Bone augmentation procedures in implant dentistry

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CRD summary
The authors concluded that it was difficult to demonstrate that one surgical procedure for reconstruction of edentulous deficient alveolar was superior to others. Although the authors' cautious conclusions reflected the evidence presented, the uncertain quality of the included studies and potential for missed studies and language bias mean that the authors' conclusions should be interpreted with caution.

Authors' objectives
To assess the success of different surgical techniques for the reconstruction of edentulous deficient alveolar ridges and the survival/success rates of implants placed in the augmented areas.

Searching
MEDLINE and 16 relevant journals were searched from 1975 to January 2008 for full-text studies published in English; search terms were reported. Reference lists of relevant studies were manually searched for additional studies.

Study selection
Studies with at least 10 consecutively treated patients who presented with deficient edentulous ridges following atrophy, periodontal disease and trauma sequelae were eligible for inclusion. Studies had to have a mean of one year follow-up after commencement of prosthetic loading. Patients affected by bone defects following ablation for tumours or osteoradionecrosis, or bone defects related to congenital malformations (including cleft lip and palate or major craniofacial malformations) were excluded. Only studies that used endosseous root-form titanium implants were eligible. Procedures considered were: onlay bone grafts; sinus floor elevation via a lateral approach; Le Fort I osteotomy with interpositional grafts; split ridge/ridge expansion techniques; and alveolar distraction osteogenesis. Outcomes included the success and related morbidity of augmentation procedures and survival/success rates of implants placed in the augmented sites.

In the included studies, details for each of the five interventions varied. For onlay bone grafts, in just over half of the sites the type of atrophy was in the maxilla and the ilium was the most frequent donor site; approximately half of all implants were reported as being placed at the same time as construction. For sinus floor elevation via a lateral approach, grafting material varied and over 60% of patients received a mixture of materials; 40% of implants were reported as being placed at the same time as augmentation. For Le Fort I osteotomy with interpositional grafts, all patients were treated for extreme atrophy of the edentulous maxilla and the donor site for most studies was the ilium; approximately half of all implants were placed during surgery. For split ridge/ridge expansion techniques, the defect site was the maxilla in most studies; all patients received implants at the time of the expansion procedure. For alveolar distraction osteogenesis, most studies assessed intraoral/intraosseous devices for maxilla and/or mandibular augmentation; most implants were placed two to three months after the completion of distraction.

Two reviewers independently screened titles and abstracts for inclusion.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Data were extracted for procedure success and implant survival and success rates; the authors did not state how many reviewers performed the data extraction.

Methods of synthesis
A narrative synthesis was conducted, with results grouped according to type of surgical intervention.
Results of the review

Onlay bone grafts:

Twenty-six studies (n=893 patients, 4,390 implants) were included: five prospective and 21 retrospective studies. Follow-up ranged from six to 240 months.

Overall survival rate of implants placed in reconstructed maxillae and mandibles was 87% (range 60% to 100%). Overall survival rate of implants placed in reconstructed maxillae (one- and two-stage placement) was 79.5% (range 60% to 100%) compared with 94.8% (range 88% to 100%) for implants placed in reconstructed mandibles.

Sinus floor elevation via a lateral approach:

Fifty-nine studies (n=4,630 patients, 13,889 implants) were included: two randomised trials, four controlled clinical trials, 12 prospective and 11 retrospective studies. Follow-up ranged from six to 144 months.

Overall implant survival rates ranged from 60% to 100% and in most studies rates were greater than 90%. The success rate of implants ranged from 75% to 100% (22 studies). Survival rates of implants undertaken with the grafting procedure ranged from 61% to 100% and for staged approach were from 73% to 100%.

Le Fort I osteotomy with interpositional grafts:

Thirteen studies (n=261 patients, 1,795 implants) were included: one prospective and 12 retrospective studies. Follow-up ranged from six to 144 months.

Overall implant survival rate ranged from 67% to 95% for implants placed in a staged approach compared with 79% to 95% for implants placed during the reconstructive procedure. A lower survival rate was noted for machine-surfaced implants (mean 85%) compared with rough-surfaced implants (mean 90%).

Split ridge/ridge expansion techniques:

Four studies (n=542 patients, 1,182 implants) were included: one prospective clinical study and three retrospective studies. Follow-up ranged from one to 93 months.

Procedure success rates ranged from 98% to 100%. Implant survival rates ranged from 91% to 97% and success rates from 86% to 98%. No studies that assessed split-ridge techniques with interpositional bone grafts met the inclusion criteria.

Alveolar distraction osteogenesis:

Seven studies (n=181 patients, 462 implants) were included: four prospective and three retrospective studies. Follow-up ranged from six to 72 months.

Overall survival rate was 96% (range 88% to 100%) and overall success rate was 99%.

Authors' conclusions

It was difficult to demonstrate that one surgical procedure offered better outcomes than another; all had advantages and disadvantages. Whether some surgical procedures (such as reconstruction of atrophic edentulous mandibles with onlay autogenous bone grafts or maxillary sinus grafting procedures in case of limited/moderate sinus pneumatisation) improved long-term implant survival was unknown.

CRD commentary

The review question and inclusion criteria were clear. Relevant data sources were searched, but these included only one relevant database. The restriction to published English-language studies meant that some relevant trials may have been missed and language bias could not be ruled out. There were no reported attempts to locate unpublished material, which meant that publication bias was a possibility. Attempts were made to minimise error and bias in the processes of study
selection; it was unclear whether this applied to data extraction. No formal assessment of validity was reported, so the reliability of the evidence was difficult to determine. The authors acknowledged that most studies appeared to be of poor methodological quality. A narrative synthesis was undertaken, which was appropriate given the disparity in the included studies.

The authors’ cautious conclusions reflected the evidence presented, but the uncertain quality of the included studies and potential for missed studies and language bias mean that the authors’ conclusions should be interpreted with caution.

**Implications of the review for practice and research**

**Practice:** The authors stated procedures that were simpler and less invasive, involved less risk of complications and reached their goals within the shortest time frame should be given priority.

**Research:** The authors stated that larger well-designed long-term trials were needed to assess which techniques were the most effective.

**Funding**

Not stated.

**Bibliographic details**


**PubMedID**

19885448

**Original Paper URL**

http://www.quintpub.com/journals/omi/abstract.php?iss2_id=471&amp;article_id=5741&amp;article=18&amp;title=Bone_Augmentation_Procedures_in_Implant_Dentistry

**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Alveolar Bone Loss /surgery; Alveolar Ridge Augmentation /methods; Bone Substitutes; Bone Transplantation /methods; Dental Implantation, Endosseous; Dental Implants; Dental Restoration Failure; Humans; Maxillary Sinus /surgery; Oral Surgical Procedures, Preprosthetic; Osseointegration; Osteogenesis, Distraction; Osteotomy, Le Fort; Treatment Outcome

**AccessionNumber**

12010001058

**Date bibliographic record published**

09/06/2010

**Date abstract record published**

22/12/2010

**Record Status**

This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.