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Editorial

Green dentistry through centralised digital hubs and teledentistry: A sustainable future for prosthodontics

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Abstract

In dentistry, especially in Prosthodontics, the digital revolution is converting traditional workflows into patient-centered, eco-friendly and effective technologies. Clinical practice can benefit from centralized digital hubs that are driven by CAD/CAM technologies, 3D printing, artificial intelligence, teledentistry and intraoral scanners. Digitization drastically decreases carbon emissions and biological and plastic waste by doing away with traditional impression materials, plaster models and logistics that rely on transportation. Small clinics and practices in isolated areas would particularly benefit from this paradigm, which gives them access to cutting-edge Prosthodontic solutions without the environmental impact of traditional techniques. This study examines how digitally enabled central hubs assist equity, efficiency and sustainability in the provision of dental treatment.

Keywords: Green dentistry, Sustainability, Intraoral scanner, CAD/CAM, 3D Printing, Teledentistry, Centralised hub, Ecofriendly prosthodontics.

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1. Introduction

With the use of digital instruments that increase precision, productivity and patient satisfaction, dentistry is changing quickly. Conventional Prosthodontic processes, which rely on plaster models, wax, stone and impression materials, produce a lot of biomedical waste, use natural resources and increase environmental risks. Green dentistry places a strong emphasis on environmentally friendly procedures that minimize waste and maximize resource utilization. By using digital impressions, computer-aided design and manufacture (CAD/CAM) and 3D printing to streamline Prosthodontic workflows, centralized digital hubs in conjunction with teledentistry offer a sustainable solution. In addition to guaranteeing excellent results, these advances support international environmental objectives: equality, efficiency and sustainability in the provision of dental treatment.[1,2]

2. Main Body

2.1. Centralised digital hubs and teledentistry

A centralised hub functions as a shared resource for multiple clinics, where data collected through intraoral scanners is digitally transmitted to the hub via secure teledentistry platforms. Prostheses are designed and fabricated using CAD/CAM and 3D printing technologies, then dispatched to clinics for patient delivery. This eliminates the need for multiple physical laboratories in every clinic, optimizing resources and ensuring uniform quality.[3]

Teledentistry strengthens this model by enabling real-time consultations, remote supervision, and data sharing. Dentists in small or remote clinics can collaborate with specialists in centralized hubs, ensuring patients have access to advanced Prosthodontic solutions without geographical barriers.[4]

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2.2. Ecofriendly impact: reducing waste and carbon footprint

Traditional Prosthodontics requires impression trays, alginate, elastomeric impression materials, disinfectants, gypsum, wax, and packaging-all of which generate significant biomedical and plastic waste. These materials not only increase treatment costs but also contribute to non-biodegradable landfill accumulation and chemical exposure. By contrast, intraoral scanning eliminates the need for these consumables entirely.[5]

1. Digital files replace physical impressions and plaster models.
2. Cloud storage and CAD design minimize the use of paper and packaging.
3. Centralization reduces redundant infrastructure and material duplication.
4. Logistics optimization through teledentistry cuts down fuel consumption and emissions.

Together, these steps create an ecofriendly and sustainable Prosthodontic ecosystem that aligns with global environmental goals.

2.3. Technological Components

2.3.1. Intraoral scanners

These replace traditional impressions, offering accuracy, patient comfort and real-time visualization. By eliminating impression materials, disinfectants, and plaster casts, they drastically reduce biomedical waste. Digital scans can be shared instantly via teledentistry, expediting treatment planning.

2.3.2. CAD/CAM technology

CAD software enables precise design of prostheses, while CAM milling ensures high-quality restorations with minimal material wastage. Milling blocks are more resource-efficient than traditional wax-ups and casting.

2.3.3. 3D printing

Additive manufacturing enables on-demand fabrication of dental models, surgical guides, and prostheses with minimal resource consumption. Biodegradable and recyclable printing resins further enhance sustainability. Unlike conventional processes that involve multiple intermediate steps, 3D printing produces structures directly from digital files, cutting waste at every stage.

3. Discussion

Integration of intraoral scanners, CAD/CAM, 3D printing, and teledentistry within centralized hubs represents a paradigm shift toward sustainable Prosthodontics. For small clinics in remote locations, this model eliminates the need for in-house laboratories, extensive material inventories and repeated transport of impressions and models. Patients benefit from shorter treatment times, improved accuracy and greater comfort, while clinics reduce operational costs.

Intraoral Scanners serve as the cornerstone of this digital model. They replace conventional impressions, eliminating the need for impression trays, alginate, elastomers and disinfection solutions. Studies show intraoral scanners improve patient comfort, reduce chairside time, and produce highly accurate digital impressions.[6,7] Their eco-friendly advantage lies in the elimination of single-use materials and reduced cross-infection risks.

