Bilateral Simultaneous Sinus and Nasal Floor Augmentation in Severe Atrophic Maxilla: a Case Report

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Abstract

Introduction: One of the most challenging cases in implantology is severely atrophic alveolar ridges which do not have adequate bone for implant placement. One common treatment option for dealing with this challenge is LeFort I osteotomy with inlay bone graft which allows implant insertion and correction of the maxillomandibular relationship simultaneously. Although this method has a high success rate, it is somewhat invasive and has potential complications in some cases. In recent decades, implant surgeons have focused on less invasive and more predictable treatment options for bone augmentation and implant rehabilitation. Now a question comes into mind when there are not much discrepancies in maxillomandibular skeletal relationship and inter arch distance, do we really need LeFort I down-grafting and take its risks? **Methods:** In this study, we present a case who did not need any change in the skeletal relationship of the jaws and inter arch space based on examination and prosthetic consultation, so we implemented bilateral simultaneous sinus and nasal floor augmentation instead of LeFort 1 interpositional inlay bone graft. **Results:** Six months after the surgery, new radiography showed adequate height and width of augmented bones gained in and under sinuses and nose floor. So there is no limitation on choosing suitable implant lengths and diameters. **Conclusion:** This study indicated successful augmentation of severely resorbed maxillary alveolar ridge with bilateral sinus and nose floor grafting technique instead of LeFort I interpositional bone graft in a case who didn't have more discrepancies in skeletal and inter arch space.

Keywords: Bone Augmentation, Sinus Lift, Nasal Floor, Atrophic Maxilla, Implant.

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Introduction

One of the most challenging cases in implantology is severely atrophic alveolar ridges which don't have adequate bony height and width for implant placement (1-4).

Being edentulous causes progressive bony resorption of the maxilla and sinus pneumatization which can lead to altered maxillomandibular vertical and anteroposterior relationship and no enough bone under the nose and sinuses. In these cases, a sufficient recipient site needs to be prepared by augmentation procedures prior to implant placement(5-6).

One common treatment option for dealing with this challenge is LeFort I osteotomy with inlay bone graft which allows implant insertion and correction of the maxillomandibular relationship simultaneously and also provides desirable esthetic outcomes. Although this technique has a satisfactory success rate, it has some disadvantages such as: insufficient flap integrity, prolonged operating time, the requirement of graft handling and shaping, insufficient graft stability ending in severe resorption, needs oversized grafts from an extraoral donor site, complications of rigid internal fixation, fracture of other parts of the maxilla during down-fracture, canting, infection, nonunion, oro-antral fistula, late skeletal relapse and etc. should be considered for this procedure (7-10).

On the other hand, maxillary sinus floor lift and augmentation has become a very popular procedure with predictable results in the last decades (11). Sinus floor augmentation procedures are generally carried out using autogenous bone graft, bone substitutes, or a combination of both. (12) And also, it has been shown that nasal floor augmentation, introduced by Garg for implant placement in premaxilla region(13), has a success rate comparable to maxillary sinus lifting, or even more due to bicortical supported primary stability of implants (14,15)**.**

In this case report, our patient showed almost a class 1 maxillomandibular relationship and acceptable interarch distance despite the severe resorption of the whole maxilla and posterior regions of the mandible. Thus, we decided to choose bilateral sinus and nasal floor augmentation procedure using autograft and xenograft instead of LeFort 1 interpositional graft.

We hope this technique will enable implant surgeons to create enough maxillary alveolar bone for implant installation in indicated cases and to be considered as an alternative method easier and less invasive than LeFort I down-grafting.

