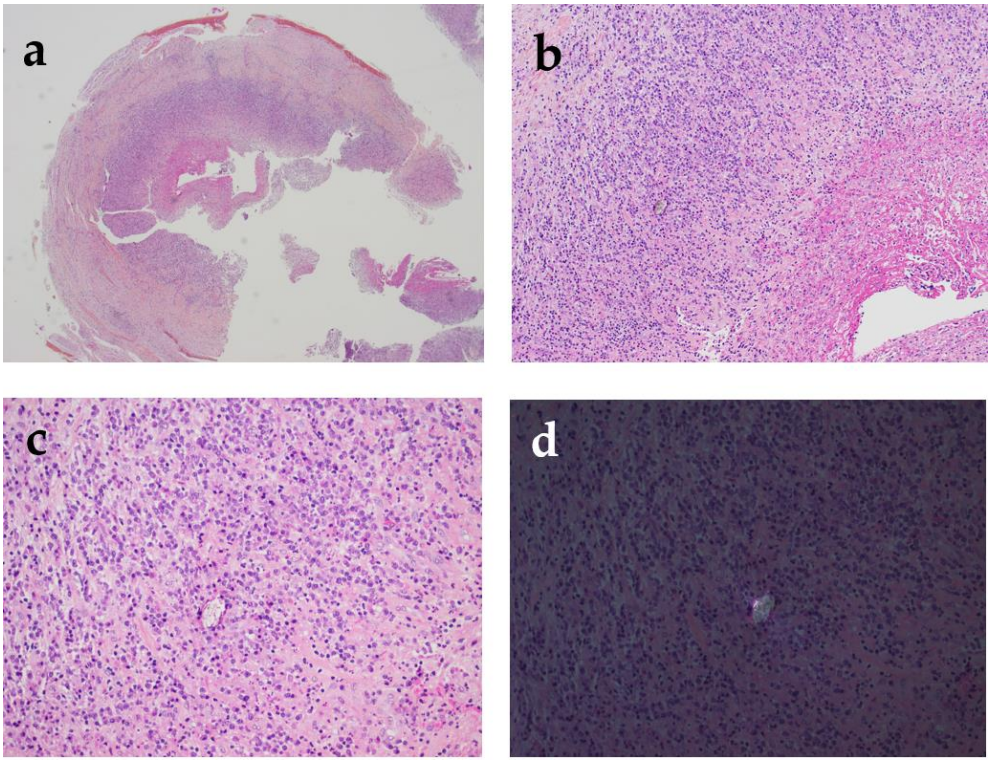


Figure 6. (**a**–**d**) Histopathological examination of the excised specimen stained by hematoxylin and eosin showing fibrous cyst wall, hemorrhage, and heavy chronic inflammatory infiltrate at (**a**) 20× and (**b**) 40× magnification. (**c**) Hematoxylin and eosin and (**d**) polarized light showing root canal filling material (60× magnification).

Control intraoral radiographs were taken, and post-operative advice was given to the patient along with a prescription for oral antibiotics (amoxicillin with clavulanic acid 2 g/day/days for 5 days). At 10-day clinical follow-up, the sutures were removed. After a healing period of three months, reopening was performed, and the healing was uneventful. Regarding the details of the prosthetic phase, one week later implants were initially restored using two screw-retained temporary resin crowns to condition the soft tissues, followed 1 month later by two screw-retained single-unit crowns (E-max-press) using RC Variobase® abutment (Straumann, Switzerland).

Marginal bone levels were measured. In brief, mesial and distal crestal bone margins were individually assessed at the time of implant placement, at, 1, 2, and 3 years, by determining the distance between the most coronal bone-to-implant contact relative to the implant platform from periapical radiographs (Romexis, Planmeca, Finnland). Radiographs were dimensionally calibrated using the implant length or platform diameter (Table 1).

