

Sorption and Solubility of 3D-Printed Dental Materials: A Systematic Review & Meta-Analysis

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ADMINISTRATIVE INFORMATION

Support - There is no financial support.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 16 August 2025 and was last updated on 16 August 2025.

INTRODUCTION

Review question / Objective What are the water sorption and solubility of 3D-printed dental materials in in-vitro studies?

Rationale 3D printing is increasingly used for dental prostheses, crowns, and splints. The clinical success of these devices depends on their resistance to water uptake and solubility, which affect strength, stability, and color. Individual in-vitro studies report variable results, and no synthesis currently exists. A systematic review and meta-analysis will provide consolidated evidence to guide material selection and research.

Condition being studied The review focuses on water sorption and solubility of 3D-printed dental materials assessed in laboratory tests. These properties indicate how materials interact with oral fluids and influence their mechanical performance and longevity in clinical use.

METHODS

Search strategy Scopus, Web of Science (Clarivate), PubMed, Embase, and Cochrane Library ("Sorption" OR "Solubility") AND ("Dental" OR "Dentistry") AND ("3D Printing" OR "3D-Printing" OR "3D Printed") AND ("Material" OR "Materials").

Participant or population In-vitro studies using 3D-printed dental materials.

Intervention Laboratory assessment of water sorption and solubility of 3D-printed dental materials under standardized testing conditions.

Comparator Not applicable.

Study designs to be included In-vitro experimental studies evaluating water sorption and/or solubility of 3D-printed dental materials.

Eligibility criteria Only those studies were included that met the inclusion criteria. The inclusion criterion has given (i) Studies that reported on 3D printed dental materials, (ii) Studies Evaluating the water sorption and solubility, (iii) In-vitro studies using ISO 4049 standard, (iv) Studies published in English language and whose full text available.

Those studies excluded (i) Studies on conventionally dental materials, (ii) Studies on industrial, or general biomedical 3D printing materials, (iii) Studies that do not have water sorption or solubility values, (iv) Studies missing clear methods, or standard test protocols, (v) Non-peer-reviewed articles, abstracts without full text, editorials, conference papers, case reports, and commentaries, (vi) Studies published in non-English languages.

Information sources Electronic databases such as Scopus, Web of Science (Clarivate), PubMed, Embase, and Cochrane Library.

Main outcome(s) The water sorption and water solubility of 3D-printed dental materials.

Data management References will be managed in EndNote. After duplicate removal, studies will be screened and data extracted into Excel, including study details and outcome values.

Quality assessment / Risk of bias analysis The Cochrane risk of bias assessment tool was used to assess the risk of bias of included RCTs [20]. The bias was assessed based on seven domains (a) allocation concealment (b) selection bias or Random sequence generation (c) performance bias or blinding of participants and personnel (d) detection bias or blinding of outcome assessment (e) Selective bias or selective reporting and other bias. Each domain's score was categorized into Low risk, high risk, or unclear.

Strategy of data synthesis Data will be put it with a random-effects meta-analysis where possible. Heterogeneity will be assessed, and subgroup analyses performed. If pooling is not feasible, results will be presented narratively.

Subgroup analysis Subgroup analyses will be conducted by material type, 3D-printing technology, post-curing protocol, and testing standard where data allow.

Sensitivity analysis Sensitivity analyses will be performed by excluding studies at high risk of bias and by leave-one-out testing to assess the robustness of pooled results.

Language restriction Only studies published in English.

Country(ies) involved Saudi Arabia.

Keywords 3D printing, Dental materials, In-vitro study, Water sorption. Solubility.

Contributions of each author

Author 1 - Mahir Mirah - The author conceived the review idea, developed the protocol, designed the search strategy, and will conduct study selection, data extraction, analysis, and manuscript preparation.

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