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The Use of Dental Implants to Treat Post-Surgical Jaw Defects: Cohort Study

Ameliyat Sonrası Oluşan Çene Defektlerini Tedavi Etmek İçin Dental İmplantların Kullanılması: Kohort Çalışması

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ABSTRACT Objective: Many studies have documented spontaneous bone repair after the excision of benign jaw lesions, however implant placement after lesional removal has received less attention. Following bone pathology enucleation, bone defects may arise. Reconstruction techniques with various bone grafting materials are preferred in order to promote bone healing and to support alveolar bone. Another option is to initially allow physiological healing of the cavity without using any graft materials. In this study, it was planned to rehabilitate the patients by using dental implants after the physiological healing of the postoperative defects. **Material and Methods:** This study included patients with benign lesions greater than 5 mm in diameter and patients who underwent dental implants without any grafting procedures. Data from 18 patients who received dental implants after complete removal of benign pathological lesions were evaluated. We included 8 males and 10 females aged 16-78 years. A total of 41 implants were placed. Implants were applied 18-36 months after removal of the lesions. Eight of the 41 implants (19.5%) were placed in the maxilla. Thirteen of the 18 (72.2%) lesions were (histopathologically) odontogenic cysts; the remaining lesions comprised odontogenic fibromyxomas, an arteriovenous malformation, and a central giant cell granuloma. **Results:** Most of the lesions in the present study were localized in the posterior mandible and the pathological fracture was not reported following cyst enucleation nor dental implant placement. **Conclusion:** No implant failed during 2 years of follow-up. It was observed that the dental implants were found usefull for the reconstruction of post-surgical defects.

Keywords: Dental implant; mouth neoplasm; mandibular reconstruction

ÖZET Amaç: Birçok çalışma, iyi huylu çene lezyonlarının eksizyonundan sonra spontan kemik iyileşmesinin gerçekleştiğini göstermiştir, ancak lezyon çıkarıldıktan sonra dental implant yerleştirilmesi literatürde daha az ilgi görmüştür. Kemiklerdeki patolojilerin enükleasyonunu takiben kemik defektleri oluşabilmektedir. Kemik iyileşmesini hızlandırmak ve alveolar kemiği desteklemek için çeşitli kemik greft materyalleri ile rekonstrüksiyon teknikleri tercih edilmektedir. Diğer seçenek ise oluşan kavitenin, herhangi bir greft materyali kullanmadan fizyolojik iyileşmesine izin vermektir. Bu çalışma, ameliyat sonrası oluşmuş defektlerin fizyolojik iyileşmesi sonrası dental implant desteğiyle hastaları tedavi etmeyi planlanmıştır. **Gereç ve Yöntemler:** Çalışmaya, çapı 5 mm'den büyük benign lezyonları olan ve cerrahi sonrası herhangi bir greftleme yapılmadan dental implant uygulanan tüm hastalar dâhil edilmiştir. Çalışmada, iyi huylu patolojik lezyonların tamamen çıkarılmasından sonra dental implant uygulanan 18 hastanın verileri değerlendirilmiştir. Çalışmaya, 16-78 yaşları arasında 8 erkek ve 10 kadın dâhil edilmiştir ve toplam 41 adet dental implant uygulanmıştır. İmplantlar, lezyonların çıkarılmasından 18-36 ay sonrasında uygulanmıştır. Kırk bir implantın 8'i (%19,5) üst çeneye yerleştirilmiştir. Yapılan histopatolojik incelemelerde, 18 lezyonun 13'ü (%72,2) odontojenik kist, diğer lezyonlar ise odontojenik fibromiksoma, arteriyovenöz malformasyon ve santral dev hücreli granülom olarak bildirilmiştir. **Bulgular:** Bu çalışmadaki lezyonların çoğu, posterior mandibulada yer almaktadır ve kist enükleasyonunu veya dental implant yerleştirilmesini takiben patolojik kırık rapor edilmemiştir. **Sonuç:** 2 yıllık takip süresince hiçbir implantta başarısızlık gözlenmemiştir. Dental implantların, ameliyat sonrası oluşan defektlerin rekonstrüksiyonunda kullanılmasının uygun olduğu gözlenmiştir.