Case presentation

A 37 year old man who was fully edentulous due to a periodontal problem with an unremarkable medical history was referred to the Taleghani hospital for maxillomandibular rehabilitation. He was concerned about establishing a more aesthetic appearance. Preoperative panoramic and Cone Beam Computed Tomography (CBCT) were taken to evaluate the bone volume of the residual ridges. Panoramic X-ray showed severe bone resorption of the whole maxilla and posterior regions of the mandible. (Fig.1) The height of the alveolar ridge in those areas was so low that it was not possible to place implant. CBCT confirmed the findings of the OPG, and in addition to that, showed the width of the bone of the premaxilla isn't sufficient, but despite the highly pneumatized sinuses, the width of the posterior alveolar ridges of the maxilla was enough. (Fig.2) Preoperative mandibular CBCT showed no adequate posterior alveolar ridges height but symphysis is the only area that has enough bone height and width. (Fig. 3)

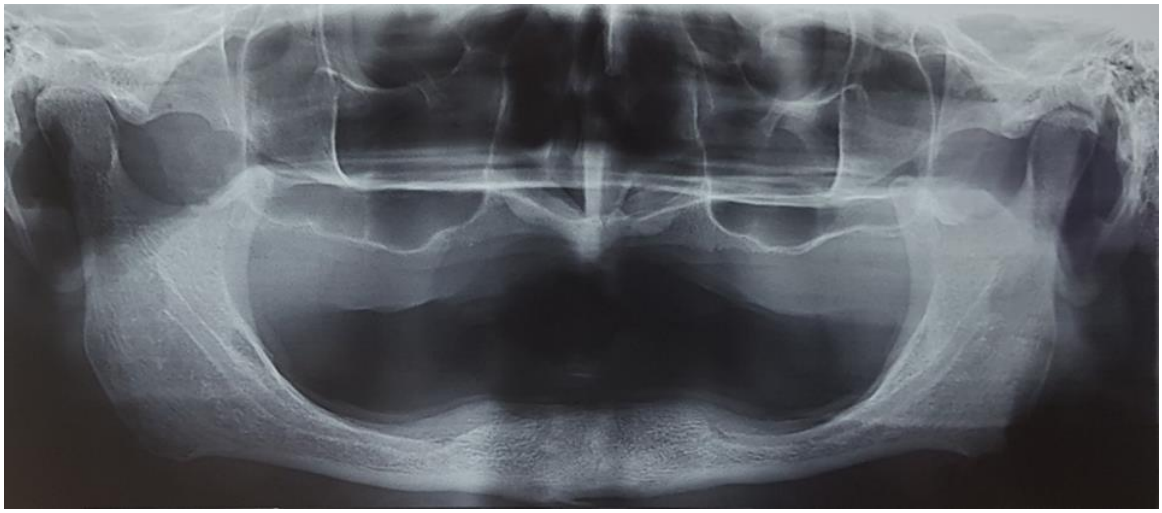

Fig. 1: Preoperative panoramic shows severe bone resorption of the whole maxilla and posterior regions of the mandible

