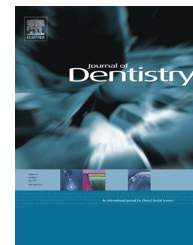


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Review

Tilted versus axially placed dental implants: A meta-analysis

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ABSTRACT

Objectives: The purpose of the present review was to test the null hypothesis of no difference in the implant failure rate, marginal bone loss, and postoperative infection for patients being rehabilitated by tilted or by axially placed dental implants, against the alternative hypothesis of a difference.

Methods: An electronic search without time or language restrictions was undertaken in July 2014. Eligibility criteria included clinical human studies, either randomised or not, interventional or observational. The estimates of an intervention were expressed in risk ratio (RR) and mean difference (MD) in millimetres.

Results: The search strategy resulted in 44 publications. A total of 5029 dental implants were tilted (82 failures; 1.63%), and 5732 implants were axially placed (104 failures; 1.81%). The difference between the procedures did not significantly affect the implant failure rates ($P = 0.40$), with a RR of 1.14 (95% CI 0.84–1.56). A statistically significant difference was found for implant failures when studies evaluating implants inserted in maxillae only were pooled (RR 1.70, 95% CI 1.05–2.74; $P = 0.03$), the same not happening for the mandible (RR 0.77, 95% CI 0.39–1.52; $P = 0.45$). There were no apparent significant effects of tilted dental implants on the occurrence of marginal bone loss (MD 0.03, 95% CI –0.03 to 0.08; $P = 0.32$). Due to lack of satisfactory information, meta-analysis for the outcome ‘postoperative infection’ was not performed.

Conclusions: It is suggested that the differences in angulation of dental implants might not affect the implant survival or the marginal bone loss. The reliability and validity of the data collected and the potential for biases and confounding factors are some of the shortcomings of the present study.

Clinical significance: The question whether tilted implants are more at risk for failure than axially placed implants has received increasing attention in the last years. As the philosophies of treatment alter over time, a periodic review of the different concepts is necessary to refine techniques and eliminate unnecessary procedures. This would form a basis for optimum treatment.

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1. Introduction

The loss of posterior teeth, particularly at an early age, leads to the loss of alveolar bone with a relative surfacing of the inferior alveolar nerve in the mandible, thus often prohibiting placement of implants in the posterior regions.¹ Bone grafting and the use of short implants have been proposed to overcome these anatomic limitations. An alternative could be the inferior alveolar nerve lateral transposition² or the use of tilted implants, which allows for maximum use of the existing bone and placement of posterior fixed teeth with minimum cantilevers, in a region where bone height and nerve proximity does not allow for the placement of axial implants.¹ Concerning the upper jaw, implant anchorage in the totally edentulous maxilla is often restricted owing to bone resorption, which is especially frequent in the posterior region of the maxillary arch, where bone grafting is often indicated.³ There is also the problem of the pneumatization, an inferior expansion of the maxillary sinus in relation to fixed anatomic landmarks which develops with time after the extraction of the posterior maxillary teeth. Pterygomaxillary and zygomatic implants could be used, but these techniques present considerable surgical complexity.⁴⁻⁶ The use of tilted implants in the anterior or posterior maxillary sinus walls may be used instead of maxillary sinus elevation or bone grafts, resulting in a simpler and less time-consuming treatment, in significantly less morbidity, in decreased financial costs associated with those procedures, and in a more comfortable postsurgical period for the patients.^{7,8}

Researchers have been trying to evaluate whether the insertion of tilted implants may influence the survival of dental implants. However, some studies may lack statistical power, given the small number of patients per group in the clinical trials comparing the techniques. The ability to anticipate outcomes is an essential part of risk management in an implant practice. Recognising conditions that place the patient at a higher risk of failure will allow the surgeon to make informed decisions and refine the treatment plan to optimise the outcomes.⁹ The use of implant therapy in special populations requires consideration of potential benefits to be gained from the therapy. To better appreciate this potential, we conducted a systematic review and meta-analysis to compare the survival rate of dental implants, postoperative infection, and marginal bone loss of tilted and axially placed dental implants.

2. Materials and methods

This study followed the PRISMA Statement guidelines.¹⁰ A review protocol does not exist.

2.1. Objective

The purpose of the present review was to test the null hypothesis of no difference in the implant failure rate, marginal bone loss, and postoperative infection for patients being rehabilitated by tilted or by axially placed dental implants, against the alternative hypothesis of a difference.

2.2. Search strategies

An electronic search without time restrictions was undertaken (and last checked) in July 2014 in the following databases: PubMed, Web of Science, and the Cochrane Oral Health Group Trials Register. The following terms were used in the search strategy on PubMed:

((dental implant) OR oral implant) AND (((tilted) OR angulated) OR axial) OR upright] [all fields]

The following terms were used in the search strategy on Web of Science, in all databases:

((dental implant) OR oral implant) AND (((tilted) OR angulated) OR axial) OR upright] [topic]

The following terms were used in the search strategy on the Cochrane Oral Health Group Trials Register:

(dental implant OR oral implant AND (tilted OR angulated OR axial OR upright))

A manual search of dental implants-related journals was also performed. The reference list of the identified studies and the relevant reviews on the subject were also scanned for possible additional studies. Moreover, online databases providing information about clinical trials in progress were checked (clinicaltrials.gov; www.centerwatch.com/clinical-trials; www.clinicalconnection.com).

2.3. Inclusion and exclusion criteria

Eligibility criteria included clinical human studies, either randomised or not, interventional or observational, comparing implant failure rates in any group of patients receiving tilted or axially placed dental implants. Zygomatic implants were not considered. For this review, implant failure represents the complete loss of the implant. Exclusion criteria were case reports, technical reports, animal studies, *in vitro* studies, biomechanical studies, finite element analysis (FEA) studies, and reviews papers.

2.4. Study selection

The titles and abstracts of all reports identified through the electronic searches were read independently by the three authors. For studies appearing to meet the inclusion criteria, or for which there were insufficient data in the title and abstract to make a clear decision, the full report was obtained. Disagreements were resolved by discussion between the authors.

2.5. Quality assessment

Quality assessment of the studies was executed according to the Newcastle-Ottawa scale (NOS).¹¹ The NOS calculates the study quality on the basis of 3 major components: selection, comparability, and outcome for cohort studies. It assigns a maximum of 4 stars for selection, a maximum of 2 stars for comparability, and a maximum of 3 stars for outcome.

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