Ridge preservation: why and when

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Fig. 5

Fig 1_ Tooth #17 will be extracted without ridge preservation.
Fig 2_ After extraction without ridge preservation of 17, the CT scan of the area (slide 20) shows presence of a significant bone deficiency. Ridge preservation should have been performed.
Figs 3, 4_ Root fracture of a central incisor and subsequent loss of the buccal plate of bone. Ridge preservation needs to be performed after extraction of this hopeless tooth.
Figs 5, 6_ A patient with thin-scalloped periodontal biotype presenting significant bony dehiscences and a fenestration. If an extraction had to be performed, ridge preservation would be necessary in order to preserve the initial ridge dimensions.

_Background

Dental implants provide the clinician and the patient with treatment options as an alternative to conventional fixed or removable prosthetic restorations in order to improve function and esthetics. Many animal and human studies have shown that the placement of endosseous implants is a predictable procedure for both fully edentulous and partially edentulous patients in the maxilla and mandible with success rates exceeding 90%.

Implant therapy is considered successful according to specific criteria, all based on the implant's integration in the patient's hard and soft tissues. However, the final esthetic outcome is playing an increasing role in defining implant therapy as successful or not. In other words, a dental implant that is perfectly osseointegrated and functional, but the overall esthetic outcome is judged as unacceptable, may nowadays be considered as a failure. A prerequisite to successful osseointegration is the presence of sufficient bone volume. If a bone deficiency is clinically encountered, implant placement may not be possible and grafting will be necessary before an implant can be placed. A major disadvantage of this staged approach is the duration of treatment. Many techniques exist today in order to predictably rebuild a deficient edentulous area—such as guided bone regeneration (GBR), distraction osteogenesis, or ridge expansion/splitting. In order to achieve an ideal implant placement, improve esthetics and minimize bone resorption after tooth extraction, a technique called ridge preservation was proposed. The purpose of this article is to review the rationale of performing ridge preservation and document a case that has been successfully treated using this technique.


Fig. 1

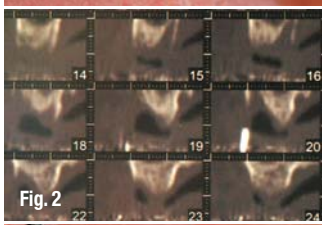

Fig. 2


Fig. 3


Fig. 4


Fig. 6

_Rationale

The concept of ridge preservation is based on the fact that significant bone changes occur after tooth extraction. Following tooth removal, normal healing is characterized by a combination of bone growth into the socket and alveolar ridge resorption in the buccal-lingual and apicocoronal dimensions. The sequence of healing after tooth extraction is well documented in human and animal studies, however, the resultant changes in alveolar bone morphology do not always follow a consistent pattern. Long-term absence of teeth leads to a "transportation" of the ridge to a more palatal or lingual position4,5 and can also reduce the ridge height so that implant placement becomes a challenge. It has been shown that alveolar dimensions were significantly reduced following tooth removal, with maxillary sites loosing more height and width than mandibular sites.8 Ridge collapse and significant ridge atrophy may continue up to 12 months post-extraction. However, marked alterations of the height and width of the alveolar ridge seemed to be more pronounced during the first three months of healing.9,10 Following tooth removal, the greatest amount of bone loss occurs in the horizontal dimension and is more pronounced on the facial than on the lingual/palatal side.11 The loss of ridge dimensions may be associated

with the thickness of the buccal plate and the amount of circumferential bone after tooth extraction.12 The thinner the buccal plate, the greater the reduction of the bucco-lingual ridge dimension. The result is a buccal concavity that can often be encountered clinically.9,11 The bucco-lingual resorption has been shown to reduce the ridge width up to 50%.11 Vertical bone loss after extraction can also be expected, though the amount of vertical bone loss is less significant than the reduction of ridge width after tooth extraction.

