A systematic review on the accuracy and the clinical outcome of computer-guided template-based implant dentistry

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CRD summary
The authors concluded that survival rates of implants placed with computer-guided technology were comparable to conventionally placed implants. A considerable number of technique-related perioperative complications were observed. Given the reliance on case series and cohort studies and the lack of reporting on study selection and study quality assessment, the reliability of the authors’ conclusions are unclear.

Authors' objectives
To evaluate the clinical performance of computer-guided template dentistry. Accuracy was also evaluated, but is not reported in this abstract.

Searching
PubMed was searched from 1966 to 2007. Search terms were reported. Unspecified English-language dental journals were searched from January 2008 to February 2009. Unspecified topic-related dental journals and reference lists of selected articles were handsearched.

Study selection
Eligible studies were of any design with a minimum of five patients that used static surgical template-based computer-guided implant systems. Studies that used dynamic navigation systems, zygoma implants, pterygoid implants or mini-implants for orthodontic purposes of epipodes and studies that exclusively reported on radiographic planning were excluded from the review. Outcomes of interest were: early (two weeks postoperatively) surgical complications or unexpected events, early prosthetic complications, late (12 months or more) implant failures and late prosthetic complications.

Age range varied widely between studies. Mean patient age was 55.3 years (range 18 to 90) where reported. Six different systems of computer-guided implant surgery were used: CADImplant, Praxim; NobelGuide, Nobel Biocare; Med3D, Med3D GmbH; coDiagnostiX, IVS-Solutions; SimPlant, Materialise; and Stent CAD, Media Lab. Most studies used stereolithographically produced surgical templates (rapid prototyping). Other studies used laboratory fabricated surgical guides for implant placing based on computer-assisted implant planing. All studies included completely edentulous teeth and most studies included partially edentulous teeth.

The authors did not state how many reviewers performed study selection.

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

Data extraction
Data on the number of patients who experienced each outcome of interest were extracted in order to calculate percentages of patients who experienced the outcome.

Two reviewers independently performed data extraction. Any disagreements were resolved by discussion.

Methods of synthesis
Percentage of patients who experienced each outcome (early surgical complications, early prosthetic complications, late implant failures, late prosthetic complications) were presented in tables.

Results of the review
Ten prospective studies (case series and cohort design, number not reported) (468 patients and 1,793 implants) were included in the review. Follow-up ranged from zero to 60 months.

**Early surgical complications:** Eight studies (428 patients, 1,581 implants) reported on early surgical complications. Thirty-nine patients (9.1%) experienced an early surgical complication. The most common complication was limited access in posterior areas (10 patients, 2.3%). Other common early surgical complications included primary bone augmentation necessary (eight patients, 1.9%), unexpected bony dehiscence (three patients, 0.7%), fracture of template (three patients, 0.7%) and infection at drill site pins (three patients, 0.7%).

**Early prosthetic complications:** Three studies (69 patients, 438 implants) reported on early prosthetic complications. Thirteen patients (18.8%) experienced an early prosthetic complication. The most common early prosthetic complication was misfit of abutment to bridge (five patients, 7.2% of patients). Other common early prosthetic complications included extensive adjustments of the occlusion (three patients, 4.3%) and incomplete seating of prosthesis (two patients, 2.9%).

**Late implant failures:** Six studies (138 patients, 721 implants) reported on implant failures after a minimum of 12 months. In four of these studies (101 patients, 537 implants), 37 implants (6.9%) failed during the follow-up period. The implant failure rate was reported to be higher in open flap surgery with delayed loading compared to flapless surgery with immediate loading procedures. Two studies (37 patients, at least 184 implants) had no implant failures.

**Late prosthetic complications:** Five studies (108 patients) reported on late prosthetic complications. Two studies (39 patients, at least 71 implants) had no prosthetic complications. In three studies (69 patients, 438 implants), all of which used a flapless procedure with immediate loading, 13 patients (12%) experienced complications.

**Authors’ conclusions**
Survival rates of implants placed with computer-guided technology were comparable to conventionally placed implants. A considerable number of technique-related perioperative complications were observed.

**CRD commentary**
The inclusion criteria were broad. The search strategy was limited to one database and it appeared that no attempts were made to locate unpublished material, so relevant studies may have been missed. The authors did not state how many reviewers were involved in study selection, so it was unclear whether this review process was subject to reviewer error or bias. Data extraction was performed by two reviewers, which reduced the risk of reviewer error. There was no assessment of study quality, so the reliability of data from the included studies could not be assessed. The authors acknowledged that the observation period of the studies was short and that little variety of computer-guided template-based implant systems was used. Given the reliance on case series and cohort studies, the best evidence available, and the lack of reporting on study selection and study quality assessment, the reliability of the authors’ conclusions are unclear.

**Implications of the review for practice and research**
**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that further research should involve clinical studies with long-term follow-up and strive for improvement of the systems and procedures regarding accuracy, predictability and reproducibility of implant placement as well as surgical and prosthetic outcomes.

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