The inter-implant distances between implants 11 and 21 and between implants 21 and 22 were 4.5 mm and 3 mm, respectively. Probing depth (PD), clinical attachment level (CAL), mucosal recession (REC), and bleeding on probing (BOP) were measured at 3 months and 1-, 2-, and 3-year follow-up. The probing depth was 4 mm around the implant at site 11 and 3 mm around that at site 21 at each measurement; the clinical attachment was 1 mm for both implants without mucosal recession (0 mm), and negative for bleeding.

The patient followed regular dental and dental prosthesis checkups as well as oral hygiene recall appointments twice a year. During these appointments, the examiner recorded the clinical periodontal parameters and checked the status of the prosthesis. At the end of the appointments, a session of supragingival prophylaxis was performed, as necessary.

The implant-supported restorations showed good aesthetic and functional results in 2021 after a follow-up period of 3 years in 2024 (Figure 7), and both implants met the criteria for implant success [20].

Table 1. Marginal bone level after treatment and at 1, 2, and 3 years. Dimensions are reported in mm.

Marginal Bone Level Site 11 (2D) [mm]				
	Site 11		Site 21	
	Mesial	Distal	Mesial	Distal
Post-OP	+2	+2	+1	0
1 year	+2	+2	+1	0
2 years	+1.5	+1.5	+1	0
3 years	+1.5	+1.5	+1	0

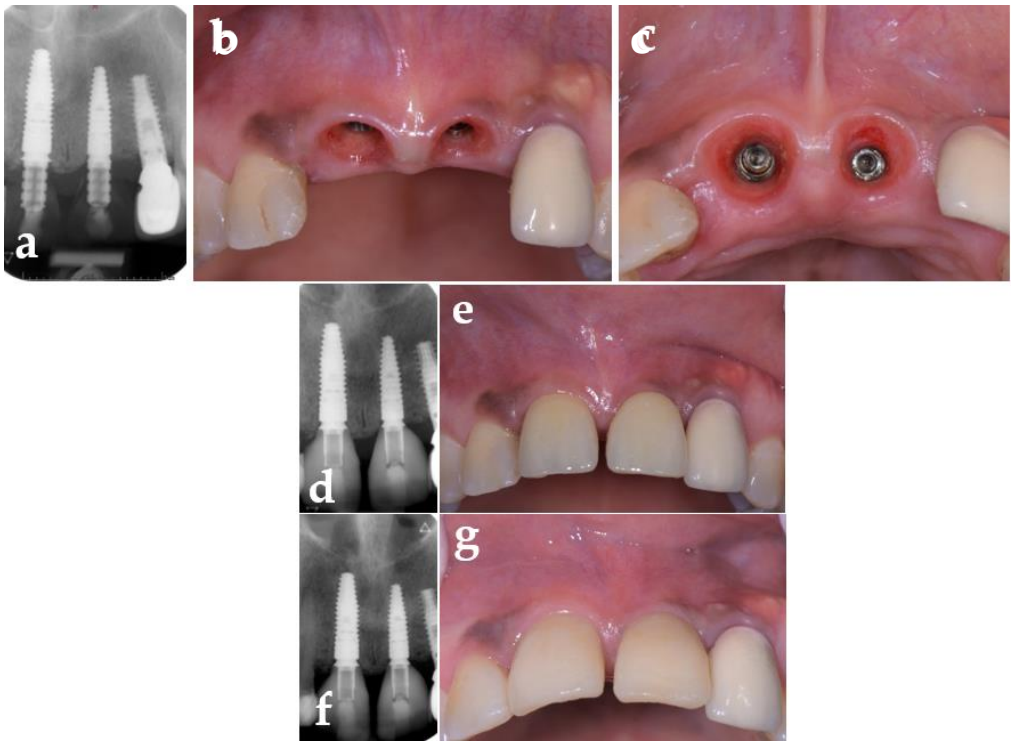


Figure 7. (**a**–**f**) Soft tissue condition when the two screw-retained single-unit crowns (E-max-press) were delivered 1 month after temporary resin crowns (**a**–**c**). Radiographic and clinical examination at 1- (**d**,**e**) and 3-year (**f**,**g**) follow-up period.

