

REVIEW ARTICLE

“Let’s go Green to get Our Globe Clean”: Green Dentistry

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ABSTRACT

Dentistry is an extremely important and foremost healing profession. In today’s world, with the increasing ecological disasters, it is highly obligatory to understand the paramount importance of being eco-friendly in every facet of our lives, including in dental practice, which has a huge impact on the environment. Eco-friendly dentistry is a term legally accepted by the Eco Dentistry Association, which is an emerging concept in dentistry. It is an approach to minimize the environmental hazards of dental practice and provide dental care in an environmentally friendly way. With the widespread introduction of beryllium into the dental industry, a large number of these workers are at risk for the development of chronic beryllium disease. Proper handling of biomedical and dental waste is indispensable for the dental profession. People have become much more cognizant of potentially harmful chemicals contained in plastic products, especially, bisphenol-A. This can be achieved by reducing waste and lowering pollution. Dental offices can use reusable towels, high-efficiency machines, and paperless records. A small change can make the overall impact of the dental office less damaging to the environment.

The purpose of this review is to discuss various ways that a dentist can choose to make the dental office “Green” and conserve precious resources with all the options available today. Eco-friendly dentistry is soon becoming the standard.

Keywords: Biomedical, Ecodentistry, Green.

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INTRODUCTION

Environmental pollution is the flaming issue today in the world. Directly or indirectly, every individual is responsible for this, and dentistry is not an exception to this.¹ However, a lot of contribution has to be provided to keeping the planet green, and everyone needs to help in several ways. There are various ways in which an

individual can help and make the world better and eco-friendly. Dental professions can add a small contribution by following the principles of Green dentistry.² Green dentistry or eco-friendly dentistry is intended to reduce the environmental impact in office administration, construction and design, and also dental procedures and materials.³ Eco-friendly dentistry is a relatively new term and an emerging concept in dentistry. It is the largest movement toward ecologically sustainable health care. In dentistry, broad-scale research has been done toward environmental hazards caused by mercury, and indeed proven that mercury is a deleterious environmental pollutant.⁴

Green dentistry is defined as a high-tech approach that reduces the environmental impact of dental practices and encompasses a service model for dentistry that supports and maintains wellness.⁵ According to the Eco Dentistry Association, green dentistry reduces waste and pollution; saves energy, water, and money; incorporates high-tech innovations, and focuses on wellness and integrative practices within the offices that result in an eco-friendly environment.

STEPS TO ESTABLISH AN ECO-FRIENDLY DENTAL PRACTICE

Eco-friendly dentistry, the evolving practice of dentistry, encompasses a simultaneous devotion to sustainability, prevention, precaution, and a minimally invasive patient-centric as well as global-centric treatment philosophy.⁶ 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 Rs—reduce, reuse, recycle, and most importantly rethink.⁷

Following are the few necessary changes that may be a challenge to some practitioners, but making these simple changes can make a huge difference to the environment. Even if the dental practitioner cannot incorporate all the following steps into their practice, taking a few simple steps from the following list might go a long way in ensuring a “Green” future.

Rethink

Every decision is made with a certain mindset and redeveloping the mindset is a strategy for change. The first step in transitioning to an eco-friendly dental practice is

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to rethink. Rethinking means taking notice of the things that we do daily in our practice. Implementing simple changes like things you can add or change and decrease energy and water consumption are the initial strategies to consider.⁸

Designing the Dental Clinic

While designing an eco-friendly dental clinic, few things need to be addressed.

Flooring

Linoleum flooring should be preferred. Linoleum was invented in England in 1863 by Frederick Walton. Linoleum flooring is manufactured by oxidizing linseed oil to form a thick mixture called linoleum cement. The factors which make linoleum friendly to the environment are that linoleum is made of sustainable, natural ingredients; it lasts for a very long time; and it disposes well.

Paint

Some of the most harmful chemicals found in the paint, which is commonly used for painting clinic walls, are volatile organic compounds or VOCs. The VOCs are unstable, carbon-containing compounds that readily vaporize into the air. As paint dries, these harmful VOCs are released into the air at high levels. The VOC reductions have been made possible by technological advancements in the paint industry. Hence, use of ultralow VOC paint or zero VOC paint in clinics is required.

