

## GREEN DENTISTRY IN PROSTHODONTICS: A STEP TOWARDS REDUCING CARBON FOOTPRINTS

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### ABSTRACT

Green dentistry, also known as eco-friendly or sustainable dentistry, is an emerging approach that integrates environmental responsibility into dental practice. By reducing waste, conserving energy and using safer materials, green dentistry aims to minimize the ecological footprint of oral healthcare while maintaining high standards of patient care. It also represents a sustainable approach to restorative dental care that minimizes environmental impact while maintaining clinical excellence. Prosthodontics, involving crowns, dentures, and implants, traditionally relies on energy-intensive processes and non-biodegradable materials. This review explores eco-friendly innovations such as digital workflows, recyclable materials and waste management strategies in prosthodontics. Evidence suggests that integrating sustainability into prosthodontic practice can reduce environmental burden, improve patient safety and enhance long-term efficiency.

**Keywords:** Green dentistry, prosthodontics, sustainability, dental materials, CAD-CAM, eco-friendly dentistry, dental waste, eco-friendly healthcare, environmental health

### INTRODUCTION

The healthcare sector significantly contributes to environmental pollution and dentistry is no exception. Traditional dental practices generate considerable waste, consume large amounts of water and energy and often rely on materials that may be harmful to both human health and the environment.<sup>1,2</sup> Green dentistry addresses these concerns by adopting sustainable practices that promote environmental stewardship without compromising clinical outcomes. Prosthodontics is a dental specialty focused on the restoration and replacement of missing teeth using prostheses such as crowns, bridges and dentures. However, conventional prosthodontic procedures involve significant environmental concerns, including high energy consumption and biomedical waste. Green dentistry introduces environmentally responsible practices into prosthodontics, aiming to reduce pollution, conserve resources and promote biocompatibility. With increasing global emphasis on sustainability, "green prosthodontics" has emerged as an essential evolution in dental care.<sup>2,3</sup>

### ENVIRONMENTAL IMPACT OF CONVENTIONAL PROSTHODONTICS

Traditional prosthodontic practices contribute to environmental degradation in several ways:

- Material Waste:** Acrylic resins, metals, ceramics, and polymers are often non-biodegradable

- Energy Consumption:** Laboratory procedures such as casting, sintering and milling require high energy
- Chemical Pollution:** Use of monomers, impression materials and disinfectants
- Biomedical Waste:** Disposable trays, gloves and packaging materials

Additionally, discarded dental prostheses and gypsum casts accumulate in landfills, further increasing ecological burden.

<sup>3,4</sup>

### PRINCIPLES OF GREEN PROSTHODONTICS

Green dentistry is a whole - earth approach to tooth care that reduces the environmental impact of dentistry and creates a caring environment for patients. It is based on the model of four R's - Rethink, Reduce, Re-use and Recycle.<sup>5-8</sup> Green prosthodontics follows the broader principles of sustainable dentistry:

- 1.●→**Rethink:** Adopt innovative and new eco-friendly technologies
- 2.●→**Reduce:** Minimize material and energy usage
- 3.●→**Reuse:** Encourage reusable instruments and materials
- 4.●→**Recycle:** Promote recycling of dental waste such as gypsum

These principles align with global sustainability goals and healthcare environmental policies.

| Green Dentistry |                   |                    |                         |
|-----------------|-------------------|--------------------|-------------------------|
| Waste Reduction | Energy Efficiency | Water Conservation | Material Sustainability |

#### KEY PRACTICES IN GREEN DENTISTRY

##### ●→Digital Dentistry

The shift from paper-based records to digital systems reduces paper waste and improves efficiency. Digital radiography eliminates the need for chemical processing, reducing hazardous waste.

##### ●→Amalgam Waste Management

Proper disposal and use of amalgam separators prevent mercury contamination in water systems.

##### ●→Eco-Friendly Materials

Dentists increasingly use biodegradable, non-toxic and recyclable materials for restorations and packaging.

##### ●→Energy Efficiency

Installing LED lighting, energy-efficient dental equipment and renewable energy sources like solar panels helps reduce carbon emissions.

##### ●→Water Conservation

Use of low-flow faucets and vacuum systems significantly reduces water usage in clinics.

