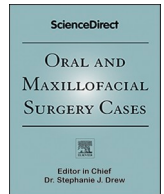




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Case Report

A single overturning of ridge for horizontal bone augmentation in maxilla with immediate implant placement: 18-Years follow-up

Mauro Libertucci^a, Saverio Cosola^{b,*}, Ugo Covani^b^a Private Practitioner in Tivoli (Rome), 0019, Italy^b Department of Stomatology, Tuscan Stomatologic Institute, Foundation for Dental Clinic, Research and Continuing Education, 55042, Forte Dei Marmi, Italy

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ABSTRACT

After tooth extraction, a remodelling process of the edentulous bone begins, and reconstructive procedure may be needed to perform an implant placement with fixed prosthetic rehabilitation.

There are several methods available to augment the atrophic ridge in horizontal or vertical direction, including autologous onlay bone grafting, sinus/nasal lift, distraction osteogenesis, split crest technique.

In 1997, some authors reported that in an animal model, the cortical perforations of the autologous graft and positioning the graft orientated with the cortical portion towards the recipient site could have.

Following these observations, a surgical case of a Single Overturning of Ridge (SOoR) for horizontal bone augmentation in maxilla with immediate implant placement was performed in 2002 and after a long follow-up, the bone volume is maintenance, and the success of the implant-prosthetic rehabilitation are shown in this case report.

1. Introduction

After tooth extraction, a remodelling process of the edentulous bone begins due to the healing of the soft tissue, the lack of function and the blood supply of the missing tooth [1].

Bone loss extends across the alveolar socket, in both vertical and horizontal directions, mostly buccally, bringing about a tridimensional resorption, as described by several respected scientific studies in literatures [2].

This process is most evident during the first year and continues for a lifetime; as a result, the atrophic residual ridge may be too palatal, making the positioning of future implant-prosthetic rehabilitation more difficult.

Several techniques are used to reduce bone resorption, especially in the first year: mini-invasive surgery that preserves the bone walls during the extraction; sutures or collagen and membrane; or immediate implant placement [3].

Socket preservation may be not sufficient and, especially if a site has been edentulous for many years, bone reconstruction techniques are needed.

There are several methods available to augment the atrophic ridge, including autologous onlay bone grafting, sinus/nasal lift, distraction osteogenesis, guided bone regeneration, split crest technique and interpositional grafting [4].

Autologous bone grafts can be classified into two main categories: treatment of bone gaps (inlay) and bone projection (onlay). They

* Corresponding author.

E-mail address: s.cosola@hotmail.it (S. Cosola).

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have several biological advantages in terms of osteoconductive, osteoinductive, and osteogenic proprieties. They may be necessary in larger bone defects in particular and are considered immunologically inert [5].

The osteogenetic potential of the periosteum of autogeneic bone grafts has been studied in literature and the orientation of host-graft bone marrow has been reported to be one of the most important factors that can influence the incorporation and the volumetric maintenance of graft size.

In 1997, Gordh M. and co-workers reported that in an animal model (Lewis rats), the cortical perforations of the graft induced a migration of the recipient bone marrow into it; in addition, better results in terms of volume persistency were observed if the graft cortical bone was orientated with the cortical portion towards the site of the perforated cortical recipient [6].

Following these observations, a surgical case of a Single Overturning of Ridge (SOoR) for horizontal bone augmentation in maxilla with immediate implant placement was performed in 2002 with a 18-year follow-up.

Positioning an autogenous bone graft orientated taking into account these indications may be clinically useful to improve the long-term success of implant placement after bone reconstruction in different conditions.

2. Case presentation

The patient aged 45-year-old, male, smoker, in June 2002, requested the masticatory, phonetic and aesthetic restoration of the edentulism in area 14 (Fig. 1a). The extraoral examination did not reveal any facial asymmetry, but the intraoral examination showed the vestibular deficiency due to the volumetric bone-loss in the edentulous area with a decrease in the bucco-lingual space between element 13 and 15. The mesio-distal distance between 13 and 15 was of 11mm and the bucco-lingual space was of 4mm. The patient had no systemic disease or other contraindication to rehabilitate the edentulous site by dental implants and fixed prosthetic rehabilitation. Plus having no urgency, a pre-prosthetic orthodontic treatment was opted to restore an adequate mesio-distal space between 13 and 15, followed by an implant insertion and contextual horizontal reconstruction of the bone crest.