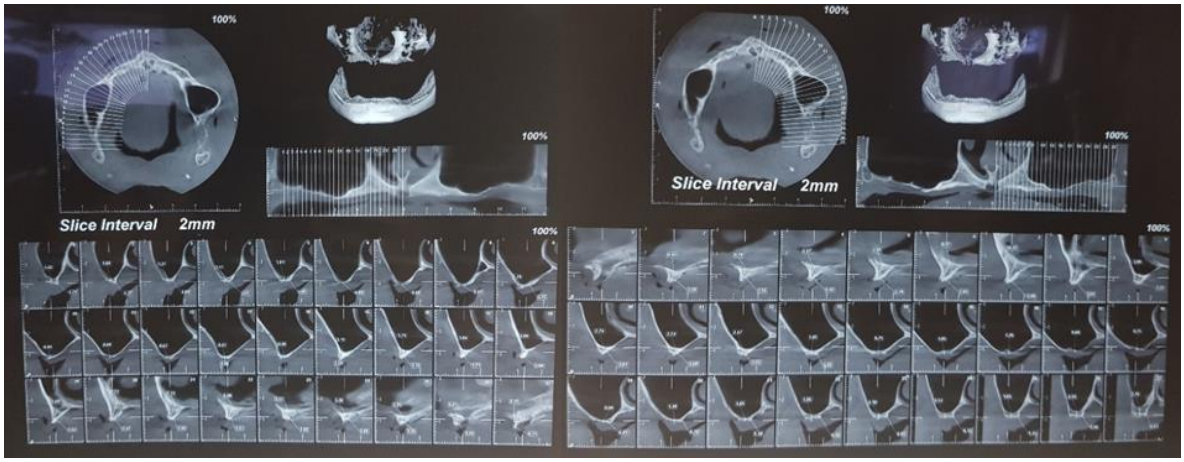

Fig. 2 Preoperative CBCT, panoramic view (upper rights panels) reveal severely resorbed anterior and posterior maxillary bone (Right& Left), axial view (upper lefts panels) show two highly pneumatized sinuses and narrow

premaxilla, sagittal views (lower panels) present inadequate vertical bone under nose and sinuses, insufficient width of premaxilla for implant installation. But the width of posterior maxillary bone is enough bilaterally.

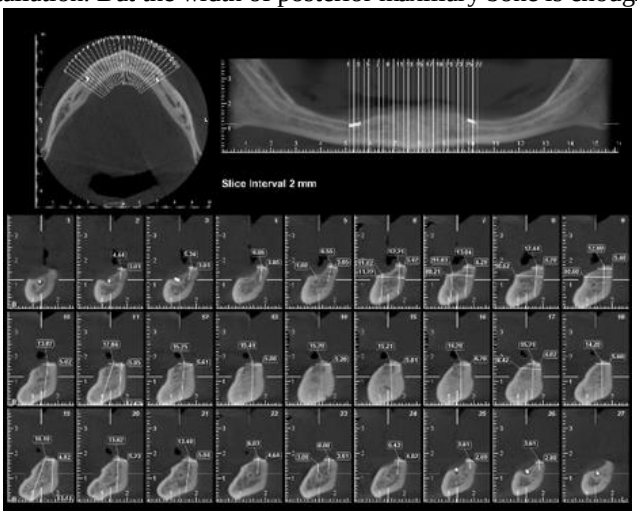

Fig. 3 Preoperative CBCT of the mandible shows severe vertical bone resorption of the posterior alveolar ridges but adequate bone height and width of the symphysis.

As part of teamwork and finalizing a treatment plan, the patient was visited by a prosthodontist to evaluate inter arch space and anteroposterior relationship of the jaws. Upon examination, he didn't request a change in the skeletal relationship of the jaws and inter arch space. Therefore, the final treatment plan was as follows: bilateral sinus and nasal floor augmentation instead of LeFort I down-grafting, lateral augmentation of the premaxilla, implant supported fixed prostheses of both jaws. The patient became fully aware of the treatment plan and signed the consent form for surgery and publication of the case report and his images.