Anahtar Kelimeler: Diş implantasyonu; ağız neoplazileri; mandibular rekonstrüksiyon

Benign lesions of the jaws can develop from both odontogenic and nonodontogenic tissues. These lesions are characterized by well-defined margins with regular borders causing expansion, displacement of adjacent structures, and directional root resorption. Panoramic radiographs, cone beam computed tomography (CT), and magnetic resonance imaging are used to effectively diagnose the extent of the lesion in all 3 planes.[1]

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The defects of the jaw may lead to significant facial deformity; altered oral function affecting swallowing, speech, mastication and/or saliva retention. Thus psychologic problems also may occur. Therefore providing of the oral function, esthetics and rehabilitation of the patients with bony defects of the jaws remains an important and challenging problem.[2]

Several types of benign jaw lesions have been described and some of them such as keratocyst, odontogenic myxoma, central giant cell granuloma may behave locally aggressive.[3] Treatments of the cysts are mostly determined on the basis of their etiologies and localizations. The aim of the treatment is to maintain oral function and prevent recurrences or malignant growth.[4]

Conservative or aggressive approaches are used to treat such lesions depending on their clinical and histological features.[3] Enucleation, marsupialization and curettage are commonly used conservative surgical removal techniques. Conservative approach has the advantage of preserving vital structures.[5,6]

Following the management of jaw lesions bone defects may arise and reconstruction techniques using various bone grafting materials to promote and accelerate bone healing have been described in the literature.[7,8] One of the first treatment protocols is to initially allow physiological healing of the cavity; thus, not placing a graft. However, as a result, deficiencies in the healing bone volume can be observed. Consequently, bone reconstruction techniques are both functionally and esthetically important following the enucleation of a benign lesion.[9]

Dental implants have been clinically and scientifically proven to adequately replace missing teeth. Only a few case reports have described dental implant placement after the enucleation of benign jaw lesions, including odontogenic cysts.[10-12] The prognoses of implants placed in defects that healed without grafting remain unknown. This study evaluated the utility of implants in aforementioned regions and discussed the preoperative clinical and radiological data.

MATERIAL AND METHODS

STUDY POPULATION

Data from 18 patients who received dental implants after the complete removal of benign pathological lesions in the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, İstanbul University, from January 2010 through December 2019 were retrospectively reviewed. The study was approved by our institutional ethics committee. The same surgical team performed all operations.

PATIENT ENROLMENT

All patients with benign lesions larger than 5 mm in diameter and who received dental implants after surgery without any grafting were included. Those who had been operated on previously or those for whom data were lacking were excluded, as were those with post-implantation follow-up times of <24 months or who underwent (intra- or extra-oral) bone augmentation.

CLINICAL PROCEDURES

This study was carried out in accordance with the Principles of the Declaration of Helsinki. Ethical approval for this study (2019/58) was obtained from İstanbul University Faculty of Dentistry Clinical Research Ethics Committee on February 5, 2020. All patients gave written informed consent to study participation and surgery. Only 2 patients underwent general surgery. Eight males and 10 females aged 16-78 years (average, 40.4 years) were included in this study. A total of 41 implants were placed and 8 (19.5%) of them were placed in the maxilla. 13 of the 18 (72.2%) lesions were (histopathologically) odontogenic cysts; the remaining lesions comprised odontogenic fibromyxomas, an arterio-venous malformation, and a central giant cell granuloma. No patient underwent aggressive surgery. The lesions ranged from 5 to 10 cm in diameter. Follow-up featured clinical and radiographic examinations at 6, 12, 24, and 36 months to evaluate the size of the residual cavity and any changes in bone density by comparing the features apparent in immediate and postoperative panoramic radiographs. Postoperative CT was scheduled only for patients at high risk of recurrence. Pa-

tient demographic and clinical characteristics are presented in Table 1.

RESULTS

The 12-month postoperative radiographs clearly showed that bone density increased after surgery (compared to the preoperative radiographs). Radiographic evaluation at 24-36 months after surgery revealed complete healing. Implantation times varied by lesional diagnosis and recurrence status. Patients with an odontogenic myxoma, a central giant cell granuloma, or odontogenic keratocysts required an average 36-month wait prior to implantation to reduce any possible risk of recurrence. Those with radicular and dentigerous cysts required a 12-24-month before implant placement. One patient with a keratocyst underwent contemporaneous surgical enucleation and implant placement (without grafting) to reduce the rehabilitation time and avoid a second surgical intervention. The patient was made aware of the possible associated complications. Adequate bone regeneration was evident after surgery and no implant failed during 2 years of follow-up.[12]

