Consensus Report by the Italian Academy of Osseointegration on the Use of Graft Materials in Postextraction Sites

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Purpose: After tooth extraction, a modeling and remodeling phase of bone and soft tissues occurs. It has been fully demonstrated that bone resorption as high as 50% can take place regarding ridge width and a variable amount concerning ridge height, making it difficult to perform implant surgery. Materials and Methods: Active members of the Italian Academy of Osseointegration (IAO) participated in this Consensus Conference, and three systematic reviews were conducted before the meeting to provide guidelines on alveolar ridge preservation procedures. The systematic reviews covered the following topics: (1) What material best preserves the dimensions of the ridge horizontally and vertically?; (2) what material favors the formation of the highest quantity of new bone?; (3) which technique would best seal the socket?; and (4) what effect does alveolar ridge preservation have on soft tissues? Results: The main conclusions reached by the assembly were that alveolar ridge preservation is advisable after dental extraction, particularly in esthetic areas, in proximity of anatomical structures (ie, maxillary sinus, inferior alveolar nerve, and mental foramen), whenever the treatment plan requires delayed placement, and whenever patients ask to postpone implant insertion for various reasons. Socket debridement is advised before the use of a “regenerative material,” and xenograft is considered the gold standard material to maintain ridge dimensions. Another indication is antibiotic therapy, which is recommended in the case of alveolar ridge preservation (amoxicillin 2 g 1 hour before the intervention and 1 g every 12 hours for 6 days). A membrane or autologous soft tissue should be used to seal the socket and protect the regenerative material, and the indicated reentry time (implant insertion) is 4 to 6 months. Conclusion: This Consensus Conference agreed that the adoption of alveolar ridge preservation can effectively prevent physiologic bone loss, especially in esthetic areas. It is recommended to cover the xenograft material with a membrane or autologous soft tissue, and antibiotic therapy is advisable. Int J Oral Maxillofac Implants 2022;37:98–102. doi: 10.11607/jomi.9290

Keywords: antibiotics, bone regeneration, dental implants, postextraction site, surgery

Dental extraction is one of the most common surgical procedures in dental practices, and the subsequent spontaneous socket healing process is a basic topic of research and discussion that is found in biomedical and clinical-based dental sciences.¹

The last phase of spontaneous healing is known as modeling and remodeling, whose aim is to restore the lost architecture and functionality of the alveolus and lasts for several months.²

It has been fully demonstrated that during this process, as much as 50% of ridge width and a variable amount of ridge height can resorb; this resorption is more substantial on the buccal aspect of the alveolus. This resorption phase leads to certain anatomical changes, which make a correct restoration with dental implants extremely challenging, both functionally and esthetically.³

One of the simplest surgical approaches to counteract such alterations is probably the renowned alveolar ridge preservation technique, in which the use of different grafting materials placed into the socket, with or without any sort of sealing material to cover the graft, aims to contrast the alveolar resorption.⁴,⁵

However, over the last two decades, different methods to counteract resorption during the healing phase

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Submitted February 8, 2021; accepted August 7, 2021. ©2022 by Quintessence Publishing Co Inc.
of the alveolus, such as immediate implant placement or guided bone regeneration (GBR) at implant insertion, have been evaluated.

The purpose of this Consensus Conference was to assess if and when alveolar ridge preservation is the most suitable treatment option after tooth extraction, which grafting material mostly counteracts the resorption during the healing phase, whether there is the necessity for coverage of the grafting material for better healing, and what the appropriate time lapse before carrying out implant surgery would be.

MATERIALS AND METHODS

Active members of the Italian Academy of Osseointegration (IAO) participated in this Consensus Conference. Three systematic reviews were conducted before the meeting, and their conclusions were evaluated to provide guidelines on the alveolar ridge preservation procedures.6–8 The three reviews were conducted following the PRISMA guidelines (http://www.prisma-statement.org/), and the review protocols were registered with PROSPERO (submission no. CRD42020196275, CRD42020196275, and CRD42020218153).

The first systematic review analyzed both dimensional and histologic changes.

The focusing questions of the first systematic review (dimensional changes) were as follows:

- After alveolar ridge preservation, what is the material that best preserves the dimensions of the ridge horizontally and vertically, assessed clinically or radiographically, at any follow-up after the surgical intervention?
- Does alveolar ridge preservation decrease the horizontal and vertical resorption of the ridge compared with spontaneous healing?6

The PICOT format was as follows:

- Patients (P): Adult patients undergoing tooth extraction.
- Intervention (I): Alveolar ridge preservation using different grafting materials—autogenous, bone marrow aspirates, xenografts, allografts, alloplastic grafts (including synthetic bioceramics, polymers, and other synthetic biomaterials), autogenous tooth grafts, bioactive agents (including autologous platelet concentrates, recombinant factors, statins, or other substances enhancing bone regeneration).
- Comparison (C): All possible comparisons among the included interventions were explored, including nonintervention (spontaneous healing).
- Outcome (O): Horizontal and vertical dimensional changes, clinically or radiographically assessed.
- Time (T): Any follow-up after the surgical intervention.