Under general anesthesia, the surgical procedures were performed as follows: (1) the mouth was rinsed with povidone iodine (Iran Najo, Iran) (2) after performing a horizontal incision from tuberosity to tuberosity (1-2 mm palatal to the alveolar crest), a full-thickness buccal flap was reflected from the crestal side coronally enough to see the nasal floor, ANS, lateral piriforms and lateral aspects of the buccal alveolus (4-6 mm beyond the upper portion of the bony window outline) (3) in order to increase the width of the premaxilla, two bone blocks were harvested from left ramus of the patient (autogenous onlay bone grafts), shaped and fixed with 2 micro screws (4)**.** The nasal mucosa was then carefully elevated enough in anterior part of the nasal floor to allow placement of the bone grafts. Two bone blocks harvested from the right lateral ramus (autograft), shaped and placed on the nasal floor (each nose) and fixed in place using a wire (0-4 stainless steel) that went beyond the graft and ran around the premaxilla (circum-premaxilla wiring). These wires inevitably crossed over the onlay bone grafts of the premaxilla and somehow strengthened their fixation (5)**.** Bilateral windows outlines (2x1 cm) were prepared in lateral walls of sinus with high-speed handpiece and diamond round bur with copious saline irrigation (Island technique) to perform maxillary sinus lift. After completing the windows osteotomies and infracture of the bony islands, schneiderian membrane was carefully elevated in all directions to the desired amount especially upward and backward for implant placement. A mixture of autograft (cancellous bone harvested from anterior iliac crest as an osteo-inductive material) and xenograft (Botiss cerabone, Straumann, Switzerland) (approximately 70:30) was used for sinus floor augmentation. Two collagen membranes (2x2 cm) (Cenomembrane, Kish tissue regeneration, Iran), were placed over the windows to cover the graft materials (6)**.** Wounds were sutured normally with absorbable Vicryl 4-0 (Ethicon, Johnson & Johnson, NJ). The patient stayed in the hospital for two nights and got antibiotics: Cefazolin 1gr every 6h (Afa chimi, Iran) and analgesic-anti-inflammatory: Dexamethasone 8mg every 8h (Iran hormone, Iran) through IV line. After discharge from the hospital, Cefalexin 500 mg every 6h (Mahban darou, Iran) to prevent infection and Novafen (Acetaminophen 325 mg, caffeine 40 mg, Ibuprofen 200 mg—Alhavi, Iran) for relieving pain were prescribed for 7 days. During the preliminary healing period, the patient was advised to rinse his mouth two times a day with chlorhexidine 0.12% (IranNajo, Iran) for two weeks.

Six months after the first surgery, a new CBCT radiograph was taken to evaluate the augmented bones and their dimensions and also precise positioning of implants in specified areas. (Fig.4) Postoperative CBCT showed adequate height and width of augmented bones gained in and under sinuses and nasal floor. So there is

no limitation on choosing suitable implant lengths and diameters.

The patient was prepared for implant surgery. Based on CBCT sizes, the length and diameter of implants were selected. Mouth was rinsed with 0.12% chlorhexidine mouthwash (Iran Najo, Iran). After local anesthesia with 2% lidocaine with epinephrine 1:80,000 (Persocaine-E, Darou-Paksh, Iran), a standard full-thickness flap of both jaws were reflected and 13 SPI tissue level implants (Element) (Thommen Medical, Switzerland) were placed after standard drilling with copious saline irrigation including eight implants in the maxilla and five implants between mental foramina of the mandible. (Figure 5) The implant surgery was a single-stage one, so healing abutments tightened onto the implants at the same time. Wounds were sutured normally with absorbable Vicryl 4-0 (Ethicon, Johnson & Johnson, NJ). Post-surgical instruction was similar to the first surgery. Post implant panoramic radiograph was taken to assess the position of the implants.