3. Discussion

To the best of our knowledge, this case report is the first describing an immediate implantation procedure after tooth extraction and enucleation of a radicular cyst and implantation at the adjacent site with simultaneous bone augmentation.

Today's literature provides information on different factors influencing the success of implants placed immediately after tooth extraction. These factors range from the implant position, the use of grafting material, and the soft tissue biotype up to the use of soft tissue augmentation [21–23]. An additional factor, which has been widely discussed, is the presence or absence of periapical pathologies. It is already standard practice to debride non-symptomatic pre-existing lesions at the time of immediate implant placement, and several studies advise against the immediate placement of implants in the presence of periapical pathologies [24,25]. Furthermore, the term retrograde peri-implantitis has been recently introduced to describe radiolucencies around the most apical part of an osseointegrated

implant. These might be provoked by the remaining scar or granulomatous tissue after immediate implant placement into extraction sockets [26]. Several studies posit that the inflammatory tissue surrounding the periapical periodontium may potentially compromise the success of immediate implant placement, leading to complications such as peri-implant inflammation, thereby impacting the surgical outcome [6–8].

In contrast to these findings, more recent studies have shown in animal experiments that implants placed in artificially induced periapical lesions osseointegrate as well as implants placed in healthy sites [27,28]. Other clinical studies have demonstrated favorable results with immediate implant placement into infected sites [9–12]. A study conducted by Roberto et al. found no significant differences between implants placed and immediately loaded in periodontally infected sockets compared to those placed in uninfected sites [29]. Further, Thomas et al. confirmed that immediate placement of implants into sites with periapical pathologies could be a successful treatment strategy, contingent on careful debridement of the extraction socket [30]. A series of cases presented by Simone et al. suggested that implant placement in infected fresh extraction sockets may yield predictable outcomes, provided adequate care is exercised pre- and post-surgery [11].

In a prospective, controlled clinical trial study, it was shown that immediate implant placement in sites with or without periapical pathology did not lead to an increased rate of complications, more interproximal bone loss, or worse clinical parameters [31,32]. Similar conclusions were found in a prospective, randomized study with 50 patients, revealing no disadvantages for implants placed directly after the extraction of teeth exhibiting periapical pathologies [9].

In our case, although the apical bone at site 11 was limited, the buccal bone wall was more than 1 mm thick and could therefore allow for the volume stability of the edentulous crest. In terms of proximal bone, the distal site benefited from the support of the periodontal ligament of tooth 12. On the other hand, site 21 was edentulous and showed severe horizontal bone atrophy, which could be corrected. Regarding the technique's therapeutic considerations, immediate implantation is indeed classically a flapless surgery, reducing the risk of additional bone resorption in the extraction socket, particularly in the buccal wall, by maintaining vascularization from the periosteum [33] and reducing post-operative morbidity [34]. However, the lack of visibility associated with a flapless technique represents a challenge when preparing the implant bed of a post-extraction socket. This is in fact a complex surgical procedure requiring the intervention of an expert surgeon [35] and presenting a risk of perforation of the buccal or palatal bone, which can sometimes go undiagnosed or even limit the possibility of placing the implant. The inclination of the axis of future implants should be along the palatal bone, and an implant axis oriented towards the buccal surface of the implant is also a contributing factor to gingival recession [36]. In our case, a flap was necessary to achieve bone augmentation at the adjacent site 21 and to optimize visibility during enucleation of the cystic lesion and drilling at sites 11 and 21. In addition, another aspect to consider with immediate implantation is the achievement of primary stability, since even micro-movements of 50 to 150 µm at the bone–implant interface may favor the development of fibrous tissue, by impairing the formation of new bone at the implant surface, and consequently compromise the osseointegration phenomenon [37]. Several studies have also reported that the high success rates of this technique were associated with the achievement of primary stability [38]. Bone anchorage for primary stability in immediate implantation primarily depends on the bone at the apical and palatal levels of the alveolus [39]. For this reason, particular attention must be paid to the proximity of neighboring anatomical structures such as the maxillary sinuses, nasal cavities, mandibular canal, and mental foramina. In the context of post-extraction sockets requiring the removal of cystic lesions, achieving primary stability can be even more complex due to the presence of the enucleation cavity, which reduces the amount of bone available and requires a more meticulous and precise surgical procedure. In our patient, one of the difficulties was to obtain primary stability because, although the palatal cortex was intact, the post-enucleation apical space was empty of bone for 10 mm

