Clinical outcomes of implants following lateral bone augmentation: systematic assessment of available options (barrier membranes, bone grafts, split osteotomy)

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CRD summary
Tooth implants in sites with lateral bone augmentation techniques had similar survival rates to implants placed in pristine sites. Some methodological limitations precluded firm judgements about the reliability or otherwise of the authors' conclusions.

Authors' objectives
To evaluate the survival and success of tooth implants using different lateral ridge augmentation procedures compared to implants placed in sites with no lateral ridge augmentation.

Searching
MEDLINE and EMBASE were searched up to November 2007 for relevant articles in English, German, French or Italian. Search terms were reported. The reviewers checked the reference lists of relevant reviews for further studies.

Study selection
Prospective longitudinal studies that reported on endosseous dental implant survival or success in jaws where lateral augmentation procedures had been performed with at least six months of loading were eligible for inclusion. A minimum of 10 patients in controlled studies were required; case series studies with fewer than 15 patients were excluded. Studies of medically compromised patients (such as cancer and uncontrolled diabetes mellitus) were excluded as were studies of major maxillofacial reconstructions, socket preservation techniques for bone augmentation, lateral augmentation procedures without loading for more than six months and studies of other implant types (transmandibular implants, zygomatic implants, implants used for anchorage therapy, maxillofacial prosthesis or other non-dental uses) were excluded.

The lateral augmentation approaches evaluated in the review were guided bone regeneration, block and particulate bone grafts and ridge expansion techniques using split ridge osteotomy. Implants were placed in both upper and lower jaws and in both anterior and posterior sites. A number of different approaches were used across the included studies to quantify the success or otherwise of the implants.

Two reviewers independently selected studies for inclusion using a three-stage screening process. Discrepancies were resolved by discussion or if necessary, a third reviewer. Kappa scores were calculated to evaluate inter-reviewer agreement.

Assessment of study quality
Two reviewers independently assessed methodological quality in terms of similarity of study groups, blinding of outcome assessors, explicitness of inclusion criteria and completeness of follow-up using criteria adapted from Khan et al. Studies were classified as being either low, medium or high risk of bias by the reviewers.

Data extraction
Two reviewers independently extracted data which were tabulated and summarised according to the technique used to achieve the graft.

Methods of synthesis
Although a meta-analysis was planned by the reviewers, a narrative synthesis was provided due to significant heterogeneity of data in the included studies.

Results of the review
Four controlled studies (126 patients, 450 implants) that comprised three non-randomised clinical trials and one cohort study were included in the review. Three studies were judged to have a high risk of bias; the remaining study had a
medium risk of bias. Mean follow-up across the four studies ranged between 12 and 59 months with a range of 21 and 82 months.

Guided bone regeneration (two studies, 303 implants):

In one study (38 implants) that compared guided bone regeneration with implants in pristine sites, at 24 months there were no significant differences found in implant survival (100% for both treatment arms), radiographic marginal bone loss between guided bone regeneration and pristine fixtures and in marginal bone loss between fixtures that presented dehiscence or fenestration effects.

In a second study (265 implants), implant survival at 59 months was 95.4% for guided bone regeneration treated with demineralised bovine bone particles (collagen), 92.6% for guided bone regeneration treated with e-PTFE non-resorbable membrane and 97.3% for the control group treated using pristine sites. There were statistically significant increases in mean marginal bone levels for the guided bone regeneration groups compared with controls (p<0.0001) and the e-PTFE treatment (2.21 ± 1.26 mm) was associated with higher marginal bone levels than use of guided bone regeneration with collagen membranes (1.83 ± 0.63 mm).

Complications with use of guided bone regeneration included redness, hyperplasia, suppuration, pain and swelling and exposure of threads in a limited number of fixtures. Increased marginal bone levels were associated with mucosal problems and recession (p<0.0001).

Autogenous bone graft (one cohort study, 35 implants): At follow-up of 12 months post loading, implant survival was 100% for the intervention group with implants augmented with block bone grafts and the control group for whom implants were placed in pristine sites. Augmentation led to increases in bone width for implant placement from 3.2 ± 0.3 mm to 6.4 ± 0.3 mm.

Bone substitute (one study, 112 implants): At the intervention (use of calcium carbonate) sites, four of 52 implants were lost before loading and four implants at follow-up of 55 months with a survival rate of 91.7% with removal from the analysis of the early implant failures. At the pristine sites, one implant was lost before loading and four implants were lost at 59 months follow-up with a survival rate of 93.2%.

Authors’ conclusions
Use of different lateral bone augmentation techniques when placing tooth implants were associated with similar survival rates of implants compared with implants placed in pristine sites. However, methodological issues in the included studies limited the conclusions and recommendations for clinical practice.

CRD commentary
The review addressed a clear question. Criteria for inclusion were stipulated. The restriction of the review to studies published in certain languages meant that there was a risk of language bias. There was no attempt to search for unpublished literature, which meant there was a risk of publication bias. There were discrepancies between the stated inclusion criteria and the studies that were included in the analysis. The authors summarised the results of excluded studies in the review. Steps were taken to minimise risk and bias throughout all steps of the review process. The reviewers' decision to summarise the results narratively was justified given the heterogeneity of the augmentation procedures and data in the included studies. There were few studies and a limited data set from which the authors' conclusions were based. Some methodological limitations precluded firm judgements about the reliability or otherwise of the authors' conclusions.

Implications of the review for practice and research
Research: The authors stated that further randomised trials were required that compared the clinical outcomes of implants placed following different lateral augmentation procedures with follow-up periods of at least five years after functional loading of the implant.

Practice: The authors stated that patients treated with simultaneous or staged lateral augmentation procedures would need to be informed of the lack of comparative studies on the clinical outcomes of implants in augmented sites.

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