In the surgical procedure, the segmentation of the vestibular cortex was carried out with two vestibular cuts and a crestal cut of 5 mm, following the implant placement (Fig. 1b,c). The next step consisted in the fracture of the bone portion isolated from the cuts with an elevator in the palate-buccal direction (Fig. 1d). After these procedures, the fractured fragment was stored in physiological solution at a temperature of 281 K (8 C°) to prevent its deterioration during implant placement. The primary stability of the implant (13 mm × 3.5 mm) was achieved by performing an osteotomy 5 mm longer than the previously fractured bone fragment. After the implant placement, the bone portion was repositioned. It could not be repositioned according to its natural cortico-medullar orientation (Fig. 1e). In line with the studies published in the late nineties highlighted in the present article, the morphology of the bone fragment was overturned in the cortico-medullar direction to improve its adaptation with the convexity of the implant surface (Fig. 1f). After a small reduction of the cortical portion of the bone fragment, carried out with a tungsten carbide round bur mounted on a surgical micromotor cooled with physiological solution, a single overturning of the bone fragment was performed, obtaining a perfect adaptation of the fragment on the implant. (Fig. 2a). For these reasons, the name of the technique is SOoR (Single Overturning of Ridge).

No mechanical fixing, such as metal synthesis pins or similar, was used for the stabilization of the bone fragment, which was obtained, by suturing the overlying flaps with detached silk stitches, taking care to correctly tense the suture itself.

Antibiotic therapy was prescribed (Bacampicillin 1200mg) every 12 hours for 6 days and Ketoprofen 80mg to be taken in case of pain. Patient was instructed to avoid smoking for 24 hours. The removal of the sutures took place after 10 days. At second stage surgery, after 5 months, it was possible to notice the restoration of the vestibular portion of the crest which is now straight between elements 15 and 13 and no longer convex (Fig. 2b) and the perfect osseointegration of the implant in radiography. The bucco-lingual space was 7mm. After the realization of the fixed prosthesis in the laboratory, composed of a gold structure on a UCLA abutment and a

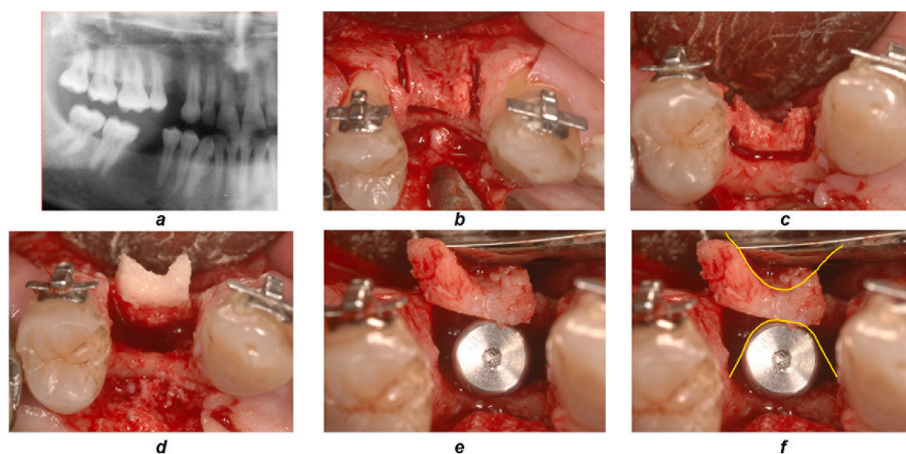


Fig. 1. a, orthopantomography at baseline; b, vestibular view of vestibular cut by piezo-surgery; c, occlusal view of vestibular cut by piezo-surgery; d, fracture of vestibular bone; e, positioning the fractured bone fragment in the same position as it was is impossible after implant placement; f, the morphology of the opposite site of fractured bone seems adapt to the implant site.

