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Degradation of PMMA Denture Base Materials Under Simulated Oral Conditions: A Systematic Review and Meta-Analysis of Mechanical, Physical, and Chemical Property Changes

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ADMINISTRATIVE INFORMATION

Support - King Khalid University.

Review Stage at time of this submission - Completed but not published.

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 29 September 2025 and was last updated on 29 September 2025.

INTRODUCTION

Review question / Objective To evaluate and quantify the mechanical, physical, and chemical property changes in PMMA denture base materials after simulated oral aging and compare the degradation among conventional, CAD/CAM-milled, and 3D-printed types.

Rationale PMMA denture bases face thermal, moisture, pH and loading stresses in the mouth, and different fabrication routes likely alter aging behavior, so a quantitative synthesis is needed to guide material selection.

Condition being studied Simulated oral aging conditions, including thermocycling, long-term water/saliva immersion, pH cycling, and mechanical fatigue.

METHODS

Search strategy Comprehensive searches were conducted in PubMed, Scopus, Embase, Web of Science, and Cochrane Library using combined keywords for PMMA.

Participant or population In-vitro specimens fabricated from denture base PMMA, including conventional heat-polymerized, CAD/CAM-milled, and 3D-printed resins.

Intervention Artificial aging regimens intended to simulate intraoral exposure, such as thermocycling, immersion, and pH cycling.

Comparator Pre- versus post-aging data within the same material and comparisons between different PMMA types tested under identical protocols.

Study designs to be included In-vitro experimental studies.

Eligibility criteria Included in-vitro studies on PMMA denture bases with quantitative pre- and post-aging data for specified mechanical, physical, or chemical outcomes; excluded non-PMMA materials, clinical studies, reviews, and non-English publications.

Information sources Electronic databases like PubMed, Embase, Scopus, Web of Science, and Cochrane Library.

Main outcome(s) Primary outcomes were flexural strength and flexural modulus.

Additional outcome(s) Secondary outcomes included surface hardness, surface roughness, water sorption, solubility, and residual monomer release.

Data management Two reviewers independently screened studies, extracted data using a piloted form, and digitized data from figures.

Quality assessment / Risk of bias analysis Risk of bias was assessed by two independent reviewers using the QUIN tool, specifically designed for dental in-vitro studies.

Strategy of data synthesis Random-effects meta-analysis was used to pool mean differences where at least three comparable studies were available; narrative synthesis was used otherwise.

Subgroup analysis Prespecified subgroups included PMMA type and aging protocol.

Sensitivity analysis Planned sensitivity analyses excluded studies with a high risk of bias, and those using non-standard test setups.

Language restriction Included only English-language publications.

Country(ies) involved Saudi Arabia.

Other relevant information The review followed PRISMA 2020 guidelines.

Keywords PMMA, denture base, aging, thermocycling, flexural strength, surface hardness, monomer release, systematic review, meta-analysis.

Dissemination plans The research will be submitted to peer-review journals and scientific meetings.

Contributions of each author

Author 1 - Lujain Ibrahim Aldosari - Conceptualization, visualization, methodology, data curation and synthesis, statistical expertise, project administration, final draft writing, funding acquisition, and publication.
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