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Systematic Review
Pre-Implant Surgery

Lateral ridge augmentation with Bio-Oss alone or Bio-Oss mixed with particulate autogenous bone graft: a systematic review

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Abstract. The objective of this systematic review was to test the hypothesis of no difference in implant treatment outcomes when using Bio-Oss alone or Bio-Oss mixed with particulate autogenous bone grafts for lateral ridge augmentation. A search of the MEDLINE, Cochrane Library, and Embase databases in combination with a hand-search of relevant journals was conducted. Human studies published in English from 1 January 1990 to 1 May 2016 were included. The search provided 337 titles and six studies fulfilled the inclusion criteria. Considerable variation prevented a meta-analysis from being performed. The two treatment modalities have never been compared within the same study. Non-comparative studies demonstrated a 3-year implant survival of 96% with 50% Bio-Oss mixed with 50% autogenous bone graft. Moreover, Bio-Oss alone or Bio-Oss mixed with autogenous bone graft seems to increase the amount of newly formed bone as well as the width of the alveolar process. Within the limitations of this systematic review, lateral ridge augmentation with Bio-Oss alone or in combination with autogenous bone graft seems to induce newly formed bone and increase the width of the alveolar process, with high short-term implant survival. However, long-term studies comparing the two treatment modalities are needed before final conclusions can be drawn.

Key words: alveolar ridge augmentation; Bio-Oss; bone substitute; dental implants; systematic review.

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Lateral ridge augmentation (LRA) involving an autogenous bone block is the most commonly used surgical procedure to augment the severely atrophic alveolar process[1–8]. However, harvesting autogenous bone from the mandible or the iliac crest is associated with donor site morbidity and increased costs[9–12]. Moreover, the use of autogenous bone grafts is associated with resorption of the graft material[9–12]. Therefore, bone substitutes alone or in combination with a particulate autogenous bone graft (PABG) are used increasingly to simplify the surgical procedure and minimize donor site morbidity.

Previous short-term human studies assessing LRA with deproteinized bovine bone mineral (Bio-Oss, Geistlich Pharma

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Table 1. PICO criteria for the present systematic review.

Patient and population (P)	All patients were adult patients with partial or total edentulism
Intervention (I)	Lateral ridge augmentation with Bio-Oss alone or in combination with particulate autogenous bone graft
Comparator or control group (C)	Lateral ridge augmentation with a mixture of Bio-Oss and particulate autogenous bone graft
Outcomes (O)	Survival of suprastructures and implants, bone regeneration, width gained at the alveolar process, width reduction of the graft material, volumetric stability of the graft material, patient-reported outcome measures, complications related to the surgical procedure
Focused question	Are there any differences in implant treatment outcomes after lateral ridge augmentation with Bio-Oss alone or in combination with particulate autogenous bone

AG, Wolhusen, Switzerland) alone or in combination with PABG have shown the formation of new bone, an increase in the width of the alveolar process, and a high implant survival rate[13–18]. A previous published systematic review concluded that horizontal defects can be augmented predictably up to a width of approximately 3.7 mm using particulate grafting material, without any preference for its origin[19]. However, the outcome of implant treatment following LRA with Bio-Oss alone or Bio-Oss mixed with PABG has not been assessed specifically in a systematic review.

Materials and methods

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-Equity 2012 checklist[20].

Objective

The objective of this systematic review was to test the hypothesis of no difference in implant treatment outcomes when using Bio-Oss alone or Bio-Oss mixed with PABG as graft material for LRA.

Consideration of eligibility criteria for this review

The inclusion criteria were developed using the PICO guidelines and included human studies evaluating LRA with Bio-Oss alone or Bio-Oss mixed with PABG (Table 1). Moreover, non-comparative human studies assessing LRA with Bio-Oss alone or Bio-Oss mixed with PABG were also included.

Outcome measures

The primary outcome measures are the most important measures for evaluating the final treatment outcome. Secondary outcome measures were also included in this systematic review as surrogate measures, due to the lack of studies focusing on the primary outcome measure.

The primary outcome measures were (1) the survival of suprastructures: loss of the suprastructure was defined as total loss due to a mechanical and/or biological complication; (2) the survival of implants: loss of implants was defined as non-integrated implants, mobility of previously clinically osseointegrated implants, and removal of non-mobile implants due to progressive peri-implant marginal bone loss or infection.

Moreover, the following secondary outcome measures were assessed: (1) bone regeneration, assessed by histological measurements; (2) width gained at the alveolar process, assessed by clinical or radiographic measurements; (3) width reduction of the graft material, assessed by two-dimensional measurements; (4) volumetric stability of the graft material, assessed by three-dimensional measurements; (5) patient-reported outcome measures; (6) complications related to the surgical procedure.

Search strategy

A search of the MEDLINE (PubMed), Cochrane Library, and Embase databases was conducted. Human studies published in English from 1 January 1990 to 1 May 2016 were included. The search strategy utilized a combination of controlled vocabulary terms (medical subject headings, MeSH) and free text terms. The headings were (alveolar ridge augmentation OR alveolar AND ridge augmentation) AND (lateral OR horizontal) AND (Bio-Oss OR bone substitute OR bovine bone OR xenograft).

The search was supplemented by a thorough hand-search, page by page, of relevant journals. The manual search also included the bibliographies of all articles selected for full-text screening, as well as previously published reviews relevant to the present systematic review. The search was performed by two reviewers (HCA and TJ). Any disagreement between the two observers was resolved by consensus.

Study selection

The titles of the identified reports were initially screened. The abstract was assessed when the title indicated that the study fulfilled the inclusion criteria. Full-text analysis was performed when the abstract was unavailable or when the abstract indicated that the inclusion criteria were fulfilled. The study selection process was performed by two reviewers (HCA and TJ). Any disagreement between the two observers was resolved by consensus.

Inclusion criteria

Human studies assessing the outcome of LRA with Bio-Oss alone or mixed with PABG were included; these studies addressed the previously described outcome measures. The review exclusively focused on studies applying LRA in non-prepared sites with delayed implant installation. In addition, at least five patients had to have been included in the study. Studies including both lateral and vertical ridge augmentation were included if the outcome measures for LRA alone could be clearly identified. Studies comparing Bio-Oss with autogenous bone graft alone were included if the outcome measures could be identified for Bio-Oss alone or in combination with PABG.

Exclusion criteria

Studies using Bio-Oss blocks alone[21] or Bio-Oss blocks in combination with granules were excluded if the outcome measures could not be identified for granules alone[22]. In addition, studies using an unknown ratio of Bio-Oss to PABG[23] were excluded, as well as studies applying immediate implant placement[24].

Quality assessment

A quality assessment of the included studies was undertaken by one review author (HCA) as part of the data extraction process. The quality assessment was performed according to the following

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