Ridge preservation following tooth extraction: A comparison between atraumatic extraction and socket seal surgery

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Objective: To evaluate whether alveolar ridge resorption following tooth extraction could be prevented or reduced using absorbable collagen material impregnated with gentamicin and sealed with an autogenous soft tissue graft to stabilize the extraction clot, and to compare this with natural healing by clot formation using a classic extraction technique.

Method and Materials: A total of 125 patients providing 173 extraction sites were included in the study. Three extraction protocols were compared: atraumatic extraction (group A, n = 101 extraction sites), atraumatic extraction sealing the socket with autogenous soft tissue graft (group B, n = 39), and atraumatic extraction with socket seal surgery and collagen matrix impregnated with gentamicin (group C, n = 33). Silicone impressions were made before and 3 months after extraction. Casts were used to measure the width of the alveolar bone at the extraction area using the incisal edge of the adjacent teeth as a reference point. Results: The clinical measurement 3 months after extraction revealed a loss of bone width of 0.3 ± 0.5 mm in group A, 0.8 ± 0.7 mm in group B, and 0.1 ± 0.1 mm in group C. There was no significant difference in bone resorption in extraction sites among the groups (P > .05). However, the difference between group A and group C was borderline significant (P = .07). After 10 days, 31 grafts from group C and 30 grafts from group B remained vital. Conclusions: It seems that extraction technique affects alveolar bone resorption, regardless of whether the socket is treated with free gingival graft or bone graft. Further, the local application of gentamicin presented more vascular ingrowth in the blood clot and granulation tissue beneath the graft, thereby supplying better nourishment during the initial healing phase of the graft. (Quintessence Int 2010;41:605–609)

Key words: atraumatic extraction, collagen, gentamicin, socket seal surgery

Tooth extraction results in alveolar bone loss and formation of atrophic ridge.¹² It has been claimed that during the first 6 months after tooth extraction, significant resorption of the alveolar ridge could influence the quality and prognosis of the final restoration.²³⁴

Several studies have proposed various ridge preservation techniques following tooth extractions, including placement of different graft materials and/or use of membranes to cover the extraction socket entrance.⁵ The use of grafting materials in fresh extraction sockets has been questioned because it is claimed to interfere with the normal healing process in the sockets in which oral implants will be inserted.⁶⁷

Indeed, studies on humans using demineralized freeze-dried bone allograft (DFDBA)⁸ and deproteinized natural bovine bone mineral (Bio-Oss, Geistlich Pharma)⁹¹⁰–¹² have shown the presence of particles of the grafted material in the alveolar sockets 6 to 9 months following their insertion.

Sealing extraction sites with autogenous soft tissue grafts enables optimal preservation of the ridge topography after tooth extraction.¹³ Because the soft tissue seal is a free soft tissue graft, its survival depends on blood supply primarily from the underlying bed.¹⁴–¹⁶
The aim of this study was to evaluate if alveolar ridge resorption after tooth extraction could be reduced or prevented by stabilizing the blood clot using collagen plug to fill the socket and grafting free soft tissue to seal it.

**METHOD AND MATERIALS**

One hundred twenty-five patients (63 females and 62 males), providing 173 extraction sites, participated in this study. The patients ranged in age from 15 to 87 years, and all were undergoing treatment for periodontal disease. All patients were physically healthy, with no underlying systemic disease as determined by medical history screening. Patients with clinical evidence of significant periapical or periodontal pathosis were excluded.

Periapical radiographs were taken prior to the surgical procedure. The extraction sites and the graft donor sites (palate) were anesthetized with an appropriate local anesthesia. The teeth were carefully removed and the socket walls slightly decorticated. Following socket debridement, the socket orifice soft tissue margins were carefully cut to remove epithelial debris using a sharp biopsy punch. The prepared sockets were filled with collagen plug (Genta-Coll, Resorba Wundversorgung), some containing gentamicin (16 mg, Gentamicinsulfat) and others without (Resorba Wundversorgung).

Circular soft tissue grafts 3- to 4-mm thick were obtained from the palate using a biopsy punch. Each graft was slightly larger in diameter than the socket orifice. The grafts were held in place by three to six simple sutures passing through the surrounding gingiva and over the graft without piercing it (Fig 1).

Special care was taken to avoid trauma to the grafted site. Sutures were removed 1 week postoperatively, and the grafts were examined weekly during the first month.

To evaluate the clinical resorption, silicone impressions were made before and 3 months after extraction. Pouring in hard stone, the cut cast was used to measure the width of the alveolar bone at the extraction area using the incisal edge of the adjacent teeth as a reference point.