Lighting

Use compact fluorescent light bulbs in the clinic. It saves energy and has revolutionized energy-efficient lighting. Wherever possible, use the natural light by making large windows as part of your clinic decor.⁹

Double-glazed Window

Double-glazed windows are made from two panes of glass that are separated by a layer of air or gas and then sealed. They are designed to provide better barrier against outside temperature than the single-paned window.

Dental Waste and Pollution

Following processes are responsible for most dental practice waste:

- Plastics
- Beryllium-containing alloys
- Dental amalgam waste products
- Conventional X-ray system
- Infection control barrier

Plastics

In recent years, many people have become much more cognizant of the potentially harmful chemicals contained in a wide range of plastic products. For example, bisphenol-A (BPA)—now essentially a household name—is a chemical used to harden plastics that can be found in water bottles, food cans, plastic containers, dental sealants, and many other manufactured commodities. According to WebMD, animal testing has raised concerns that BPA in large amounts could affect hormone levels as well as cause brain and behavioral issues, cancer, heart problems, and other conditions, such as diabetes and attention deficit hyperactivity disorder. It is no surprise, then, that people often question if dental materials and appliances contain BPA.

In a 2003 to 2004 health survey, the Centers for Disease Control and Prevention made a surprising discovery. It found BPA in the urine of nearly 93% of the more than 2,500 people tested.

While scientists debate the issue, we can take steps to reduce our family's exposure to BPA.¹⁰

Here are suggestions from the National Institute of Environmental Health Sciences:

- Avoid polycarbonate containers that contain BPA.
- Choose glass, porcelain, and stainless steel containers instead of plastic.

Beryllium-containing Alloys

The reason for the popularity of metal alloys in dentistry is due to their combined binding properties of strength, modulus, wear resistances, biocompatibility, and longevity.

Alloys used in dental restoration range from noble and precious metals alloys to base metal alloys. Base metal alloys were introduced in 1971, as an economical alternative to gold alloys. The base metal alloy systems most commonly used in dentistry today include stainless steels, nickel–chromium, cobalt–chromium, titanium, and nickel–titanium alloys. Beryllium is used in the nickel alloy as a cheaper alternative to precious metals. The nickel alloy typically contains 1 to 2% beryllium. Although the beryllium composition is low, the risk to dental health professionals who grind, machine, or polish the alloy is grave. With the widespread introduction of beryllium into the dental industry, a large number of these workers are at risk for the development of chronic beryllium disease (CBD). The CBD is a serious lung disease that can be disabling and even fatal. The CBD has been reported among dental laboratory personnel in the past, and a recent letter to Occupational Safety and Health Administration (OSHA) indicates that these cases continue to occur. The CBD primarily affects the

lungs. The CBD may occur among dental laboratory technicians when they inhale dust containing beryllium while working on items, such as dental crowns, bridges, and partial denture frameworks made from dental alloys containing beryllium.¹¹

Following measures can be used to reduce the exposure of dental laboratory technicians to beryllium:

- Engineering controls
 - Engineering controls are the first line of defense in employee protection. Therefore, employers should provide appropriate engineering controls and should train their workers in their use and in work practices to ensure that dental laboratory technician exposures to beryllium are maintained below the current OSHA permissible exposure limits.
- Work practices to reduce beryllium exposure
 - Substitute work practices that generate less dust, such as hand filing, for procedures that produce more dust, such as power grinding.
 - Use appropriate respiratory protection.

