Mini-implants in orthodontics: a systematic review of the literature
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CRD summary
This review assessed the success and complications encountered with mini-implants for orthodontic anchorage as well as factors associated with success or failure. The authors acknowledged the poor quality of included studies and concluded that within- and between-study heterogeneity, lack of clarity and poor methodology ensured that the study question remained largely unanswered by the available evidence.

Authors' objectives
To quantify the success and complications encountered with the use of mini-implants for orthodontic anchorage and to assess factors associated with success or failure.

Searching
PubMed via MEDLINE, EMBASE, Science Direct, EBM Reviews and Web of Science databases and Ovid, Google Scholar and Bandolier search engines were searched to March 2008 for studies published in English, French, German or Italian; search terms were reported. Manual searches of seven relevant journals were undertaken and reference lists of included articles were searched manually to identify additional articles.

Study selection
Studies of at least 10 implants in patients of any age who required absolute anchorage for orthodontic purposes and reported success rates of mini-implants less than 2.5mm in diameter were eligible for inclusion. Studies had to provide a definition of success after 120 days of force application that was reported at a predetermined time or at completion of orthodontic anchorage objectives. Studies on miniplates were excluded, as were articles that dealt with technique or opinions, case reports, reviews and in-vitro studies.

Primary outcomes (immobility, mobility, displacement and failure) were success or failure of mini-implants as anchorage devices during orthodontic tooth movement. Secondary outcomes incorporated complications that arose from treatment (biologic damage, inflammation and pain and discomfort measures).

In included studies, force levels varied from 50g to 400g; most studies used 200g or less. Duration of force application varied from three to 37 months. Timing of assessment of study outcomes varied from three to 27 months after application of orthodontic forces. Implant types varied between and within included studies. Implant diameters ranged from 1.0mm to 2.3mm. Mean age of participants ranged from 12.2 to 34.3 years. Most participants were female.

Two reviewers independently selected studies for inclusion in the review. Disagreements were resolved by consensus.

Assessment of study quality
The authors did not state that they assessed validity. Two reviewers undertook an assessment of study reporting quality using the following criteria: definition of success; study design; description of methodology; and control of variables. Each criteria was allocated one point for a clear description. Studies were rated clear (3 or 4 points), partially clear (2 points) or unclear (0 or 1 point). The authors recorded whether studies were prospective or retrospective. Disagreements were resolved by consensus.

Data extraction
Two reviewers extracted primary and secondary outcomes as percentages; disagreements were resolved by consensus.

Methods of synthesis
A narrative synthesis was provided, supported by tables. Differences between studies were discussed in the text.

Results of the review
Nineteen studies were included in the review (total n=at least 990, range eight to 209); nine prospective studies; eight
retrospective studies; and study design not described for two studies. Reporting quality rated five studies as clear, eight as partially clear and six as unclear.

Five studies did not specify the type of primary outcomes. Immobile screws were considered successful in seven studies. Five studies accepted mobility. Rates of primary outcomes ranged from 0% to 100%. If usable mobile and displaced implants were included as successful, success rates were generally greater than 80%. Three studies reported no biologic damage. Inflammation varied from 0% to 34% (six studies). Pain and discomfort ranged from 0% to 80% (four studies).

No studies that proposed variables associated with implant success met inclusion criteria; factors selected as independent variables were not controlled.

Authors' conclusions
Mini-implants can be used as temporary anchorage devices, but research in this field was still in its infancy. Interpretation of the findings was conditioned by a lack of clarity and poor methodology in most studies. Questions of patient acceptability, rate and severity of adverse effects of mini screws, and variables that influenced success remained unanswered.

CRD commentary
The review question and inclusion criteria were clear. A thorough search for studies with some language restrictions was undertaken; language bias may have been present. There was no apparent search for unpublished studies and so some studies may have been missed. Appropriate measures to reduce reviewer bias and error were taken for study selection and data extraction. Reporting quality of studies was assessed. Methodological quality of included studies was not assessed formally, but the authors acknowledged the poor quality of included studies. Most studies contained small samples with over half containing less than 50 participants. Due to heterogeneity within and between included studies, the authors' decision to present the findings in a narrative synthesis was appropriate. The authors' conclusions appeared to reflect the limited available evidence. As acknowledged by the authors, the poor quality of included studies should be considered when interpreting the findings.

Implications of the review for practice and research
**Practice:** The authors stated that monitoring of occlusion and tongue jiggling as well as implant mobility and orthodontic forces should be implemented as part of the implant-maintenance protocol.

**Research:** The authors stated that randomised clinical trials were required to assess the different outcomes between mini-implants and other forms of anchorage. A standardised methodology should be used to analyse primary and secondary outcomes of mini-implants in orthodontic treatment protocols.

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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.