_Indications

Oftentimes alveolar socket defects are discovered following tooth removal. In the presence of the following scenarios, ridge defects that necessitate grafting can occur (see Figures 1–8):

_ Traumatic extraction of a tooth, including resection of bone or breaking of a socket wall.
_ Presence of root prominence and fenestrations (thin periodontal biotype).
_ Previous apicoectomy.
_ Root-fracture, periodontal disease or abscesses with concurrent loss of a socket wall.

Careful circumferential examination of the alveolus after extraction helps to determine if a bone dehiscence or fenestration is present. If a dehiscence, a fenestration or a thin bone wall is observed, ridge preservation should be performed to minimize changes in the ridge dimensions. If the alveolar socket walls after extraction are thick and intact, ridge preservation may not be necessary, since the surrounding bone walls may be able to withstand post-surgical resorption. However, changes in alveolar morphology are often unpredictable. Especially when teeth are extracted in the esthetic zone, grafting of the ridge may be a prerequisite to maximize the esthetic outcome.13,14 If the socket is left to heal without grafting and ridge preservation is not to be performed, the following scenarios can be clinically encountered:

_ Implant placement may not be possible because of a lack of sufficient bone volume, thus requiring a ridge augmentation procedure prior to implant placement.
_ Implant placement may be possible, but in a non-ideal position, followed by compromised restorative function and esthetics.
_ Implant placement may be possible in an ideal position, but a bone dehiscence may occur at implant placement because of insufficient bone volume, thus requiring a regenerative procedure at the time of implant placement.


Fig. 7


Fig. 8


Fig. 9


Fig. 10


Fig. 11


Fig. 12

_Outcomes

Clinical studies in humans testing the efficacy of ridge preservation show that this technique significantly improved ridge height and width when compared to extraction alone. Different materials were used for ridge preservation in clinical trials: membranes without bone graft,4,5 or in combination with particulate grafts.7,8 Ridge preservation offers the most predictable maintenance of ridge dimensions and position, though some reduction of ridge dimension can still be observed. It appears that significant non-uniform loss of augmented alveolar height and width of approximately 1.0 to 1.5 mm occurs during healing of the grafted area.7 There is evidence that the greater the amount of bone that is added during ridge preservation, the greater the net healing,7 therefore additional extra socket buccal and coronal bone graft may be essential in order to preserve original contours. The amount of total bone and trabecular space observed on histologic analysis is similar in preservation sites and in extraction sites. Since non-vital bone is usually placed in sockets, those healed sites present both vital and non-vital bone, which corresponds to residual graft particles.8 When grafted sites are allowed to heal during an ad-

Figs 7, 8_ Maxillary molar with significant mesiobuccal root prominence. If extraction of this tooth was to be performed, ridge preservation would be necessary.
Fig 9_ Guided membrane exposure: after extraction of a maxillary first molar, ridge preservation was performed leaving a resorbable membrane exposed.
Fig 10_ Ten weeks after ridge preservation, the area of the exposed membrane is re-epithelialized and a minimal buccal concavity is observed.
Fig 11_ Initial x-ray shows a periradicular radiolucency extending into the furcation area.
Fig 12_ Initial buccal view of tooth 36 with periodontal probe indicating significant attachment loss on the buccal side of the distal root.


Fig. 19

Fig 13_ Occlusal view of the socket following extraction.
Fig 14_ Socket filled with composite bone graft and bioabsorbable membrane secured under buccal flap.
Fig 15_ Advancement of flaps fully covering the membrane and sutures.
Fig 16_ Healing of area 5-months post-operatively, at day of implant placement.
Fig 17_ Occlusal view of healed socket at 5 months, at day of implant placement.
Fig 18_ Occlusal view of implant with healing abutment and sutures.
Fig19_ One-year follow-up shows presence of healthy soft-tissue margins.
Fig 20_ One year follow-up x-ray shows minimal crestal bone resorption.

equate period of time, implants are to be placed. Survival rates of dental implants placed in grafted areas are similar to those of implants placed in native bone.15 Therefore, ridge preservation does not appear to affect implant success rate.