One patient with an odontogenic fibromyxoma (patient 8) experienced recurrence at the first year of surgery. The recurrent lesion was removed, and implants were placed 3 years following the second surgery. Most patients underwent curettage or enucleation. Only 1 patient with a large dentigerous cyst underwent marsupialization and enucleation.[10] No bone fracture developed, even in patients with large mandibular lesions. A secondary infection was observed at 3 months after surgery in only 1 patient (patient 11) who had a reconstruction plate installed at the base of the mandible in order to to prevent possible mandibular fracture. Patient 4 complained of inferior alveolar nerve paresthesia. After prescription of neurogenerative vitamins, the paresthesia disappeared by week 5 postoperatively. A total of 41 implants were placed; none failed within the 2-year follow-ups. Two-stage implant surgery was performed on all patients. Figure 1, Figure 2 and Figure 3 show a patient (patient 1) with a large odontogenic

TABLE 1: Data of the patients, lesions and implants.

Patients	Gender	Age	Diagnosis	Management of the lesion	Location	Recurrence of the lesion	Number of implants	Failed implants
1	Male	35	Odontogenic fibromyxoma	Curettage	Mandible posterior	None	1	None
2	Female	43	Odontogenic fibromyxoma	Curettage	Mandible posterior	None	2	None
3	Female	16	Arterio-venous malformation	Curettage	Mandible posterior	None	3	None
4	Female	17	Dentigerous cyst	Marsupialization and enucleation	Mandible posterior and ramus	None	2	None
5	Female	40	Radicular cyst	Enucleation	Maxilla anterior	None	3	None
6	Female	45	Central giant cell granulma	Curettage	Mandible posterior	None	2	None
7	Male	63	Odontogenic keratocyst	Enucleation	Mandible posterior and ramus	None	2	None
8	Male	40	Odontogenic fibromyxoma	Curettage	Mandible posterior	None	3	None
9	Male	78	Keratocyst	Enucleation	Mandible posterior	None	3	None
10	Male	52	Radicular cyst	Enucleation	Maxilla anterior	None	1	None
11	Male	65	Odontogenic keratocyst	Enucleation	Mandible posterior	None	2	None
12	Female	29	Odontogenic keratocyst	Enucleation	Mandible posterior	None	2	None
13	Female	42	Odontogenic keratocyst	Enucleation	Mandible posterior	None	3	None
14	Male	46	Radicular cyst	Enucleation	Maxilla anterior	None	2	None
15	Female	15	Residuel cyst	Enucleation	Mandible posterior	None	2	None
16	Female	28	Odontogenic keratocyst	Enucleation	Mandible posterior	None	2	None
17	Female	52	Radicular cyst	Enucleation	Maxilla anterior	None	2	None
18	Male	22	Odontogenic keratocyst	Enucleation	Mandible anterior and posterior	None	4	None

FIGURE 1: Preoperative cone beam computed tomography of the patient which shows bone destruction of a large odontogenic fibromyxoma.

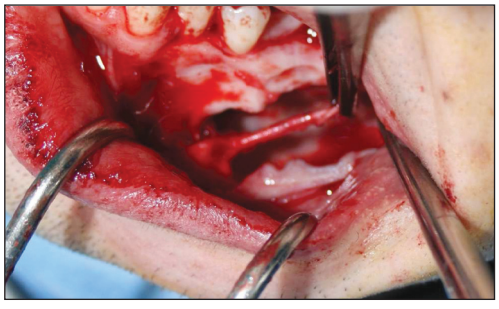

FIGURE 2: Intraoperative view of the remained defect and the inferior alveolar nerve.

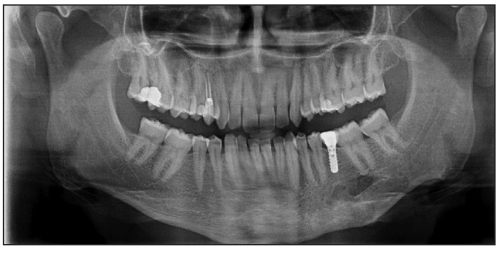

FIGURE 3: The panoramic radiograph which shows 2 years-follow up of the implant.

fibromyxoma in the mandible who received a dental implant at 2 years following the surgical curettage of the lesion. Figure 4 and Figure 5 show a patient (patient 3) with a large arterio-venous malformation in the mandible who received 3 dental implants at 2 years after surgical curettage. The patient underwent preoperative endovascular embolization before tooth extraction and implant placement. Figure 6, Figure 7 and Figure 8 show the patient (patient 6) who underwent surgical curettage of a central giant cell granuloma of the mandible. The patient received 2 implants

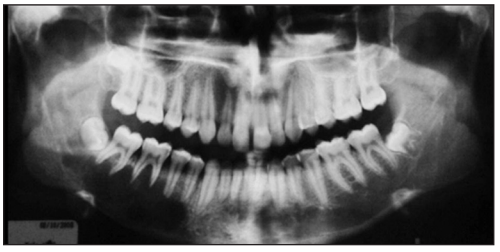

FIGURE 4: The preoperative panoramic radiograph which shows large radiolucent area of an arterio-venous malformation at the right posterior side of the mandible.