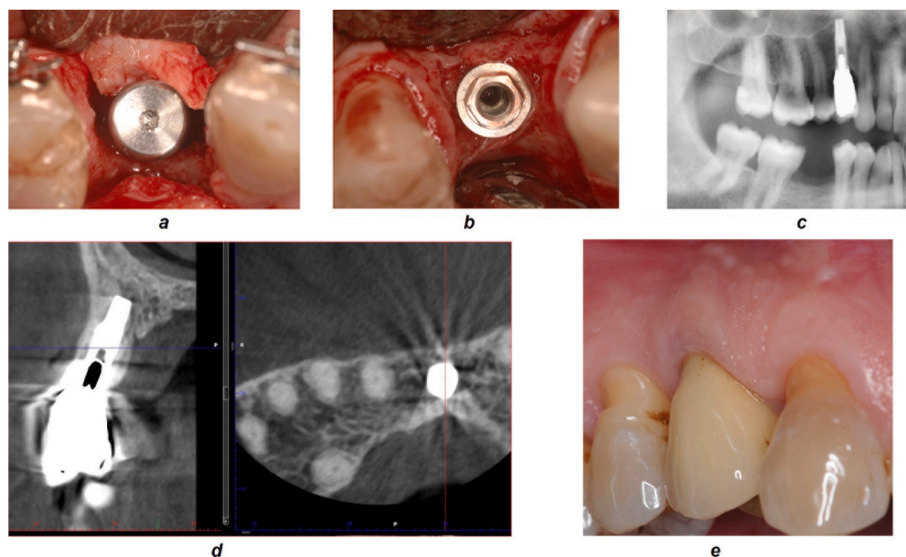


Fig. 2. a, the overturning of the fractured bone with cortical site versus the implant site and bone marrow positioned on the vestibular site; b, occlusal view of implant site after 5 months from the surgical bone augmentation and immediate implant placement; c, orthopantomography after 18-years of follow-up with implant showing no sign of marginal bone loss; d, CBCT after 18-years of follow-up with implant site showing no sign of vestibular neither palatal bone resorption; e, Intra-oral photo of prosthetic rehabilitation after 18-years of follow-up, the peri-implant probing depth is of 1 mm, no changes from baseline.

metal-ceramic crown, the prosthesis was fixed to the implant with a gold-coated titanium screw (Gold Tite screw) while the crown was fixed to the mesostructure with cement based on zinc oxide, octanoic acid and ethoxybenzoic acid. Over the years, clinical and radiological checks have all been performed with positive results. The radiographic images of orthopantomography and CBCT were performed in 2020, after 18 years of follow-up, demonstrating that the biological concepts underlying this technique are worthy of further study by the scientific community (Fig. 2c,d). Intraoral image after 18 years also shows the soft tissues in perfect health with no volume deficiency (Fig. 2e).

3. Discussion

Autogenous bone grafts are still commonly used in oral and maxillo-facial surgery in deep bone defects. This surgical case shows a particular technique to orientate the bone graft to improve the volumetric results of the treatment. In addition, the long clinical and radiological follow-up period of this case confirms the high performance of the surgical technique and the good quality of the neo-formed bone.

In the literature, there is still a debate about which orientation of the autologous bone graft produces the best volume maintenance.

Some studies have reported that if the recipient cortical bed is perforated there are no advantages over a non-perforated bed regarding the healing and integration of an autologous bone graft [7]. However, if the cortical perforations of the graft are combined with the host bed perforation, the incorporation of the bone graft is locally and mechanically stable [8].

Onlay bone grafts are usually used to increase horizontal and/or vertical ridge volume defects of bone augmentation required for implant placement. The autogenous bone graft is taken from intraoral donor sites, such as the symphysis and ramus of the mandible. In this case report, the donor site could be considered the ramus of the mandible, since the fracture during the split crest procedure occurred in the edentulous site of the maxilla. Positioning the cortical surface of the separated bone in contact with the cancellous receiving bone seems to improve the volume persistency, perhaps due to the osteogenic potential of the periosteum. The bone marrow in contact with the soft tissue could increase the angiogenesis and the osteogenesis, as hypothesised by previous animal trials [9].

This surgical case is in line with the Yazar's overview of the topic [10]. The cortical grafts have better performance in mechanical stability, can survive for more time and are more useful in cases of bone-volume deficiency. Cancellous bone, however, has no mechanical strength and therefore it loses more volume because there is a fast revascularisation and the graft resorbs completely, 'significantly stimulating osteocytes to form new bone.