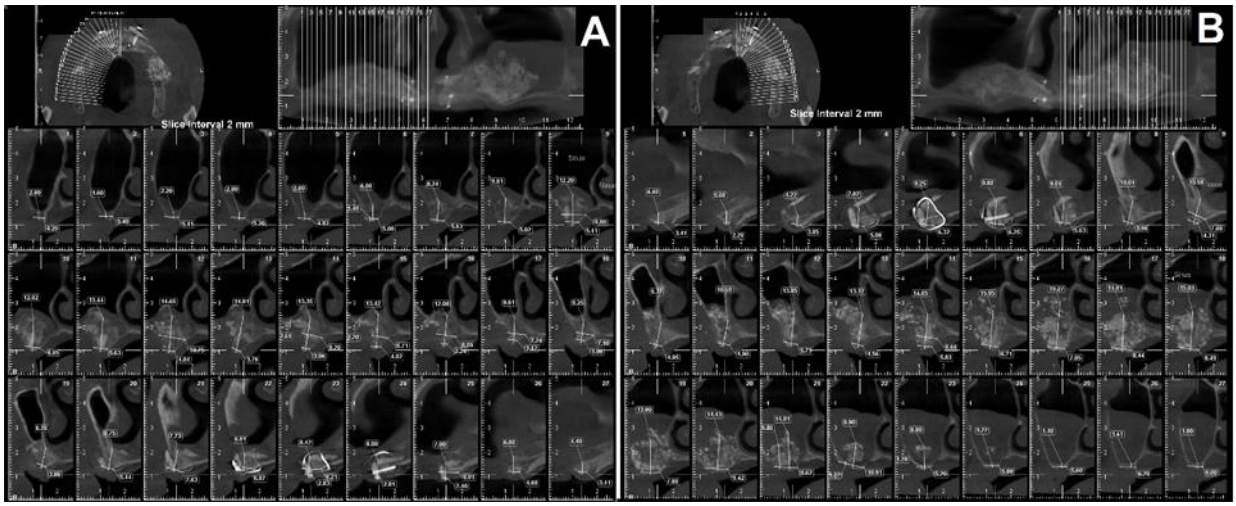

Fig. 4 Six months CBCT shows adequate height and width of anterior and posterior maxillary bone (augmented and native alveolar bones totally) for implant placement. (a) Right side of maxilla (b) Left side of maxilla.