_Methods

During tooth removal, a minimally traumatic technique is essential to preserve the periodontal tissues. Periotomes are used to sever the periodontal attachments to the tooth, which is then carefully removed, all the while being careful to minimize the trauma to the socket walls. Following extraction, the socket is debrided and inspected to determine the integrity of socket walls and their thickness. If all four surrounding bone walls are thick and intact, ridge preservation is not necessary, and an implant could be placed immediately or delayed. The selection of regenerative materials in ridge preservation procedures is dependent in large part upon alveolar bone defect morphology.16 The larger the defect, the more important is the space maintaining effect of a bone graft material and a barrier membrane. Different materials have been employed in ridge preservation procedures. One can use particulate autogenous and non-autogenous grafts, such as allografts (mineralized8 and demineralized7, xenografts12 and synthetic compounds (eg, hydroxyapatite17, bioactive glass18). There are also reports indicating use of autogenous bone cores.19 Regarding barriers, different materials are used, such as non-resorbable membranes (ePTFE, reinforced with titanium or not)4, resorbable membranes (eg, collagen8, glycolide/lactide polymers5), a cellular dermal matrix20 as well as collagen sponges.12 Autogenous tissues can also be used to cover the bone graft, such as a free gingival graft, a free connective tissue graft or a rotated or advanced flap. A barrier can be either fully covered with an advanced flap (see clinical case) or left exposed at the area corresponding to the extracted tooth (see Figures 9 and 10). Avoiding advancement of the flap will minimize the esthetic disfigurement; however, it should be avoided when a non-resorbable membrane is used.5


Fig. 13

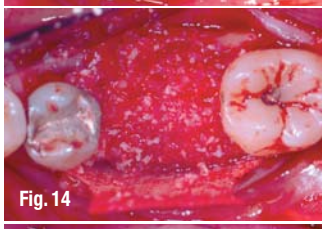
Fig. 14


Fig. 15


Fig. 16


Fig. 17


Fig. 18


Fig. 20

_Clinical case

A 62-year-old Caucasian female presented to the Department of Periodontology, at Tufts University School of Dental Medicine, in Boston, with her lower left first molar (36) fractured. She had no medical contraindications to surgical treatment. Her chief complaint was pain upon chewing on that tooth. The clinical examination indicated severe attachment loss on the buccal and lingual sides of the distal root (probing depth 9–14 mm) and mobility grade II (Figs. 11, 12). Radiographic examination revealed extensive bone loss at the apical region. The treatment plan included extraction of 36, ridge preservation and single implant placement. Tooth 36 was sectioned with a handpiece and removed atraumatically. The socket was then thoroughly debrided and rinsed with sterile saline (Fig. 13). Full thickness flaps were elevated buccally and lingually, exposing all alveolar bone walls. A combination of DFDBA and mineralized xenograft (BioOss) was used to fill the socket (Fig. 14), which was subsequently covered with a collagen membrane (Ossix) trimmed to fit the dimensions of the surgical area. Flaps were advanced to fully cover the membrane and secured with horizontal mattress and sin-

gle interrupted sutures (Vicryl 4/0) (Fig. 15). The healing was uneventful. At 5-months post-operatively, a tapered, wide platform implant (5 x 13 mm) with internal connection was placed (Replace Select). The socket was completely filled with bone (Figs. 16, 17). While preparing the osteotomy, the bone quality was judged satisfactory. The implant had adequate primary stability (>35 N/cm2) and the healing abutment was placed at the same day (Fig. 18). Soft tissues were then sutured around the healing abutment. The one-year follow up shows minimal bone resorption and healthy soft tissue contours (Figs. 19, 20)

_Abstract

Clinicians and patients often demand a high degree of esthetic and functional predictability in any dental treatment following tooth removal. When a treatment plan includes implant therapy or conventional fixed prosthetics, the maintenance of the alveolar ridge dimensions is of capital importance. Ridge preservation is a surgical technique performed at the time of tooth extraction allowing one to predictably preserve the alveolar ridge contour. The purpose of this article is to present the rationale and outcomes of ridge preservation based on the pertinent literature and present a case that was successfully treated using this treatment modality.

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