Bone augmentation procedures in localized defects in the alveolar ridge: clinical results with different bone grafts and bone-substitute materials

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CRD summary
The review concluded that no one grafting procedure for jaw bone defect types investigated could be identified as superior due to the considerable variability across studies. Despite the limitations of the review and included studies, this overall conclusion reflected the evidence presented and is likely to be reliable.

Authors' objectives
To evaluate the efficacy of different grafting procedures for the augmentation of localised alveolar ridge defects.

Searching
PubMed and the Cochrane Library were searched to 1 January 2008 for publications in any language; search terms were reported. Bibliographies of each retrieved article and the contents lists of 19 relevant journals were handsearched.

Study selection
Any study with at least 10 patients that evaluated different bone grafts and bone-substituting materials for the augmentation of localised alveolar ridge bone defects were eligible for inclusion. Included studies had to have at least 12 months follow-up after loading of the implants. Eligible studies could be of immediate or delayed implants, dental implant placement in the maxilla and/or mandible, or simultaneous augmentation with implant or augmentation with later implant placement.

Studies were excluded if: the bone defect was caused by tumour resection, osteonecrosis, peri-implantitis; there was simultaneous grafting of extraction socket or intra-alveolar defects; grafts were of complete ridges in severely atrophied edentulous jaws; results could not be separated for different procedures; or the grafting protocols used growth factors or other bioactive molecules.

The main outcome was implant survival. Other outcomes included: degree of defect reduction; complications; gain in ridge width and height; need for re-grafting or additional grafting; and healing times.

A wide range of interventions and protocols were used. Augmentations other than sinus augmentations tended to use a membrane (non-resorbable or resorbable membrane). The most common grafting materials were deproteinised bovine bone mineral and autogenous particulate. Other grafting materials used included: autogenous block; demineralised freeze-dried bone allograft; no graft (coagulum); autograft from bone trap; allograft (freeze-dried bone allograft or algal-derived or coral-derived); alloplast (hydroxyapatite, beta-tricalcium phosphate, bioglass or calcium sulphate). A third of studies used two grafting materials.

The authors did not report how many reviewers performed the selection.

Assessment of study quality
The authors did not state that methodological quality was assessed.

Data extraction
The authors extracted the following: proportion of implants surviving (median and range); overall complication and re-grafting rates; mean times to healing; and mean gain in ridge height or width.

The authors did not state how many reviewers performed the data extraction.

Methods of synthesis
The authors presented a narrative synthesis, ordered by type of augmentation. Differences between studies were
Results of the review
Thirteen RCTs (n=380 participants), one controlled clinical trial (n=44 participants), 44 prospective studies (n≥1,424 participants), 26 retrospective studies (n≥1,490 participants), and 24 case series (n=558 participants) met the inclusion criteria. Follow-up ranged from 12 to 106.8 months.

Dehiscence-type and fenestration-type defects: Median (range) implant survival rates were: 95.4% (93 to 100%; seven studies) overall; 96.5% (92.9 to 100%; four studies) for a non-resorbable membrane; and 95.4% (94 to 100%; nine studies) for a resorbable membrane.

Horizontal ridge augmentation: Implant survival was 100% (97 to 100%; 10 studies) overall and 100% (96.9 to 100%; seven studies) for autogenous block grafts.

Vertical ridge augmentation: Implant survival was 100% (95 to 100%; six studies) overall, 95 to 100% for autogenous block (six studies), 100% with autogenous particulate (one study), and 100% with demineralised freeze-dried bone allograft (one study).

Maxillary sinus floor elevation: Implant survival was: 95.5% (61.2 to 100%) overall; 100% (range 92 to 100%; 12 studies) with a membrane; 94.7% (61.2 to 100%; 27 studies) without a membrane; 96.8% (82 to 100%; 16 studies) for bone substitute; 94.2% (61.2 to 100%; 30 studies) for autograft with or without bone substitute; 84.9% (61.2 to 94.4%; 10 studies) for autogenous block; 97.1% (82.4 to 100%; six studies) for particulated autografts; 97% (85 to 100%; 10 studies) for deproteinised bovine bone mineral; 100% (96 to 100%; three studies) for alloplast particulate as hydroxyapatite; 100% for composite graft of particulated autograft and allograft (four studies); 94.3% (89 to 100%; five studies) for autografts with deproteinised bovine bone mineral; 90.7% (82.1 to 96.8%; three studies) for demineralised freeze-dried bone allograft and deproteinised bovine bone mineral; and 100% (97.7 to 100%) with no grafting material.

Transalveolar sinus floor elevation: Survival was 96% (83 to 100%) overall; 96% (91.4% to 97.3%; 3 studies) for no grafting material; 94.8% and 97.8% for autogenous bone (two studies); and 99% (95 to 100%; four studies) for deproteinised bovine bone mineral.

The results of further analyses were reported.

Authors' conclusions
The identification of one superior grafting procedure for any of the osseous defect types under investigation was not possible due to the heterogeneity of the available data. However, a series of grafting materials can be considered well-documented for different indications based on this review.

CRD commentary
The review addressed a well-defined question in terms of participants, interventions, study design and relevant outcomes, but in some ways the question was too wide. Relevant databases were searched, but only for studies published in English, so some relevant studies may have been missed. Publication bias was not assessed. Methods to reduce error and bias in the review process were not reported.

The authors did not report whether study quality was assessed, and little relevant detail was provided. Some typographical errors and inconsistencies between the table and text were noted. Some relevant study details were reported, but there were no details of the age or gender of patients or loss to follow-up. The decision to undertake a narrative synthesis was appropriate, given the heterogeneity across studies.

The authors' conclusion seems appropriate given the heterogeneity across the studies.

Implications of the review for practice and research
Practice: The authors stated that the decision whether to use a simultaneous or staged approach for maxillary sinus floor
elevation should be based on an individual evaluation of bone quality and quantity. They also suggest that for maxillary sinus floor elevation, it may be advantageous clinically to use an autogenous material to prevent foreign body-related sinus infection.

**Research:** The authors did not state any implications for research.

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