

# INPLASY

## Effect of Zinc-Coated Dental Implants on Osseointegration Outcomes: A Systematic Review and Meta-analysis

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### ADMINISTRATIVE INFORMATION

**Support** - Qassim University.

**Review Stage at time of this submission** - Preliminary searches.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY202630100

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 March 2026 and was last updated on 27 March 2026.

### INTRODUCTION

**Review question / Objective** To assess the effects of zinc-coated titanium implants on osseointegration.

**Rationale** The surface modification of dental implants has been widely studied to enhance osseointegration; however, the therapeutic effects of zinc-impregnated coatings remain controversial.

**Condition being studied** Titanium (Ti) implants, which were modified or coated with zinc.

### METHODS

**Search strategy** A complete electronic search was performed in January 2026 on PubMed, Web of Science, and Scopus. A search strategy was conducted using keywords, including “bone formation,” “implants,” “zinc,” and “animal studies.” The key search terms were (“osseointegration” OR “bone formation” OR “bone growth” OR “bone regeneration” OR “bone

remodeling”) AND (“implants” OR “titanium implants” OR “dental implants” OR “bone-implant interface”) AND (“zinc” OR “zinc nanoparticles” OR “zinc coating” OR “Zn” OR “antibacterial” OR “antimicrobial”) AND (“animal model” OR “animal experimentation”). Reference lists of the included studies were reviewed for additional related articles.

**Participant or population** Animal models.

**Intervention** Titanium (Ti) implants, which were modified or coated with zinc.

**Comparator** Unmodified Ti implants with zinc.

**Study designs to be included** Evaluation of titanium (Ti) implants, which were modified or coated with zinc; (3) a comparison group comprising unmodified Ti implants with zinc.

**Eligibility criteria** The eligibility criteria for the studies were as follows: (1) conducted on animal models; (2) an evaluation of titanium (Ti) implants,

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which were modified or coated with zinc; (3) a comparison group comprising unmodified Ti implants with zinc; and (4) reported quantitative parameters indicating bone formation related to Ti implants, including the bone-to-implant contact ratio (BIC), bone area measured around the implant site (BA), or bone volume/total volume (BV/TV). English-language studies were included. In vitro studies, clinical human studies, reviews, case reports, and those without sufficient quantitative data were excluded.

**Information sources** A complete electronic search was performed in January 2026 on PubMed, Web of Science, and Scopus..

**Main outcome(s)** Bone-to-implant contact ratio (BIC), bone area measured around the implant site (BA), or bone volume/total volume (BV/TV).

**Data management** Data were extracted with a pre-tested form. The extracted data consisted of study characteristics (author and year), coating method, form of zinc, animal model, number of animals per group and total implants tested, duration of healing time before analysis, and quantitative outcomes (BIC, BA, or BV/TV).

**Quality assessment / Risk of bias analysis** Study quality was evaluated using the ARRIVE 2.0 reporting guidelines for animal research [44]. The ARRIVE guidelines consist of 21 items. Each item scored 2 points (reported), 1 point (unclear), or 0 points (not reported). Thereafter, the quality coefficient will be measured to classify the studies as excellent (0.8–1), average (0.5–0.8), or poor (<0.5).

**Strategy of data synthesis** The data were quantitatively synthesized when possible. Weighted mean differences with 95% CI were used for continuous outcomes (i.e., BIC, BA, and BV/TV). The  $I^2$  statistic was used to investigate heterogeneity. In cases of significant heterogeneity, a random-effects model was applied; otherwise, a fixed-effect model was implemented. Meta-analyses were performed with Review Manager (RevMan) software (Version 5.3.3).

**Subgroup analysis** Not planned.

**Sensitivity analysis** Not planned.

**Language restriction** English-language studies.

**Country(ies) involved** Saudi Arabia.

**Keywords** Dental implants; Osseointegration; Zinc coating; Surface modification; Bone regeneration; Meta-analysis.

#### Contributions of each author

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