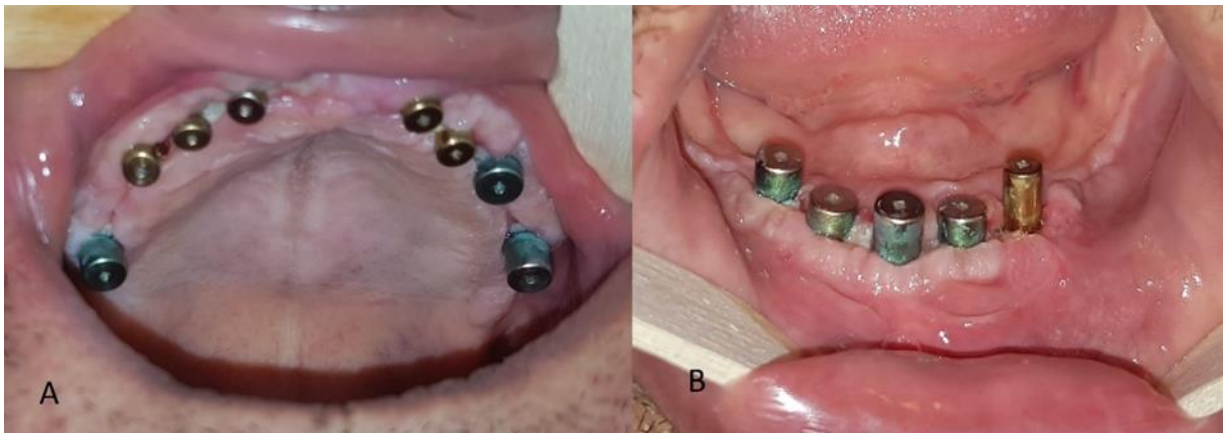

Fig. 5 Post implant intra-oral photographs. (a) Maxilla (b) Mandible

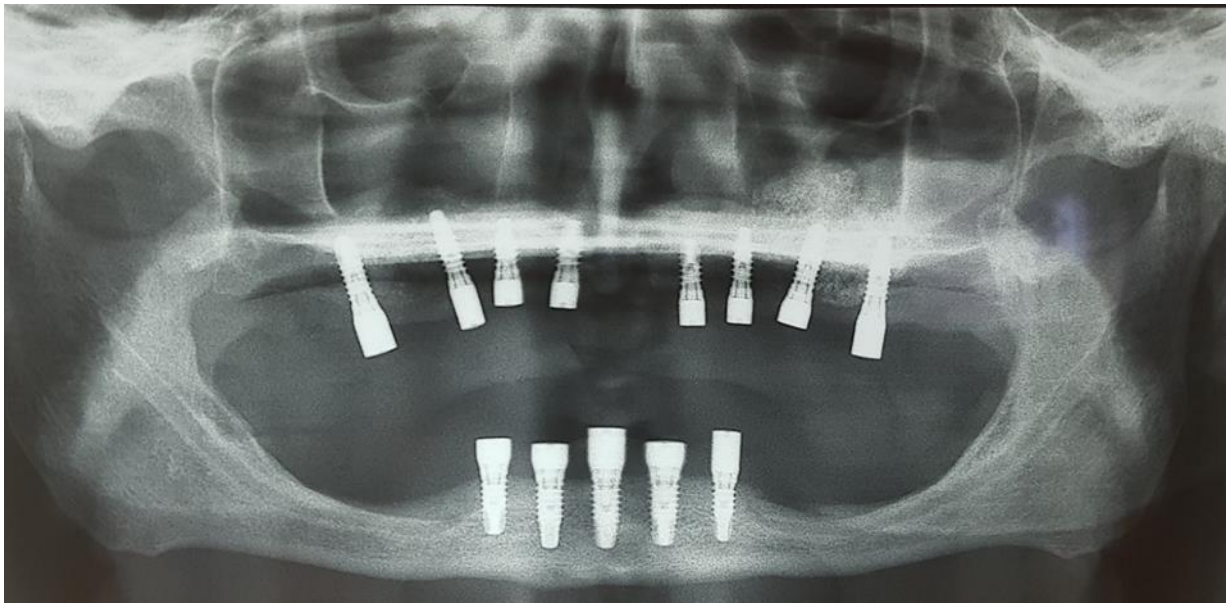

Fig. 6 Post implant panoramic radiograph shows implants of upper and lower jaws in place

Discussion

Implant rehabilitation of severely atrophic maxilla has always been a complex task for implant surgeons and dentists. Poor quality and quantity of the available bone challenges the essential condition for successful implant placement (8, 11,16).

The common option available for the implant surgeons to correct severely resorbed maxilla with excessive inter arch space and class III skeletal relationship is Lefort I interpositional graft.

The Le Fort I maxillary osteotomy with interpositional bone graft, also known as the maxillary down-grafting procedure, allows simultaneous skeletal correction and bony augmentation by means of forwards and/or downward repositioning of the maxilla with inlay bone graft that provides good bone support for implant placement (16).

However there are some difficulties regarding the maxillary down-grafting procedure. Maxillary fracture due to weakness of residual bone is a major concern. Maxillary fracture during osteotomy may result in problems with fixation and hence in healing after the surgery. Thus special attention should be paid when maxillary bone is extremely resorbed and the strength of its bone has been reduced (17).

Internal rigid fixation is part of the maxillary down-grafting procedure. Possible complications of internal rigid fixation systems include infection, nonunion, palpable or painful hardware, and the often under-recognized issue of misalignment of the fracture fragments during reduction, indications for hardware removal include palpability as the main reason, followed by pain, loosening of plate/screw, and wound dehiscence /exposure of plates (18,19).

Late skeletal relapse, inadequate flap integrity, prolonged surgery due to harvesting an interpositional bone graft from an extraoral donor site, shaping, placing in the bony gap and fixing and need for general anesthesia and hospitalization and etc. are other potential disadvantages of this technique (10).

In recent decades, more implant surgeons have focused on less invasive and more predictable treatment options for bone augmentation and implant rehabilitation cases including severely resorbed maxilla. Now a question comes into the mind when there is not much discrepancies in maxillomandibular skeletal relationship and inter arch distance, do we really need to perform LeFort I downgrafting and take its risks?

On the other hand, it has been reported in several studies that sinus and nasal floor augmentation have predictable results and less complications (11, 14, 15), so they can be a good alternative for LeFort I interpositional graft (10, 20).