beyond the dental apex, and the residual bone height between the apical level of the cavity and the nasal cavity was 3 mm, which greatly limited the possibility of apical anchorage. Nevertheless, primary stability was achieved by optimizing bone anchorage through the palatal bone and residual apical bone to the post-enucleation cavity using a 14 mm long BLT implant while maintaining a 2 mm safety margin from the nasal cavity. Typically, bone augmentation simultaneous with immediate implantation is required to fill the gaps between the vestibular cortex and the exposed implant surface [40]. In our case, filling was carried out between the vestibular cortex and the implant surface, as well as at the apical level of the post-enucleation cystic cavity, using bone ceramics combined with autologous bone collected during drilling. Furthermore, a membrane was used to cover the implant sites, particularly for the Guided Bone Regeneration of the adjacent site 21. Immediate implantation also offers the possibility of an immediate fixed provisional restoration, provided that primary stability is achieved and sufficient insertion torque of around 35 N/cm is applied [41], optimizing peri-implant soft tissue management and the aesthetics of the restoration [42–44]. In our case, the insertion torque was sufficient, but the adjacent site requiring implant placement with augmentation did not allow this possibility under optimal conditions. In addition, reopening after the osseointegration phase and soft tissue conditioning using temporary crowns was necessary.

4. Conclusions

Numerous advances in clinical techniques and biomaterials have greatly expanded the indications for dental implant treatment options. This case report describes for the first time an immediate implantation procedure after extraction and enucleation of an apical cystic lesion in the anterior region after more than 3 years of follow-up. The patient was very satisfied with the speed of the surgery, which was performed in a single operation to achieve a fixed, functional, and aesthetic solution. An inflammatory periapical cyst lesion in the aesthetic area does not seem to be an absolute contraindication to immediate implant placement in selected cases but requires a careful procedure protocol. Additional studies are necessary to assess the survival rates of immediate implants placed in this clinical setting.

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Institutional Review Board Statement: The presented study adhered to the Helsinki Declaration of ethical principles by the World Medical Association. The study did not require the approval of the Ethics Commission on Human Research of Geneva (CCER-Geneva) according to the Federal Human Research Act (Art.3al.a), since the study involved less than five patients.

Informed Consent Statement: Written informed consent was obtained from the patients to publish this paper.

Data Availability Statement: The original contributions presented in the study are included in the article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Adell, R.; Lekholm, U.; Rockler, B.; Brånemark, P.I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int. J. Oral Surg.* **1981**, *10*, 387–416. [CrossRef]
2. Soegiantho, P.; Suryawinata, P.G.; Tran, W.; Kujan, O.; Koyi, B.; Khzam, N.; Algarves Miranda, L. Survival of Single Immediate Implants and Reasons for Loss: A Systematic Review. *Prosthesis* **2023**, *5*, 378–424. [CrossRef]
3. Perez, A.; Hamzah, S.; Lombardi, T. Immediate versus Delayed Implant Placement in Patients with Tooth Agenesis: An In-Line Retrospective Pilot Study Comparing Clinical and Patient-Related Outcomes. *Appl. Sci.* **2023**, *13*, 9368. [CrossRef]
4. Buser, D.; Chappuis, V.; Belser, U.C.; Chen, S. Implant placement post extraction in esthetic single tooth sites: When immediate, when early, when late? *Periodontol. 2000* **2017**, *73*, 84–102. [CrossRef]