The focusing questions of the first systematic review (new bone formation) were as follows:

- After alveolar ridge preservation, what is the material that best consents to produce more bone formation assessed histologically at any follow-up after the surgical intervention?
- Does alveolar ridge preservation affect the percentage of new bone formation compared with spontaneous healing?

Patients (P), Intervention (I), and Comparison (C) were the same as the aforementioned PICOT:

- Outcome (O): Percentage of new bone formation evaluated from a bone biopsy, histologically assessed.
- Time (T): Any follow-up period after the surgical intervention.

The research was conducted on MEDLINE via PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Scopus, and EMBASE using an ad hoc search string that was adapted to each database: (((((“tooth extraction”) OR “socket”) OR “alveolus”) OR “dental extraction”)) AND (((((“bone grafts”) OR “biomaterials”) OR “autografts”) OR “collagen”) OR “cell therapy”) OR “platelet concentrates”) OR “alloplasts”) OR “allografts”) OR “xenograft”) OR “bioceramic scaffolds”)) AND (((“alveolar ridge preservation”) OR “socket preservation”) OR “socket grafting”) OR “socket filling”) OR “ridge maintenance”). The last electronic search was carried out in March 2021. Two thousand seven hundred thirty articles were screened, and 88 of them were included.

The focusing questions of the second systematic review were as follows:

- Is the placement of a biomaterial over the extraction socket beneficial compared to healing without coverage in terms of horizontal and vertical alveolar dimensional changes and percentage of bone formation?
- What is the relative efficacy of different available biomaterials for sealing sockets during alveolar ridge preservation compared to each other?8

The following focused questions were elaborated following the PICO format:
• Population (P): Patients receiving extraction and alveolar ridge preservation.
• Intervention (I): Alveolar ridge preservation placing a biomaterial to seal the socket coronally (autogenous grafts, allogeneic membranes [eg, amnion-chorion membrane]), resorbable collagen membranes (crosslinked or non-crosslinked and non-resorbable membranes).
• Comparison (C): Alveolar ridge preservation without placing a biomaterial to seal the socket (control: no sealing biomaterial).
• Outcome (O): Horizontal and vertical alveolar dimensional changes and percentage of new bone formation.

A literature search was carried out using electronic databases (MEDLINE [PubMed], EMBASE, Cochrane Central Register of Controlled Trials, Scopus), using an ad hoc search string that was adapted to each database: (((((tooth extraction) OR “socket”) OR “alveolar ridge preservation”) OR “dental extraction”)) AND (((((“bone grafts”) OR “biomaterials”) OR “autografts”) OR “collagen”) OR “cell therapy”) OR “platelet concentrates”) OR “alloplasts”) OR “allografts”) OR “xenograft”) OR “bioceramic scaffolds”) AND (((“alveolar ridge preservation”) OR “socket preservation”) OR “socket grafting”) OR “socket filling”) OR “ridge maintenance”). One thousand eight hundred forty-six articles were screened, and 12 of them were included.

The focusing questions of the third systematic review were as follows:

• What alveolar ridge preservation biomaterials produced the most beneficial effects compared with spontaneous healing in terms of keratinized mucosa thickness (KMT) as well as horizontal and vertical dimensional soft tissue changes?
• What alveolar ridge preservation biomaterial was associated with the lowest 3D soft tissue changes postextraction compared with other materials?9

The focused questions were elaborated following the PICOT format:

• Patients (P): Patients undergoing tooth extraction with or without alveolar ridge preservation.
• Intervention (I): Alveolar ridge preservation using different bone graft (autogenous, bone marrow aspirates, xenografts, allografts, alloplastic grafts, autogenous tooth grafts, as well as bioactive agents [including autologous platelet concentrates, recombinant growth factors, and statins]), and membrane biomaterials (resorbable crosslinked collagen membranes, resorbable non-crosslinked collagen membranes, resorbable synthetic membranes, autogenous soft tissue, collagen sponges, and nonresorbable membranes).
• Comparison (C): All possible comparisons among the included interventions were explored, including spontaneous healing.
• Outcome (O): For soft tissues, the following outcomes were evaluated and compared: horizontal width linear changes (mm), vertical buccal linear changes (mm), and KMT changes (mm).
• Time (T): At least 6 weeks follow-up after extraction.

A literature search was conducted through electronic databases (MEDLINE [PubMed], EMBASE, Cochrane Central Register of Controlled Trials, and Scopus) using an ad hoc search string that was adapted to each database: ((((((“tooth extraction”) OR “socket”) OR “alveolar ridge preservation”) OR “dental extraction”))) AND ((((((“bone grafts”) OR “biomaterials”) OR “autografts”) OR “collagen”) OR “cell therapy”) OR “platelet concentrates”) OR “alloplasts”) OR “allografts”) OR “xenograft”) OR “bioceramic scaffolds”))) AND (((“alveolar ridge preservation”) OR “socket preservation”) OR “socket grafting”) OR “socket filling”) OR “ridge maintenance”)) AND (“(soft tissue OR “mucosa”) AND (“horizontal width) OR (“vertical) OR “buccal” OR “vestibular “ OR “lingual” OR “palatal” OR “volume) AND “change”). The research generated 2,395 articles, of which 22 were included.