In comparison with LeFort I down-grafting, some advantages of these methods are as follows: *(1)* shorter operating time and easier surgery *(2)* no need for rigid internal fixation, and consequently not facing with its complications like nonunion, infection, misalignment of the osteotomized maxilla, indications for hardware removal, and so on *(3)* no need for oversized inlay bone blocks which are usually harvested from an extraoral donor site, so the probability of morbidity would be less *(4)* can be done using only bone substitutes but in cases

of autogenous bone graft interests as a part of bone augmentation procedure, oral sources usually are adequate *(5)* can be done under local anesthesia so hospitalization is not required for all cases. In this way, the patient's costs may be less (9, 21, 22)**.**

But along with the benefits of these methods, it deserves to mention some of their disadvantages that are not too very worrying. Perforation of the Schneiderian membrane is the most common operative complication during sinus floor augmentation, and its incidence varies between 20% and 44% during the lateral window approach (23)**.** But articles review results show the total survival rate of the implants into the sinus cavity has been 95.6% (24)**.** Other complications that are rare which include inflammation, suture dehiscence, fistulas, sinusitis, epistaxis, and infection of the graft material (25-27). Nasal lifting can also be simply done at the office. Possible complications are bleeding, hematoma, infection, and rhinitis. Because nasal mucosa is thicker and has more resistance in comparison with Schneiderian membrane, its rupture is less mentioned in the articles. Even if it happens, repairing it is easier than sinus membrane perforation (10, 21)**.**

So, it can be said in total that the possible complications of the advanced sinus and nasal floor augmentation are less severe and easier to handle than LeFort I down-grafting.

Conclusion

In patients who need bone augmentation to obtain adequate height and width of residual atrophic ridge for inserting implants, where the maxilla has been compromised by low sinuses and nasal floor but the discrepancy in maxillomandibular anteroposterior relationship and inter arch space are not so high that needs to be corrected by forward and/or downward moving of the osteotomized maxilla, advance bilateral maxillary sinus and nasal floor lifting might be a useful alternative pre-prosthetic surgical technique with less complications than LeFort I down-grafting in oral rehabilitation.

Conflict of interests

All authors declare that they have no competing interest.

Acknowledgements

None

References

1. Kao, S.-Y., et al., Reconstruction of the Severely Resorbed Atrophic Edentulous Ridge of the Maxilla and Mandible for Implant Rehabilitation: Report of a Case. J Oral Implantol. 2002;28(3): 128-132.

2. Kao, S.Y., et al., Lateral trap-door window approach with maxillary sinus membrane lifting for dental implant placement in atrophied edentulous alveolar ridge. J Chin Med Assoc. 2015; 78(2): 85-88.

3. Keller, E.E., D.E. Tolman, and S. Eckert, Surgical-prosthodontic reconstruction of advanced maxillary bone compromise with autogenous onlay block bone grafts and osseointegrated endosseous implants: a 12-year study of 32 consecutive patients. Int J Oral Maxillofac Implants. 1999;14(2): 197-209.

4. Kao, S.-Y., et al., Transpositioned Flap Vestibuloplasty Combined with Implant Surgery in the Severely Resorbed Atrophic Edentulous Ridge. J Oral Implantol. 2002;28(4):194-199.

5. Samieirad, S., Soofizadeh, R., Shokouhifar, A., Mianbandi, V. A Two-step Method for the Preparation of Implant Recipient Site in Severe Atrophic Maxilla: A Case Report of the Alveolar Ridge Split Technique Followed by Bone Expansion. J Dent Mater Tech. 2019; 8(2): 59-64.

6. Samieirad, S., Eshghpour, M., Tohidi, E., Jouya, A., Soufizadeh, R., Kermani, H. Using Absorbable Gelatin Sponge to Facilitate Sinus Membrane Elevation during Open Sinus Lift: Technical Notes and Case Series. J Dent Mater Tech. 2019; 8(1): 1-7.

7. Pingarron-Martin, L., et al., Le fort I osteotomy with bone grafts in preprosthetic surgery: technical note. Craniomaxillofacial trauma & reconstruction. Craniomaxillofac Trauma Reconstr. 2013;6(2): 143-146.

8. Terheyden, H., A new technique of Le Fort I interpositional grafting for dental implants. Int J Oral Surg. 2017;46: 53-54.