FIGURE 5: The panoramic radiograph which shows 2 years-follow -up of the 3 dental implants.

FIGURE 6: The radiographic view of the large central giant cell granüloma.

FIGURE 7: Intraoperative view of the remained defect and the surgicell applied to the defect.

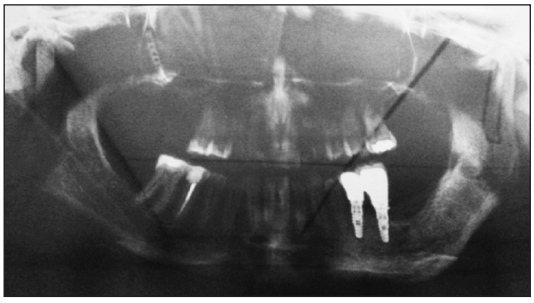

FIGURE 8: The radiographic view of the implants 2 years after the placement.

FIGURE 9: Intraoperative view of the large radicular cyst placed in the anterior maxilla.

FIGURE 10: Two years after 3 implant placement.

36 months after the curettage. Figure 9 and Figure 10 show the patient (patient 5) who underwent surgical enucleation of a radicular cyst of the maxilla.

DISCUSSION

This study evaluated the utility of dental implants placed in post-surgical defects that had healed physiologically without bone grafting procedures.

Many studies have mentioned grafting methods for the reconstruction of defects following the removal of large benign jaw lesions. Grafts have been recommended to reduce the risk of mandibular fracture as cyst removal might cause a big bone defect. Mitchell compared spontaneous healing of residual cystic defects to healing assisted, by the placement of a bovine-derived collagen paste. The study concluded that the paste in fact delayed bone healing.[13] Horowitz and Bodner used xenografts and autologous aspirated bone marrow for grafting 20 cystic jaw defects. Of 4 (20%) unsuccessful grafts, 2 were in the maxilla and the other 2 in the mandible. One excised cyst was of medium size and 3 were large scaled. The grafted areas developed signs of infection, and the grafts shifted their inital position. As a result, a further operation was necessary for removing infected graft and bone-healing was delayed.[14]

On the other hand, Chiapasco et al. studied 29 patients from whom large mandibular cysts had been surgically enucleated and following the follow up periods spontaneous bone regeneration occurred without need of any grafting procedures.[15] Chacko et al. reported similar results which demonstrated that the spontaneous bone regeneration was evident after the surgical removal of jaw cysts in the absence of grafting. Even in patients with very large cysts, no pathological fracture was reported, and even large cystic cavities were surrounded by bony walls following the healing period.[16] Ihan Hren and Miljavec evaluated spontaneous bone healing of large mandibular bony defects in 33 patients via computer-aided radiography. The mean final bone density in the defect areas was 88% of that surrounding healthy bone.[17] In this study a reconstruction plate was placed in order to reduce the possible risk of mandibular fracture, as grafting of the cyst cavity wasn't preferred in this study. Only 1 patient required a reconstruction plate. We also marsupialized prior to the enucleation of large lesions. Our results are consistent with those of similar studies; large cystic defects should be allowed to heal without grafting prior to implant insertion. It should be kept in mind that perioperative preservation of the periosteum and bony walls are vital to allow normal healing.[15-18]

An advantage of waiting for physiological healing (rather than grafting) is that follow-up radiographs do not feature graft artefacts.[18] Also, there are no costs associated with allogenic or alloplastic

graft materials. The use of autogenous bone grafts (alone or in combination with alloplastic materials) may trigger infection or resorption and increase postoperative morbidity and the surgical time. If an allogeneic graft or xenograft is placed, it might increase the postoperative healing period and such biomaterials should be avoided.[15,18]