5. Chen, S.T.; Buser, D. Clinical and esthetic outcomes of implants placed in postextraction sites. *Int. J. Oral Maxillofac. Implants* **2009**, *24*, 186–217. [PubMed]
6. Perez, A.; Caiazzo, A.; Valente, N.A.; Toti, P.; Alfonsi, F.; Barone, A. Standard vs customized healing abutments with simultaneous bone grafting for tissue changes around immediate implants. 1-year outcomes from a randomized clinical trial. *Clin. Implant Dent. Relat. Res.* **2020**, *22*, 42–53. [CrossRef] [PubMed]
7. Javed, F.; Romanos, G.E. The role of primary stability for successful immediate loading of dental implants. A literature review. *J. Dent.* **2010**, *38*, 612–620. [CrossRef]
8. Trisi, P.; Perfetti, G.; Baldoni, E.; Berardi, D.; Colagiovanni, M.; Scogna, G. Implant micromotion is related to peak insertion torque and bone density. *Clin. Oral Implants Res.* **2009**, *20*, 467–471. [CrossRef]
9. Lindeboom, J.A.H.; Tjiook, Y.; Kroon, F.H.M. Immediate placement of implants in periapical infected sites: A prospective randomized study in 50 patients. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* **2006**, *101*, 705–710. [CrossRef]
10. Manor, Y.; Alkasem, A.; Mardinger, O.; Chaushu, G.; Greenstein, R.B.N. Levels of bacterial contamination in fresh extraction sites after a saline rinse. *Int. J. Oral Maxillofac. Implants* **2015**, *30*, 1362–1368. [CrossRef]
11. Fugazzotto, P.A. A retrospective analysis of implants immediately placed in sites with and without periapical pathology in sixty-four patients. *J. Periodontol.* **2012**, *83*, 182–186. [CrossRef] [PubMed]
12. Jung, R.E.; Zaugg, B.; Philipp, A.O.H.; Truninger, T.C.; Siegenthaler, D.W.; Hämmerle, C.H.F. A prospective, controlled clinical trial evaluating the clinical radiological and aesthetic outcome after 5 years of immediately placed implants in sockets exhibiting periapical pathology. *Clin. Oral Implants Res.* **2013**, *24*, 839–846. [CrossRef] [PubMed]
13. Kakar, A.; Kakar, K.; Leventis, M.D.; Jain, G. Immediate Implant Placement in Infected Sockets: A consecutive cohort study. *J. Lasers Med. Sci.* **2020**, *11*, 167–173. [CrossRef] [PubMed]
14. Johnson, N.R.; Gannon, O.M.; Savage, N.W.; Batstone, M.D. Frequency of odontogenic cysts and tumours: A systematic review. *J. Investig. Clin. Dent.* **2014**, *5*, 9–14. [CrossRef] [PubMed]
15. Shivhare, P.; Singh, A.; Haidry, N.; Yadav, M.; Shankarnarayan, L. Multilocular radicular cyst—A common pathology with uncommon radiological appearance. *J. Clin. Diagn. Res.* **2016**, *10*, 13–15. [CrossRef] [PubMed]
16. Noda, A.; Abe, M.; Shinozaki-Ushiku, A.; Ohata, Y.; Zong, L.; Abe, T.; Hoshi, K. A bilocular radicular cyst in the mandible with tooth structure components inside. *Case Rep. Dent.* **2019**, *2019*, 6245808. [CrossRef] [PubMed]
17. Quadri, A.; Keerthi, R.; Khan, T.A. Unusual aggressive large radicular cyst invading maxillary sinus: A case report. *Int. J. Sci. Stud.* **2016**, *4*, 180–183.