##### ●→Waste Segregation and Recycling

Proper classification of biomedical waste ensures safe disposal and promotes recycling wherever possible.<sup>9,10</sup>

| Various Aspect□   | Traditional Dentistry□      | Green Dentistry□                | ✕ |
|-------------------|-----------------------------|---------------------------------|---|
| Radiography□      | Film-based, chemical waste□ | Digital, no chemical waste□     | ✕ |
| Materials□        | Mercury amalgam□            | Biocompatible alternatives□     | ✕ |
| Records□          | Paper-based□                | Electronic systems□             | ✕ |
| Energy Use□       | High□                       | Energy-efficient equipment□     | ✕ |
| Waste Management□ | Limited segregation□        | Structured recycling protocols□ | ✕ |

Comparison of various aspects in the Traditional vs Green Dentistry

#### SUSTAINABLE PRACTICES IN PROSTHODONTICS

##### Digital Dentistry (CAD-CAM Technology)

The adoption of computer-aided design and manufacturing (CAD-CAM) has revolutionized prosthodontics by eliminating physical impressions and plaster models, reducing material waste and improving precision and efficiency. Digital workflows significantly reduce laboratory waste and energy consumption compared to traditional techniques.

##### Eco-Friendly Dental Materials

Green prosthodontics promotes the use of the biocompatible ceramics (e.g., zirconia), BPA-free resins and recyclable metals. These materials reduce toxicity and environmental hazards while maintaining durability and aesthetics.

##### Recycling of Gypsum Products

Gypsum casts used in prosthodontics contribute substantially

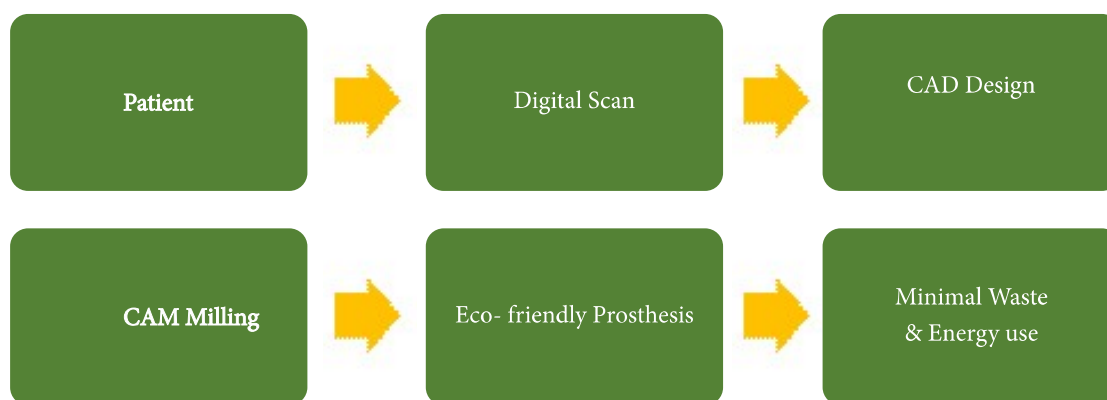
to solid waste. Recycling techniques allow reuse of gypsum in construction and dental applications, reducing landfill burden.

##### Energy-Efficient Laboratory Practices

With the use of energy-efficient furnaces and milling machines, optimization of laboratory workflows and adoption of renewable energy sources are some practices for incorporating energy efficiency. Such measures significantly lower carbon emissions associated with prosthesis fabrication.

##### Waste Management and Infection Control

With the management of proper segregation of biomedical waste, reduction of single-use plastics and use of eco-friendly disinfectants are some steps towards green dentistry. These practices ensure both environmental safety and infection control compliance.<sup>11,12</sup>



### Green Prosthodontics Workflow

#### BENEFITS OF GREEN PROSTHODONTICS

**Environmental Benefits:** Major benefits of reduced landfill waste and pollution, lower carbon footprint and through this there is conservation of natural resources.

**Clinical Benefits:** Improved biocompatibility of materials, enhanced precision with digital systems and reduced chairside time are some major clinical benefits.

**Economic Benefits:** Long-term cost savings through efficiency and reduced material wastage are major economic benefits.

**Professional Impact:** With the use of practices will increase patient awareness and trust and this will also help in the alignment of the field of dentistry with sustainable healthcare practices.<sup>8,16</sup>

#### MAJOR CHALLENGES AND LIMITATIONS

Some of the major challenges which the dentist are facing are high initial investment in digital technologies, limited awareness among practitioners, lack of standardized guidelines and resistance to transitioning from conventional methods but despite these challenges, the long-term advantages outweigh the barriers.<sup>8-10</sup>

#### FUTURE PERSPECTIVES

The future of green prosthodontics lies in the development of biodegradable dental materials, integration of artificial intelligence in prosthesis design, expansion of fully digital workflows and implementation of sustainability guidelines in dental education. Advances in biodegradable materials, artificial intelligence and energy-efficient systems will further enhance sustainability. These sustainable and eco- friendly innovations will continue to transform prosthodontics into an environmentally responsible discipline.<sup>5-8</sup>

#### CONCLUSION

Green dentistry in prosthodontics is a necessary advancement towards sustainable oral healthcare. By incorporating digital technologies, eco-friendly materials and effective waste management strategies, prosthodontists can significantly reduce environmental impact while enhancing patient care. More continued research, education and policy support are essential for widespread adoption.

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