



Editorial

Eco-Responsibility in Prosthodontics: Shaping a Sustainable Dental Future

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With global society facing the mounting climate crisis, health care systems long thought to be passive are being challenged today for their ecological impacts. Dentistry and, in this case, prosthodontics have long been focused on outcomes based on patient care without consideration of the ecological impacts of clinical practice. Prosthodontics, however, today must evolve into a profession that not only delivers functional and aesthetic rehabilitation but also environmental responsibility.

Prosthodontics is material^{1,2}- and energy-thirsty by design. Beginning with impression materials, casting alloys, and resin polymers and continuing with digital fabrication equipment and disposable consumables, the environmental price of creating one prosthesis can be high. A standard crown fabrication process is typically a multi-step process with material usage, water-expensive laboratory procedures, and energy-demanding furnace use—all with carbon emissions, water waste, and landfill load. Data show that the

healthcare sector contributes to producing some 4.4% of overall greenhouse gas emissions (Karlner et al., 2019), and dentistry's contribution is small but not insignificant. Duane et al. (2017) found in a study that up to 60% of emissions related to general dental practice can be attributed to material usage and travel—both factors that are predominant in prosthodontic treatment.

The arrival of digital dentistry—CAD/CAM milling, 3D printing, and intraoral scanning—has offered accuracy, minimized chairside time, and even cost benefits. Is it, however, environmentally better? Digital impressions, in a sense, minimize reliance on alginate or silicone-based materials and gypsum casts. Milled restorations can potentially bypass conventional steps such as flasking, curing, and investing. However, milling machines and sintering ovens are energy-intensive. Moreover, milling blocks made of polymers tend to generate much waste due to subtractive manufacturing processes. Life cycle

analyses (LCA) of conventional and digital workflows are currently few, but evidence (Schnitzler et al., 2021) exists that well-optimized digital workflows can have total environmental gains — especially if deployed in centralized laboratories with efficient power infrastructure and recycling centers.

Roads to a Greener Prosthodontics^{2,3}

A shift towards sustainable prosthodontic practice is a well-planned, systematic process, informed by clinical evidence and ethics. The following are five key components to inform the shift:

1. Material Sustainability

Recyclable, biodegradable, or low-energy synthesized materials must be used. Development of eco-friendly denture base resins, bio-derived waxes, and remeltable metal alloys must be expedited. Segregation and recycling of dental materials must also be institutionalized in dental schools and dental laboratory environments.

2. Green Clinics and Laboratories

Prosthodontic laboratory design and operatory can be made more energy-efficient and less wasteful. This can be achieved by employing LED lighting, motion sensors, low-flow water systems, and digital reports to minimize paper consumption. Prosthodontic laboratories can be incentivized to use locally sourced materials to minimize transportation emissions.

3. Digital Workflow Optimization

As they digitize, clinics should examine the material and energy expense at each step. Cloud computing can reduce the need for in-clinic hardware. Shared scanning and milling facilities can eliminate duplication of high-energy equipment in each clinic.

4. Ethical Treatment Planning

Conservative prosthodontics—preserving tooth structure and avoiding overtreatment—adheres to both biologic and ecological principles. Planning for treatment should not only consider patient advantage but also stewardship of resources.

5. Education and Advocacy

Prosthodontic education needs to incorporate sustainability as a central competency. From the undergraduate clinic to board training in a specialty, future clinicians need to take their environmental footprint into account and become educated about green substitutes. Editorial boards, organizations, and policy makers need to encourage eco-standards in dental licensure and accreditation. We editors, reviewers, and researchers have a scholarly duty to facilitate sustainable innovation. Journals need to disseminate eco-audits in clinical trials, open up research avenues in green material science, and provide space for critical discussion in climate-sensitive care. Academic conferences need to provide a platform for promoting green technology, energy audits, and environmental policy initiatives in prosthodontics. A future worth smiling about Prosthodontics has always been an art and a calling—restoring not only teeth but dignity, speech, nutrition, and quality of life. With the age of climate emergency, this empathy has now to transcend the patient to the planet. Sustainability in prosthodontics is not a sacrifice on quality—it is an evolution of conscience. In our pursuit of creating smiles, it is imperative that we create a future where every impression, every crown, and every denture not only touches the patient but also contributes to a smaller environmental footprint.

A fundamental shift from conventional restorative paradigms to environmentally conscious clinical approach is required for the transition to sustainable

prosthodontics. Life-cycle analysis, material innovations, and evidence-based procedures can all be integrated to guarantee that prosthodontic care meets environmental and functional standards. Restoring oral health and minimising the ecological burden of care are two responsibilities that we as dental professionals have to shoulder. In doing so, prosthodontics can lead the broader dental profession toward a truly sustainable future.

References

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Dr Vivek V. Nair
Editor, IPS Kerala