CAD/CAM Technology allows prostheses to be designed digitally, ensuring accuracy and repeatability. By storing files digitally, remakes can be produced without new impressions, further reducing material waste and cost.[8] This digital storage also enhances long-term patient record management.

3D Printing has revolutionized model and prosthesis fabrication. Unlike subtractive milling, 3D printing uses only the required material, reducing wastage and offering sustainable options such as biocompatible resins.[9] Eco-friendly resins and recyclable materials further support green dentistry initiatives.

Teledentistry Integration ensures that clinics in remote areas, which often lack laboratory facilities, can still provide advanced Prosthodontic solutions. The ability to transfer scans digitally instead of shipping impressions reduces transportation-related carbon emissions, supporting global sustainability goals.

3.1. Flow chart

Patient Scan → Digital File Transfer (Teledentistry) → Centralized Hub (Design + AI Assistance) → CAD/CAM Milling or 3D Printing → Dispatch Final Prosthesis → Patient Delivery.

4. Conclusion

Centralised digital hubs, integrated with teledentistry and powered by intraoral scanning, CAD/CAM and 3D printing, offer a sustainable, ecofriendly alternative to conventional Prosthodontics. By eliminating waste-generating materials, reducing logistics and optimizing resource use, these hubs contribute to both environmental sustainability and equitable patient care. This approach represents the future of Prosthodontics; where technology, quality, and ecology converge. As governments and professional bodies worldwide move toward environmentally responsible healthcare, centralized hubs powered by digital dentistry can serve as a benchmark for green dental practices.

5. Recommendations on Practical Aspects

1. Adopt intraoral scanners in small and remote clinics to eliminate impression materials.

2. Develop regional centralized hubs with CAD/CAM and 3D printing capacity to support multiple clinics.
3. Promote Teledentistry platforms for seamless communication and digital data transfer.
4. Use eco-friendly 3D printing resins and recyclable materials to further reduce environmental burden.
5. Encourage training and awareness among dentists and technicians about the benefits of sustainable workflows.
6. Government and policy support should incentivize green practices through subsidies, tax benefits or accreditation systems.

6. Conflict of Interest

None.

References

1. Schwendicke F, Samek W, Krois J. Artificial Intelligence in Dentistry: Chances and Challenges. *J Dent Res*. 2020;99(7):769–74. https://doi.org/10.1177/0022034520915714.
2. Estai M, Kanagasingam Y, Mehdizadeh M, Vignarajan J, Norman R, Huang B, et al. Teledentistry as a novel pathway to improve dental health in school children: a research protocol for a randomised controlled trial. *BMC Oral Health*. 2020:14;20(1):11. https://doi.org/10.1186/s12903-019-0992-1.
3. Revilla-León M, Özcan M. Additive Manufacturing Technologies Used for Processing Polymers: Current Status and Potential Application in Prosthetic Dentistry. *J Prosthodont*. 2019;28(2):146–58. https://doi.org/10.1111/jopr.12801.
4. Ghai S. Teledentistry During COVID-19 Pandemic. *Diabetes Metab Syndr*. 2020;14(5):933–5. https://doi.org/10.1016/j.dsx.2020.06.029.
5. Lokmic-Tomkins Z, Davies S, Block LJ, Cochrane L, Dorin A, Gerich H, et al. Assessing the carbon footprint of digital health interventions: a scoping review. *J Am Med Inform Assoc*. 2022;29(12):2128–39. https://doi.org/10.1093/jamia/ocac196
6. Rudolph H, Salmen H, Moldan M, Kuhn K, Sichwardt V, Wöstmann B, et al. Accuracy of intraoral and extraoral digital data acquisition for dental restorations. *J Appl Oral Sci*. 2016;24(1):85–94. https://doi.org/10.1590/1678-775720150266.
7. Mangano F, Gandolfi A, Luongo G, Logozzo S. Intraoral Scanners in Dentistry: A Review of the Current Literature. *BMC Oral Health*. 2017;17(1):149. https://doi.org/10.1186/s12903-017-0442-x.
8. Miyazaki T, Hotta Y, Kunii J, Kuriyama S, Tamaki Y. A review of dental CAD/CAM: current status and future perspectives from 20 years of experience. *Dent Mater J*. 2009;28(1):44-56. https://doi.org/10.4012/dmj.28.44.
9. Rezaie F, Farshbaf M, Dahri M, Masjedi M, Maleki R, Amini F, et al. 3D Printing of Dental Prostheses: Current and Emerging Applications. *J Compos Sci*. 2023;7(2):80. https://doi.org/10.3390/jcs7020080.

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