Sustainable 3D Printing: Optimizing waste reduction and Recycling

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INTRODUCTION & AIM

Environmental concerns in dentistry include reliance on petrochemical plastics and increasing waste.

3D printing offers efficient and accurate dental model fabrication, but sustainability is still emerging.

Aim: To systematically review recent (2020–2025) To review recent advances in sustainable materials and 3D printing technologies used for dental model fabrication..

METHOD

Systematic review according to PRISMA guidelines

1.-Databases searched:

2.-Included: studies (2020–2025)
English, German, Spanish

3.-**In vitro peer review studies only**

4.-Keywords/ MeSH terms related to *sustainable materials for dental 3D printing*

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RESULTS & DISCUSSION

A total of five in vitro studies met the inclusion criteria and contain sufficient information for this review. All studies are in vitro and are peer reviewed articles from the years 2023-2024

The materials investigated in these studies were: polylactic acid (PLA), recycled PLA, recycled resins and soy-based resins.
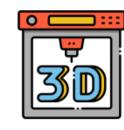
Employed Fused filament fabrication (FFF) and Vat polymerization Technology (VAT)

Discussion

•Sustainable materials showed **good dimensional accuracy** and **clinical feasibility**.
•**PLA and recycled PLA** performed most consistently.
•**FFF** often produced less waste and simpler material handling.

CONCLUSION

1.-Emerging sustainable 3D printing materials can **reduce ecological impact** in dental model production

2.-Adoption is still **new in dentistry**, but early results are **very positive**.

3.-Encourage dentists to adopt eco-friendly 3D printing for a healthier planet and sustainable practice.

FUTURE WORK / REFERENCES

1.-Test sustainable 3D-printed materials in real clinical situations to see how well they perform and how long they last.

2.-Create and refine new biodegradable and recyclable polymers that offer the precision needed for accurate dental models.

3.-Improve sustainable workflows in dentistry, including better recycling of printed materials and wider clinical use of eco-friendly printing methods.

- Nagata et al. (Fit accuracy of esin crown on a dental model fabricated using fused filament deposition modelling 3D printing andpolylactic acid filament, 2023)
- Nagata et al. (Accuracy of Dental Models Fabricated Using Recycled Poly-Lactic Acid, 2023)
- Chao et al. (Cost-effective recycled resin for digital light processing 3D printing, 2023)
- Wakamori et al.(Comparative Verification of the Accuracy of Implant Models Made PLA, Resin, and Siicone, 2023)
- Pauls & Hornberg (Accuracy of soy based resins for dental 3D printing, 2024)