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The Clinical Efficacy of Onlay Restoration for Tooth Defect After Root Canal Treatment: A Systematic Review and Meta-Analysis

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ADMINISTRATIVE INFORMATION**Support** - No support.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100118**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 28 October 2026 and was last updated on 28 October 2026.**INTRODUCTION**

Review question / Objective To systematically evaluate the efficacy of onlay versus full crown restoration after root canal treatment, providing evidence-based support for the restoration of tooth defects.

Condition being studied Tooth defects following root canal treatment are a common clinical problem due to the loss of tooth structure during endodontic procedures and the reduced structural integrity of treated teeth. Appropriate coronal restoration is essential to protect the remaining tooth structure, restore masticatory function and aesthetics, and improve long-term tooth retention. Full crown restoration has traditionally been used to restore endodontically treated teeth, whereas onlay restoration has emerged as a minimally invasive alternative that preserves more healthy tooth structure. However, the comparative clinical efficacy of these two restorative approaches remains uncertain. This systematic review and

meta-analysis aims to evaluate and compare the clinical outcomes of onlay and full crown restorations for tooth defects following root canal treatment.

METHODS

Participant or population Patients with tooth defects following root canal treatment who require coronal restorative treatment, particularly those with premolars or molars requiring restoration, will be included. No restrictions on age or sex will be applied, provided that the participants meet the eligibility criteria of the original randomized controlled trials.

Intervention The intervention is onlay restoration for tooth defects following root canal treatment. Onlay restorations include partial-coverage restorations intended to restore the morphology and function of the affected teeth while preserving as much sound tooth structure as possible. Different restorative materials and fabrication

techniques will be considered according to the included studies.

Comparator The comparator is full crown restoration for tooth defects following root canal treatment. Full crown restorations provide complete coronal coverage of the prepared tooth. Different restorative materials and fabrication techniques will be considered according to the included studies.

Study designs to be included Randomized controlled trials (RCTs) comparing onlay restoration with full crown restoration in patients with tooth defects following root canal treatment will be included. Only original clinical studies providing relevant outcome data will be eligible.

Eligibility criteria Studies will be eligible if they meet the following criteria: (1) include patients requiring restorative treatment for tooth defects following root canal treatment; (2) compare onlay restoration with full crown restoration; (3) report relevant clinical outcomes, including overall restoration success or failure, restoration integrity, marginal adaptation, marginal discoloration, surface texture, periodontal status, secondary caries, or food impaction; (4) assess outcomes using recognized criteria, such as the modified United States Public Health Service (USPHS) criteria or the World Dental Federation (FDI) criteria; and (5) use a randomized controlled trial design.

Studies published in Chinese or English from database inception to December 2025 will be considered. Duplicate reports, case reports, review articles, conference papers, other non-original research, and studies without extractable valid data will be excluded. When multiple reports originate from the same study or research center, the most recent eligible report or the report with the longest follow-up, as appropriate, will be selected to avoid duplication of data.

Information sources The following electronic databases will be searched from their inception to December 2025: PubMed, Embase, the Cochrane Library, China National Knowledge Infrastructure (CNKI), Wanfang Data, and the Chinese Scientific Journal Database (VIP). Both Chinese and English search strategies will be used, combining Medical Subject Headings (MeSH), free-text terms, and Boolean operators. Search terms will cover root canal treatment, onlay restoration, dental inlays, and full crown restoration, together with relevant synonyms. The detailed search strategies are provided in Supplementary Material 1 of the manuscript.

No additional information sources, such as trial registries, grey literature databases, or direct contact with study authors, are specified in the manuscript.

Main outcome(s) The primary outcome is the overall restoration success rate following root canal treatment, comparing onlay restoration with full crown restoration.

Secondary outcomes include restoration integrity, marginal adaptation, marginal discoloration, surface texture, periodontal status, secondary caries, and food impaction. These outcomes will be evaluated according to the modified United States Public Health Service (USPHS) criteria or, where applicable, the World Dental Federation (FDI) criteria. For USPHS-based assessments, clinically acceptable outcomes and clinical failures will be compared according to the definitions reported in the original studies.

Dichotomous outcomes will be expressed as relative risks (RRs) with 95% confidence intervals (CIs). Outcomes will be assessed at the follow-up time points reported in the included studies. No single uniform follow-up time point is specified because follow-up durations vary across studies.

Quality assessment / Risk of bias analysis Two researchers will independently assess the methodological quality and risk of bias of the included randomized controlled trials. Disagreements will be resolved through discussion.

The Cochrane Risk of Bias Assessment Tool will be used to assess random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, completeness of outcome data, selective outcome reporting, and other potential sources of bias. Each item will be classified as having a low, high, or unclear risk of bias.

The modified Jadad scale will also be used to assess randomization, allocation concealment, blinding, and the reporting of withdrawals and dropouts. Scores of 4–7 will indicate high methodological quality, scores of 1–3 will indicate low methodological quality, and studies scoring 0 will be excluded from the analysis, as specified in the manuscript.

Strategy of data synthesis Statistical analyses will be performed using Stata version 15.0. For dichotomous outcomes, pooled relative risks (RRs) and corresponding 95% confidence intervals (CIs) will be calculated to compare onlay restoration with full crown restoration.

Statistical heterogeneity will be assessed using the chi-square test and the I^2 statistic. A fixed-effect

model will be used when $P \geq 0.10$ and $I^2 \leq 50\%$, indicating limited heterogeneity. A random-effects model will be used when $P > 0.10$, indicating substantial heterogeneity, in accordance with the criteria described in the manuscript.

The primary analysis will compare the overall restoration success rates between the two groups. Separate meta-analyses will be conducted for restoration integrity, marginal adaptation, marginal discoloration, surface texture, periodontal status, secondary caries, and food impaction when sufficient data are available. Studies using FDI criteria will be summarized narratively when quantitative pooling is not feasible.

Sensitivity analyses will be conducted to evaluate the robustness of the pooled estimates. Potential publication bias will be assessed using funnel plots and Egger's test where appropriate, with $P > 0.05$ interpreted as indicating no statistically significant evidence of publication bias.

Subgroup analysis No prespecified subgroup analyses are described in the manuscript. The primary analyses will compare onlay restoration with full crown restoration across the eligible randomized controlled trials. If subgroup analyses are subsequently planned to explore clinical or methodological heterogeneity, the relevant subgroup variables and criteria should be defined before registration and supported by sufficient data.

Sensitivity analysis Sensitivity analysis will be performed using a leave-one-out approach, sequentially excluding each included study and recalculating the pooled effect estimates. The results will be compared with those of the primary analysis to assess the robustness and stability of the findings. Substantial changes in the pooled relative risks, 95% confidence intervals, or statistical significance after the exclusion of individual studies will be examined to identify studies that may have an important influence on the overall results.

Country(ies) involved China.

Keywords Onlay, Full crown, Root canal treatment, Meta-analysis.

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