18. Avril, L.; Lombardi, T.; Ailianou, A.; Burkhardt, K.; Varoquaux, A.; Scolozzi, P.; Becker, M. Radiolucent lesions of the mandible: A pattern-based approach to diagnosis. *Insights Imaging* **2014**, *5*, 85–101. [CrossRef]
19. Kolari, V.; Rao, H.T.A.; Thomas, T. Maxillary and mandibular unusually large radicular cyst: A rare case report. *Natl. J. Maxillofac. Surg.* **2019**, *10*, 270–273. [CrossRef]
20. Misch, C.E.; Perel, M.L.; Wang, H.L.; Sammartino, G.; Galindo-Moreno, P.; Trisi, P.; Steigmann, M.; Rebaudi, A.; Palti, A.; Pikos, M.A.; et al. Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. *Implant Dent.* **2008**, *17*, 5–15. [CrossRef] [PubMed]
21. Chen, S.T.; Darby, I.B.; Adams, G.G.; Reynolds, E.C. A prospective clinical study of bone augmentation techniques at immediate implants. *Clin. Oral Implants Res.* **2005**, *16*, 176–184. [CrossRef]
22. Evans, C.D.; Chen, S.T. Esthetic outcomes of immediate implant placements. *Clin. Oral Implants Res.* **2008**, *19*, 73–80. [CrossRef] [PubMed]
23. Grunder, U.; Gracis, S.; Capelli, M. Influence of the 3-d bone-to-implant relationship on esthetics. *Int. J. Periodontics Restor. Dent.* **2005**, *25*, 113–119.
24. Barzilay, I. Immediate implants: Their current status. *Int. J. Prosthodont.* **1993**, *6*, 169–175.
25. Tolman, D.E.; Keller, E.E. Endosseous implant placement immediately following dental extraction and alveoloplasty: Preliminary report with 6-year follow-up. *Int. J. Oral Maxillofac. Implants* **1991**, *6*, 24–28. [CrossRef] [PubMed]
26. Quirynen, M.; Vogels, R.; Alsaadi, G.; Naert, I.; Jacobs, R.; van Steenberghe, D. Predisposing conditions for retrograde peri-implantitis, and treatment suggestions. *Clin. Oral Implants Res.* **2005**, *16*, 599–608. [CrossRef]
27. Novaes, A.B., Jr.; Vidigal, G.M., Jr.; Novaes, A.B.; Grisi, M.F.; Polloni, S.; Rosa, A. Immediate implants placed into infected sites: A histomorphometric study in dogs. *Int. J. Oral Maxillofac. Implants* **1998**, *13*, 422–427.
28. Marcaccini, A.M.; Novaes, A.B., Jr.; Souza, S.L.; Taba, M., Jr.; Grisi, M.F. Immediate placement of implants into periodontally infected sites in dogs. Part 2: A fluorescence microscopy study. *Int. J. Oral Maxillofac. Implants* **2003**, *18*, 812–819.
29. Papalexiou, V.; Novaes, A.B., Jr.; Grisi, M.F.; Souza, S.S.; Taba, M., Jr.; Kajiwara, J.K. Influence of implant microstructure on the dynamics of bone healing around immediate implants placed into periodontally infected sites. A confocal laser scanning microscopic study. *Clin. Oral Implants Res.* **2004**, *15*, 44–53. [CrossRef]
30. Crespi, R.; Capparè, P.; Gherlone, E. Immediate loading of dental implants placed in periodontally infected and non-infected sites: A 4-year follow-up clinical study. *J. Periodontol.* **2010**, *81*, 1140–1146. [CrossRef]
31. Truninger, T.C.; Philipp, A.O.H.; Siegenthaler, D.W.; Roos, M.; Hämmerle, C.H.F.; Jung, R.E. A prospective, controlled clinical trial evaluating the clinical and radiological outcome after 3 years of immediately placed implants in sockets exhibiting periapical pathology. *Clin. Oral Implants Res.* **2011**, *22*, 20–27. [CrossRef]