The patients were divided randomly into three groups:

- **Group A:** 72 patients, 101 extraction sites, atraumatic extraction (extracting the tooth by rotation and traction movements)
- **Group B:** 32 patients, 39 extraction sites, atraumatic extraction with the socket being filled with collagen plug and sealed with a free soft tissue graft
- **Group C:** 21 patients, 33 extraction sites, atraumatic extraction with the socket being filled with collagen plug impregnated with gentamicin (Genta-Coll) and sealed with a free soft tissue graft

Mean values and standard deviations were calculated for alveolar ridge width of each group pre- and postoperatively. Statistical analysis was performed using analysis of variance (ANOVA) test. The level of significance was .05.

**RESULTS**

A total of 14 patients were excluded from the study. Nine grafts were nonvital in group B and two in group C 10 days postoperatively, and two patients from group B as well as one from group C did not return for the 3-month postoperative follow-up.

All of the extraction sites in group A, 30 in group B, and 31 in group C healed uneventfully. Ten days postoperatively, the soft tissue around the extraction socket was similar in groups B and C. Two weeks after the extractions, the sockets in group A were completely covered by soft tissue.

There was no significant difference between the preoperative mean widths of the alveolar bone in all of the extraction sites.

Mean bone resorption in the alveolar ridge 3 months postoperatively was $0.3 \pm 0.5 \text{ mm}$ in group A, $0.8 \pm 0.7 \text{ mm}$ in group B, and $0.1 \pm 0.1 \text{ mm}$ in group C. The minimum and maximum resorption measurements, respectively, were $0.0$ and $2.0 \text{ mm}$ in group A, $0.0$ and $2.6 \text{ mm}$ in group B, and $0.0$ and $0.4 \text{ mm}$ in group C. There was no significant difference in bone resorption in the extraction sites.
between all groups postoperatively ($P > .05$). However, the difference between group A and group C was borderline significant ($P = .07$).

**DISCUSSION**

Alveolar ridge resorption after extractions is an undesirable although unavoidable process. Several studies report ridge preservation techniques, including placement of different graft materials\textsuperscript{13,17} or sealing extraction sockets with connective tissue either to prepare a suitable site for implant placement\textsuperscript{18} or with immediate implant placement.\textsuperscript{19}

Atraumatic extraction techniques resulted in significantly less bone resorption than did the classic extraction technique of moving the tooth laterally with an elevator.\textsuperscript{20}

Immediate implants may help reduce or even eliminate this resorption.\textsuperscript{21} However, there are some advantages to delaying placement of immediate implants by 6 to 8 weeks after extraction: for example, elimination of associated infections\textsuperscript{22,23} and completion of mucosal healing to simplify placement of grafts or membranes.\textsuperscript{23,24}

DFDBA and bioactive glass have also been studied as alternative socket-filling materials. Traces of DFDBA and bioactive glass particles were still detected in the socket 6 to 9 months after extraction.\textsuperscript{25,26}
The survival of free tissue graft depends on nourishment from plasma elements resulting from the formation of blood clots and the granulation tissue beneath the graft.16,27

In the present study, collagen type I was used, and demonstrated ideal tissue integration28 and therefore quick vascularization, resulting in good vessel supply to the graft especially if the collagen was impregnated with gentamicin.

Stavropoulos and colleagues found that impregnation of Bio-Oss with 2 mg/mL gentamicin before implantation tended to improve the healing outcome after guided tissue regeneration.29 Preliminary data from an experimental study suggested that gentamicin may promote early vascularization of bone grafts.30 In this study, corallin hydroxyapatite spheres pretreated with either saline/gentamicin 2 mg/cm3 solution or with specific (r)TGF-β2 [recombinant transforming growth factor beta 2]) or nonspecific (plasma) angiogenetic factors were implanted in anophthalmic sockets in rabbits. The saline/gentamicin grafts presented significantly more vascular ingrowth compared with untreated controls after 2 weeks.

Gentamicin has an antibacterial effect that has a selective effect on Staphylococcus aureus and S epidermidis, which are frequently associated with implant- and arthroplasty-related osteomyelitis.31 Cardarcoli et al studied the dynamics of bone tissue formation in tooth extraction sites.31 They found that bone formation in the oral zone of the socket started 2 weeks after the middle and apical zones due to the proximity to the infectious material in the oral cavity.32

The antibacterial effect of the gentamicin and the tissue graft in the present study prevent bacterial contamination of the oral cavity, and that may speed bone formation by 2 weeks, especially in the oral zone.

These results show that the extraction method and technique are the most important factor to prevent alveolar bone loss no matter how the socket is treated after extraction. On the other hand, the gingival graft can increase the width of the keratinized tissue, which can improve the esthetic outcome, and the local application of gentamicin tends to improve the graft healing.

CONCLUSION

Our results show that the extraction method is the most important factor to preserve the alveolar bone loss regardless of how the socket is treated after extraction. On the other hand, the gingival graft can increase the width of the keratinized tissue, which can improve the esthetic outcome, and the local application of gentamicin tends to improve the graft healing.

REFERENCES