9. Posnick, J.C. and A. Sami, Use of allogenic (iliac) corticocancellous graft for Le Fort I interpositional defects: technique and results. J Oral Maxillofac Surg. 2015;73(1): 168.e1-12.

10. Lorean, A., et al., Nasal floor elevation combined with dental implant placement: a long-term report of up to 86 months. Int J Oral Maxillofac Implants. 2014;29(3): 705-708.

11. Romero-Millan, J.J., et al., Implants in the Posterior Maxilla: Open Sinus Lift Versus Conventional Implant Placement. A Systematic Review. Int J Oral Maxillofac Implants. 2019;34(4):e65-e76

12. Deshmukh, A., et al., Bilateral maxillary sinus floor augmentation with tissue-engineered autologous osteoblasts and demineralized freeze-dried bone. Contemp Clin Dent. 2015; 6(2): 243-246.

13. Garg, A.K., Nasal sinus lift: an innovative technique for implant insertions. Dent Implantol Update. 1997; 8(7): 49-53.

14. Garcia-Denche, J.T., et al., Nasal Floor Elevation for Implant Treatment in the Atrophic Premaxilla: A Within-Patient Comparative Study. Clin Implant Dent Relat Res. 2015; 17 Suppl 2: e520-530.

15. Mazor, Z., et al., Nasal floor elevation combined with dental implant placement. Clin Implant Dent Relat Res. 2012;14(5): 768-771.

16. Varol, A., et al., Implant Rehabilitation for Extremely Atrophic Maxillae (Cawood Type VI) with Le Fort I Downgrafting and Autogenous Iliac Block Grafts: A 4-year Follow-up Study. Int J Oral Maxillofac Implants. 2016;31(6): 1415-1422.

17. Eshghpour, M., V. Mianbandi, and S. Samieirad, Intra- and Postoperative Complications of Le Fort I Maxillary Osteotomy. J Craniofac Surg. 2018;29(8): e797-e803.

18. Orringer, J.S., V. Barcelona, and S.R. Buchman, Reasons for removal of rigid internal fixation devices in craniofacial surgery. J Craniofac Surg. 1998; 9(1): 40-44.

19. Campbell, C.A. and K.Y. Lin, Complications of rigid internal fixation. Craniomaxillofac Trauma Reconstr. 2009; 2(1): 41-47.

20. Camargo, I.B., et al., The nasal lift technique for augmentation of the maxillary ridge: technical note. Br J Oral Maxillofac Surg. 2015;53(8): 771-774.

21. El-Ghareeb, M., et al., Nasal floor augmentation for the reconstruction of the atrophic maxilla: A case series. J Oral Maxillofac Surg. 2012; 70(3): e235-e241.

22. Yan, M., et al., Transalveolar sinus floor lift without bone grafting in atrophic maxilla: A meta-analysis. Sci Rep. 2018; 8(1): 1451.

23. Zijderveld, S.A., et al., Anatomical and surgical findings and complications in 100 consecutive maxillary sinus floor elevation procedures. J Oral Maxillofac Surg. 2008. 66(7): 1426-1438.

24. Ragucci, G.M., et al., Influence of exposing dental implants into the sinus cavity on survival and complications rate: a systematic review. Int J Implant Dent. 2019. 5(1):.1-9.

25. Smedberg, J.I., et al., Implants and sinus-inlay graft in a 1-stage procedure in severely atrophied maxillae: prosthodontic aspects in a 3-year follow-up study. Int J Oral Maxillofac Implants. 2001. 16(5): 668-674.

26. Huynh-Ba, G., et al., Implant failure predictors in the posterior maxilla: a retrospective study of 273 consecutive implants. J Periodontol. 2008. 79(12): 2256-2261.

27. Pieri, F., et al., Immediate fixed implant rehabilitation of the atrophic edentulous maxilla after bilateral sinus floor augmentation: a 12-month pilot study. Clin Implant Dent Relat Res. 2012. 14 Suppl 1: e67-82.

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