In oral surgery, cancellous bone often requires additional support to rehabilitate bone defects. Therefore, they have been used mostly for the treatment of bone gaps (inlay bone grafting), while cortical grafts have been necessary in clinical situations which require immediate mechanical strength.

4. Conclusion

This clinical case, with a very long follow-up is based on previous observations in animal model suggests a new approach in oral

surgery, orientating the onlay bone grafting with the cortical part in contact with the host bone marrow to enhance mechanical stability, maintain volume and, because of the properties of cancellous bone, promote new bone formation.

Proof of consent

Appropriate consents, permissions and releases were obtained by the patient to include radiographs and pictures of the clinical case in conformity to the Health Insurance Portability and Accountability Act of 1996 ("HIPAA") and other U.S. federal and state laws relating to privacy and security of personally identifiable information, the General Data Protection Regulation (GDPR) (EU) 2016/679 and member state implementing legislation, Canada's Personal Information Protection and Electronic Documents Act, India's Information Technology Act and related Privacy Rules, (together "Data Protection and Privacy Laws").

All authors have read and approved the manuscript, the clinician Mauro Limbertucci, Saverio Cosola and Ugo Covani, with the agreement to be accountable for all aspects of the work. The authors declare that they have no conflict of interest.

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References

- [1] Marconcini S, Denaro M, Cosola S, Gabriele M, Toti P, Mijiritsky E, Proietti A, Basolo F, Giammarinaro E, Covani U. Myofibroblast gene expression profile after tooth extraction in the rabbit. *Materials* 2019 Nov 9;12(22):3697. <https://doi.org/10.3390/ma12223697>.
- [2] Araújo MG, Silva CO, Misawa M, Sukekava F. Alveolar socket healing: what can we learn? *Periodontol* 2000 2015 Jun;68(1):122–34. <https://doi.org/10.1111/prd.12082>.
- [3] Covani U, Ricci M, Bozzolo G, Mangano F, Zini A, Barone A. Analysis of the pattern of the alveolar ridge remodelling following single tooth extraction. *Clin Oral Implants Res* 2011 Aug;22(8):820–5. <https://doi.org/10.1111/j.1600-0501.2010.02060.x>. Epub 2010 Dec 29.
- [4] Pape HC, Evans A, Kobbe P. Autologous bone graft: properties and techniques. *J Orthop Trauma* 2010 Mar;24(Suppl 1):S36–40. <https://doi.org/10.1097/BOT.0b013e3181cec4a1>.
- [5] Alberius P, Gordh M, Lindberg L, Johnell O. Onlay bone graft behaviour after marrow exposure of the recipient rat skull bone. *Scand J Plast ReConstr Surg Hand Surg* 1996 Dec;30(4):257–66. <https://doi.org/10.3109/02844319609056403>.
- [6] Gordh M, Alberius P, Lindberg L, Johnell O. Bone graft incorporation after cortical perforations of the host bed. *Otolaryngol Head Neck Surg* 1997 Dec;117(6):664–70. [https://doi.org/10.1016/s0194-5998\(97\)70050-0](https://doi.org/10.1016/s0194-5998(97)70050-0).
- [7] Adeyemo WL, Reuther T, Bloch W, Korkmaz Y, Fischer JH, Zöller JE, Kuebler AC. Influence of host periosteum and recipient bed perforation on the healing of onlay mandibular bone graft: an experimental pilot study in the sheep. *Oral Maxillofac Surg* 2008 May;12(1):19–28. <https://doi.org/10.1007/s10006-008-0098-4>.
- [8] Alberius P, Gordh M, Lindberg L, Johnell O. Effect of cortical perforations of both graft and host bed on onlay incorporation to the rat skull. *Eur J Oral Sci* 1996 Oct-Dec;104(5–6):554–61. <https://doi.org/10.1111/j.1600-0722.1996.tb00141.x>.
- [9] Thompson N, Casson JA. Experimental onlay bone grafts to the jaws. A preliminary study in dogs. *Plast Reconstr Surg* 1970 Oct;46(4):341–9. <https://doi.org/10.1097/00006534-197010000-00003>.
- [10] Yazar S. Onlay bone grafts in head and neck reconstruction. *Semin Plast Surg* 2010 Aug;24(3):255–61. <https://doi.org/10.1055/s-0030-1263067>.