32. Siegenthaler, D.W.; Jung, R.E.; Holderegger, C.; Roos, M.; Hammerle, C.H. Replacement of teeth exhibiting periapical pathology by immediate implants: A prospective, controlled clinical trial. *Clin. Oral Implants Res.* **2007**, *18*, 727–737. [CrossRef] [PubMed]
33. El-Naggar, A.K.; Chan, J.K.C.; Grandis, J.R.; Takata, T.; Slootweg, P.J. WHO classification of head and neck tumours. (4th edition). *IARC* **2017**, *9*, 204–207.
34. Ebenezer, V.; Balakrishnan, K.; Asir, R.V.D.; Sragunar, B. Immediate placement of endosseous implants into the extraction sockets. *J. Pharm. Bioallied Sci.* **2015**, *7*, 234–237. [CrossRef] [PubMed]
35. Roe, P.; Kan, J.Y.K.; Rungcharassaeng, K.; Caruso, J.M.; Zimmerman, G.; Mesquida, J. Horizontal and vertical dimensional changes of peri-implant facial bone following immediate placement and provisionalization of maxillary anterior single implants: A 1-year cone beam computed tomography study. *Int. J. Oral Maxillofac. Implants* **2012**, *27*, 393–400. [PubMed]
36. Cosyn, J.; Sabzevar, M.M.; De Bruyn, H. Predictors of inter-proximal and midfacial recession following single implant treatment in the anterior maxilla: A multivariate analysis. *J. Clin. Periodontol.* **2012**, *39*, 895–903. [CrossRef] [PubMed]
37. Hämmerle, C.H.F.; Chen, S.T.; Wilson, T.G. Consensus statements and recommended clinical procedures regarding the placement of implants in extraction sockets. *Int. J. Oral Maxillofac. Implants* **2004**, *9*, 26–28.
38. Fickl, S.; Zuhr, O.; Wachtel, H.; Bolz, W.; Huerzeler, M. Tissue alterations after tooth extraction with and without surgical trauma: A volumetric study in the beagle dog. *J. Clin. Periodontol.* **2008**, *35*, 356–363. [CrossRef]
39. Rocci, A.; Martignoni, M.; Gottlow, J. Immediate Loading in the Maxilla Using Flapless Surgery, Implants Placed in Predetermined Positions, and Prefabricated Provisional Restorations: A Retrospective 3-Year Clinical Study. *Clin. Implant Dent. Relat. Res.* **2003**, *5*, 29–36. [CrossRef]
40. Merli, M.; Bernardelli, F.; Esposito, M. Immediate versus early nonocclusal loading of dental implants placed with a flapless procedure in partially edentulous patients: Preliminary results from a randomized controlled clinical trial. *Int. J. Periodontics Restor. Dent.* **2008**, *28*, 453–459.
41. Degidi, M.; Piattelli, A. A 7-year Follow-up of 93 Immediately Loaded Titanium Dental Implants. *J. Oral Implantol.* **2005**, *31*, 25–31. [CrossRef] [PubMed]
42. Ottoni, J.M.P.; Oliveira, Z.F.L.; Mansini, R.; Cabral, A.M. Correlation between placement torque and survival of single-tooth implants. *Int. J. Oral Maxillofac. Implants* **2005**, *20*, 769–776. [PubMed]
43. Greenstein, G.; Cavallaro, J. Implant Insertion Torque: Its Role in Achieving Primary Stability of Restorable Dental Implants. *Compend. Contin. Educ. Dent.* **2017**, *38*, 88–95. [PubMed]
44. Balaji, P.; Balaji, S.M.; Ugandhar, P. Immediate implant in single rooted teeth—Study on primary stability and bone formation. *Indian J. Dent. Res.* **2015**, *26*, 421. [CrossRef]

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