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PROPERTIES OF 3D-PRINTED DENTAL RESINS IN FIXED PROSTHODONTICS

OBJECTIVES

Three-dimensional (3D) printing has emerged as a key tool for creating dental restorations, producing accurate dental restorations with reduced fabrication time. This systematic review aims to synthesize and critically evaluate the available evidence on 3D-printed dental resins for definitive fixed prosthodontics, focusing on material performance and clinical relevance. Specifically, the review will characterize the mechanical, surface, optical, antimicrobial, and biological properties of these resins.

METHODS

According to the PRISMA guidelines (Fig.1):

Pico question: "In teeth requiring indirect fixed prosthodontic restorations, does the use of 3D-printed resins, compared with other types of 3D-printed resins or alternative fabrication methods, provide enhanced properties and clinical performance?"

Databases: PubMed/MEDLINE; Scopus; Web of Science; BASE.

Key words: 3D Printing, Definitive Resins, Properties, Dental Resins.

Inclusion Criteria

- ✓ In vitro studies on 3D-printed dental resins;
- ✓ Evaluation of 3D-printed resin properties;
- ✓ Control group with other 3D-printed dental resins.

Exclusion Criteria

- × Non-human studies;
- × Systematic reviews;
- × Resins not for fixed protheses;
- × No 3D-printing technology;
- × Zirconia, ceramics, conventional composites or other material beside dental 3D-printed resins.

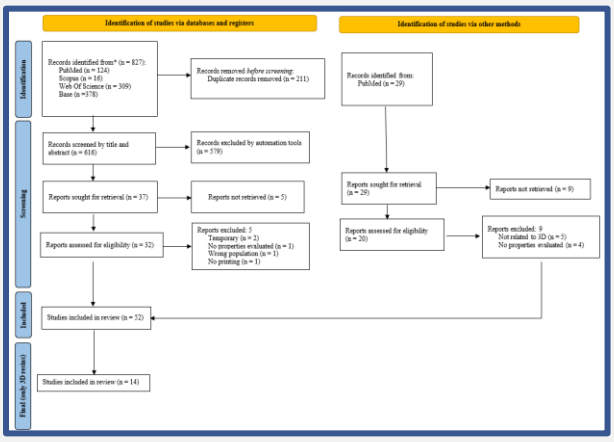

Figure 1: Flowchart following PRISMA guidelines (Page et al., 2021).

RESULTS

14 in vitro studies met the inclusion criteria (2023–2025)

Mechanical Properties

- ↓ Aging
- ↑ Post-Processing
- ↑ Surface Treatment

Surface Properties

- Sandblasting recommended for bonding.
- Glazing preferred for smoother surfaces

Optical Properties

- Post-curing time is critical for color stabilization.
- Thicker restorations show lower translucency.
- Proper curing and glazing keep ΔE ≈ 2–3 → clinically acceptable

Biocompatibility Properties

Optimized post-curing and surface finishing are essential for safe clinical performance.

Post-Processing & Surface Preparation

Proper post-curing and surface treatment are critical to optimize both mechanical and biological performance

Printing Technology Influence

- DLP printers → superior outcomes, especially higher SBS values.
- Printer type and printing parameters significantly affect mechanical and adhesive properties

Material Comparison

Studies varied in resin type and composition, influencing performance outcomes.

Surface Treatments and Conditioning

- APA provides best adhesion balance.
- Glazing offers multifunctional benefits with reduced surface damage risk

Sample Design Influence

Printing layer thickness has a significant and generally negative impact on the properties of 3D printed dental resins.

Artificial Aging

Immersion affects aesthetics, thermocycling affects mechanical integrity, and wear affects surface texture.

(Borella et al., 2023; Celikel & Sengul, 2024; Dederichs et al., 2025; Demirsoy et al., 2024; Ersöz et al., 2024; Fiore et al., 2024; Grymak et al., 2024; Kang et al., 2023; Korkmaz et al., 2024; Nam et al., 2023; Nam et al., 2024; Rizzante et al., 2024; Sasany et al., 2024; Wang et al., 2025)

CONCLUSIONS

- Promising alternative in fixed prosthodontics;
- Reduced waste, efficient workflows, high precision, acceptable short-term survival, and patient satisfaction;
- Lower mechanical strength, greater surface roughness;
- Post-curing, nanoparticle incorporation, and surface treatments (glazing, APA) improve properties.

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