All the reviews were conducted following the PRISMA statement. Eligibility process, risk of bias, and data extraction were done independently by more authors. Pairwise and network meta-analysis were conducted for the three reviews.

The main results of the systematic reviews were as follows.

First Review
When compared with untreated sockets, alveolar ridge preservation is effective in reducing both horizontal and vertical shrinkage. In the network meta-analysis, xenografts performed better than the other materials in preserving ridge dimension. On the other hand, statistically significantly better histomorphometric outcomes (higher percent of vital bone) were achieved by platelet concentrate.6

Second Review
No specific sealing techniques and/or biomaterials can be recommended over another in the context of alveolar ridge preservation due to a lack of sufficient data. The limited number of studies comparing alveolar ridge preservation with and without biomaterials to seal the socket suggests that the application of a membrane is associated with superior results in terms of preservation of alveolar ridge dimensions. Randomized controlled trials (RCTs) studying this topic with larger sample sizes
are needed to better elucidate the effects of different coverage biomaterials on alveolar ridge preservation treatment outcomes.8

Third Review
The use of crosslinked collagen membranes and autogenous soft tissue grafts, with a minimum of 6 weeks of follow-up, represented the best biomaterial choices for sealing sockets during alveolar ridge preservation in terms of minimizing postextraction soft tissue dimensional shrinkage.7

The results of the systematic reviews were discussed on September 26, 2020, in the consensus meeting. After voting on the questions raised, a general agreement was reached on possible guidelines (Table 1).

RESULTS
Table 1 illustrates the main results achieved by the assembly. Alveolar ridge preservation is advisable after dental extraction in esthetic areas, in proximity of anatomical structures (ie, maxillary sinus, inferior alveolar nerve, and mental foramen), whenever the treatment plan requires a delayed placement, and whenever patients ask to postpone implant insertion for various reasons.

Socket debridement is performed before using a “regenerative material”; a xenograft is considered the best material to maintain the ridge dimensions.

The alveolar ridge preservation is carried out with antibiotic therapy (amoxicillin 2 g 1 hour before the intervention and 1 g every 12 hours for 6 days), and the socket is preferably sealed with a membrane or autologous soft tissue. A suggested reentry surgical time of 4 to 6 months is advisable, depending on the material adopted.

DISCUSSION
The results would recommend the use of a grafting material to prevent a volumetric shrinkage in the postextraction sites.

The final conclusions are in accordance with the systematic reviews obtained through a network meta-analysis of RCTs, which indicate that a xenogeneic grafting material represents the best option in terms of hard tissue

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<th>Table 1 Consensus Questions</th>
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<td>Questions</td>
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<td>Do you perform any alveolar preservation technique?</td>
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<td>When do you think it is better to perform an alveolar preservation technique?</td>
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<td>Which are these circumstances?</td>
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<td>Is socket debridement necessary?</td>
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<td>Which material do you use most?</td>
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<td>Which is the best material to reduce bone shrinkage after tooth extraction?</td>
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<td>How long after socket regeneration with xenograft would you perform implant surgery?</td>
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<td>What do you recommend in case of alveolar ridge preservation?</td>
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<td>Which is the best way to seal the socket?</td>
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Answers chosen by the assembly are highlighted in bold.
volume preservation, while alloplasts and platelet-rich fibrin (PRF) may produce the highest bone regeneration based on histologic analysis; furthermore, autologous and collagen membranes promote alveolus soft tissue sealing. The use of grafting materials in general may help in soft tissue preservation after tooth extraction.6–8

The systematic reviews adopted a network meta-analysis method. This statistical approach, due to the use of a conventional pairwise meta-analysis, enables the comparison of various data that do not directly match in the same study.

Despite the high methodologic quality, certain limits of the present research should, however, be noted. In fact, RCTs do not, currently, clarify the validity of the use of antibiotics and antiseptic agents in postextraction site regeneration. Despite the effort to analyze their effect, systematic reviews failed to give a definitive conclusion on this issue. However, the majority of the members agreed on the use of a preoperative single dose of antibiotic as well as on the use of antiseptic agents.

Additional limitations were due to the lack of clinical subgrouping deriving from, for example, the initial condition of the socket walls, which could provide reliable data minimizing the heterogeneity of a single group. However, further data fragmentation may prevent aggregation in a network, or even pairwise, meta-analysis.

**CONCLUSIONS**

The use of alveolar ridge preservation can be effective in preventing physiologic bone loss, especially in esthetically demanding cases. A xenograft material covered by a membrane or autologous soft tissue is recommended, and an antibiotic therapy is advisable.

**ACKNOWLEDGMENTS**

The authors reported no conflicts of interest related to this study.

**REFERENCES**