Dental Amalgam Waste

Dental amalgam particles are a source of mercury, which pollutes the environment in various ways. It is known to be neurotoxic and nephrotoxic.^{12,13} Mercury is being used in amalgam restorative materials since more than 150 years.¹⁴

Health risk of mercury: Mercury is released in the form of vapors and ions, which is dangerous and it is easily absorbed into the blood stream via the alveoli of the lungs. Amalgam restoration may release mercury in the range of 1 to 3 µg/day depending upon the number of restorations present in the mouth.¹⁵ A study conducted by measuring the intraoral vapor levels over a 24-hour period in patients with at least nine amalgam restorations showed that the average daily dose of inhaled mercury vapor was 1.7 µg (from 0.4 to 4.4 µg), which is approximately 1% of the threshold limit value of 300 to 500 µg/day established by the World Health Organization, based on a maximum allowable environmental level of 50 µg/day in the workplace.¹⁶ According to Berdouses et al,¹⁷ mercury exposure from amalgam can be greatly increased by personal habits, such as chewing and brushing. Dentists and dental nurses are at risk of potential exposure to inorganic mercury through their handling of amalgam, although nowadays, their exposure has reduced due to low mercury-to-alloy ratio and through mercury management.

The release of amalgam particles into the dental office waste water or on solid waste is of major concern as once mercury enters the water or soil, bacteria converts it into methyl mercury, which is a potent neurotoxin that

causes brain, kidney, and lung damage.^{16,17} The National Institute for Occupational Safety and Health has recommended the permissible exposure limit to be changed to 0.05 mg/m³ averaged over a 40-hour workweek.¹⁸

Precautions during preparing placement of amalgam:

- Instead of manual manipulations, only preencapsulated amalgam should be used always.
- The capsules should be recapped after use and stored in closed containers for recycling.
- Avoid skin contact with mercury or freshly mixed amalgam.
- High-volume evacuation systems must be employed during finishing or removing amalgam restoration.
- After condensation, the scrap should be collected and stored in water, glycerin, or X-ray fixer in a tightly capped jar (almost filled with liquid to reduce the space where mercury can collect).
- Rubber dams, high-volume evacuation, and water cooling should be used to reduce the vapor released during removal of old amalgam restorations.
- Amalgam scrap should be disposed of as hazardous waste or should be sent to a recycler. Waste mercury is disposed similarly.
- Since amalgam decomposes on heating, amalgam scrap should not be disposed in the waste that could eventually be incinerated.¹⁹

Conventional X-ray System

All the conventional dental offices use traditional film X-rays. Conventional X-ray creates trash and toxic chemical waste that the dental office is left to dispose, and the chemical fixer and lead foils from X-ray processes have to go somewhere, which often means the public sewer system.

Health Risk of X-ray Waste

- *X-ray fixer solutions:* These are considered hazardous wastes because of high silver content. They have to be disposed of as a hazardous waste or sent to silver recovery systems.
- Developer solutions can go into the waste water drain. X-ray developer fixer should not be mixed. If mixed, they should be separated and treated independently.
- *X-ray lead foil/shields:* Lead foils and shields contain pure lead. Lead is treated as hazardous waste or recycled for scrap metal content.²⁰

Dentists can use digital X-ray equipment, which is a high-tech green dental practice that has instant image availability, improved image quality, enhanced diagnostic efficacy, minimal patient radiation exposure, and eliminates the need for processing toxic X-ray fixers and lead foils, which is useful for the patient as well as dentist.²¹

Infection Control Barrier

Dental office infection control and sterilization processes can be a major source of pollution and waste in the traditional dental practice. Chemicals used in infection control and sterilization processes in the dental office can be quite dangerous. They can jeopardize employee health, contribute to weak air quality in office, and pollute community water stream. Nontoxic alternatives for infection control and sterilization have the same or greater effectiveness in getting the work done, while protecting the health and safety of dental practitioners, patients, and the neighborhood.

Following are ways of dentistry's green future:

- Steam sterilization replaces chemical-based sterilization
- Toxic cold sterilization methods are eliminated
- Eco-friendly disinfectants maintain a hospital grade environment in the operatory.²²

Saving Energy, Water, and Money

Conservation is a critical aspect of dentistry's green future. It is the *mantra* of green dentistry because it extends the life of our precious resources and helps maintain more money in our bank accounts. An exciting development in green dentistry's future is the recent introduction of energy- and water-saving dental equipment. The light-emitting diode (LED) operatory lights can reduce electrical energy consumption by 70%, eliminating the need for expensive halogen bulbs, and allowing for easier placement of composite restorations. Several manufacturers have engineered waterless vacuum systems, which save about 360 gallons of water per day, per dental office—enough to fill an average-sized hot tub everyday.²³