Spontaneous bone healing after the removal of benign jaw lesions has been reported in many studies but implant placement after lesional removal has received little attention.[15-17,19] Only a few case reports have been published. In most of these, implants were inserted after bone grafting. Karamanis et al. reported a case of a large mandibular dentigerous cyst treated via enucleation followed by marsupialization. The defect site was grafted and at 12th month, an implant was placed.[11] Aoki et al. reported a maxillary dentigerous cyst treated via marsupialization. The post-surgical defect was grafted with autogenous bone and at 11th month postoperatively an implant was also placed.[20] Nilius et al. reported the multidisciplinary management of a multiple odontogenic keratocysts that were enucleated. The defect was contemporaneously augmented with an allograft. Four implants were inserted into the surgical sites.[21] AboulHosn et al. reported on a large radicular cyst in the mandible treated via decompression and enucleation with contemporaneous bony cavity filling using a cortico-cancellous particulate allograft. At 6th month postoperatively, 2 dental implants were inserted.[22] No study reported any implant-associated complications. Unlike these studies, we placed dental implants in post-surgical defects caused by the removal of large benign lesions in the absence of grafting. Only 1 patient with an odontogenic fibromyxoma experienced recurrence at 1 year after surgery. The recurrent lesion was re-curetted, and implants were placed at 3 years after the second surgery. No implants failed and no sign of infection was observed within the 2 years after placement.

Complete jaw ossification requires approximately 12 months after the enucleation of defects up to 3 cm in diameter. For larger defects, complete bone healing can be expected after 24 months.[18] In the present study, the lesions were 5 mm or more in diameter. Chiapasco et al. and Ihan Hren and Miljavec reported near-complete healing of such defects at 24 months after surgery.[15,17] However, if the lesions may recur (odontogenic keratocysts or odontogenic fibromyxomas), implants should not be placed earlier than at 36 months after surgery. Although most odontogenic keratocyst recurrences develop within 5-7 years after the initial surgery, recurrence even after 40 years has been reported.[23] Long-term annual follow-up should be scheduled after implant placement.

Most lesions in the present study were localized at the posterior mandible. After surgical removal and extraction of the associated teeth; one possible treatment option is to apply partial dentures. However, patients complaint of the mobility of the abutment teeth, plaque retention, taste problem, speech difficulties and instability of the prosthesis during biting.[24] Dental implants are thus preferred.

The success of the implants in the present study is explained by the close follow-up and awareness of the possible risk of the recurrence associated with the lesions.[15] Dental implants inserted into pre-existing natural bone have long lifetimes.[11] Any jaw pathology evident prior to implant placement indicates that the possibility of implant infection must be considered. Routine postoperative follow-up featured panoramic radiography, which may assess cortical bone healing only imprecisely; CT is better in this regard but exposes the patient to more radiation.[15] We preferred to use CT to evaluate only the patients with the lesions associated with high recurrence rates such as odontogenic keratocysts, odontogenic fibromyxomas, central giant cell granuloma and arterio-venous malformations.[16] We founded buccal perforations in seven patients but a lingual perforation was observed in only 1 patient with an odontogenic fibromyxoma (patient 1). It is important to radiologically distinguish a healed, lingually perforated area from a recurrence during follow-up and before implant placement.

CONCLUSION

Dental implants can be safely used to repair post-surgical defects that have healed physiologically. As a primary option it can be considered to wait before placing dental implants instead of grafting the post surgical defects.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Sırmahan Çakarer, Erol Cansız, Başak Keskin Yalçın, Metin Berk Kasapoğlu;* ***Design:*** *Sırmahan Çakarer, Erol Cansız, Başak Keskin Yalçın, Metin Berk Kasapoğlu;* ***Control/Supervision:*** *Erol Cansız, Sırmahan Çakarer;* ***Data Collection and/or Processing:*** *Başak Keskin Yalçın, Metin Berk Kasapoğlu;* ***Analysis and/or Interpretation:*** *Sırmahan Çakarer, Erol Cansız, Başak Keskin Yalçın, Metin Berk Kasapoğlu;* ***Literature Review:*** *Metin Berk Kasapoğlu, Başak Keskin Yalçın;* ***Writing the Article:*** *Sırmahan Çakarer, Erol Cansız, Başak Keskin Yalçın, Metin Berk Kasapoğlu;* ***Critical Review:*** *Sırmahan Çakarer, Erol Cansız;* ***References and Fundings:*** *Erol Cansız, Sırmahan Çakarer;* ***Materials:*** *Sırmahan Çakarer, Erol Cansız, Başak Keskin Yalçın, Metin Berk Kasapoğlu.*

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