Following are energy, water, and money savers that are part of dentistry's green future:

- Looking for energy star-rated printers, computers, dishwashers and the like. More the stars on the label mean more energy-conserving the appliance is.
- Converting LED operatory lights.
- Installing an in-office water distiller.
- Training the assistant to ensure that everything with an on-off switch is powered off at night.
- Converting to waterless vacuum system/centralized suction.
- Installing LED "Exit" signs and other emergency indicators.
- Using eco-friendly, waterless hand sanitizers.
- Installing motion sensors to automatically turn off lights when people leave nonmedical areas like business offices, supply closets, and staff lunch rooms.²⁴

Instruments and Materials

There is the need of purchasing environmentally friendly alternatives among dental materials for the care of the planet as well as the patient. For over years, Hu-Friedy has offered a program called "environ dent," which allows practitioners to recycle old hand instruments and receive a free instrument for helping the planet.⁷ Use of disposable towels, patient bibs, suction tubes, sterilization pouches, and instruments, etc. generates a lot of waste. Hence, dentists need to switch to reusable alternatives, which can be sterilized.

Green Dentistry is High-Tech Dentistry

It was only about 50 years ago that dentistry was revolutionized by air turbine-driven hand pieces and low-risk local anesthetics. Since then, the technology revolution has escalated, with new innovations appearing every few years, not every 50. We know this trend will continue, and high-tech innovations will continue to make the practice of dentistry more reliable, easier on practitioners, and more cost-effective. It turns out that almost every high-tech innovation in dentistry also has environmental benefits. Take computer-aided design/computer-aided manufacturing (CAD/CAM) systems, for instance. There is the chair-time advantage of single-visit restorations, but consider that single visits by patients mean lower carbon emissions because the patient's travel to the office is reduced by half. Consider also that CAD/CAM systems eliminate the need for disposable impression materials, and the freight and transportation impacts associated with sending restorations back and forth to a laboratory.

Here are 10 high-tech innovations that are part of dentistry's green future:

1. Digital imaging
2. The CAD/CAM systems
3. In-office sharps disposal equipment that renders sharps inert
4. Steam sterilizers that eliminate use of chemicals
5. Digital patient charting, scheduling, and billing
6. Digital patient communications, like e-mail appointment reminders, reducing paper, and saving staff time
7. Diode lasers, which eliminate the need for packing cords
8. Use of a Website as a primary marketing tool
9. Electronic media (e.g., iPad) to record patient intake forms
10. Oil-free compressors²⁴

Responsible Waste Disposal

Dental clinics generate a number of biomedical wastes, including blood-soaked materials and human tissues,

expired drugs, syringes, broken glass, scalpels, specimen tubes, and slides.²⁵ The waste should be properly disposed using color coding of waste categories. The plastic bags used for waste disposal are especially non-chlorinated, which can be incinerated.

The Biomedical Waste (management and handling) Rule 1998, prescribed by the Ministry of Environment and Forests, Government of India, came into force on July 28, 1998. This rule applies to those who generate, collect, receive store disposes, treat, or handle biomedical waste in any manner. Biomedical waste should be segregated into containers/bags at the point of generation of the waste.

The color codings used for disposal of waste are as follows:

- **Yellow:** Collected in colored nonchlorinated plastic bags or containers.
 - *Soiled waste:* Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs, and bags containing residual or discarded blood and blood components.
 - *Chemical waste:* Chemicals used in production of biological and used or discarded disinfectants.
 - *Chemical liquid waste:* Liquid waste generated due to use of chemicals in the production of biological and used or discarded disinfectants, silver X-ray film developing liquid, etc.
- **Red:** Collected in red colored nonchlorinated plastic bags or containers.

Contaminated waste (recyclable): Wastes generated from disposable items, such as syringes (without needles and fixed needle syringes) and gloves.

- **White:** Collected in puncture-proof, leak-proof, tamper-proof containers

Waste sharps including metals: Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used discarded and contaminated metal sharps.

- **Blue:** Collected in cardboard boxes with blue colored markings.

Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.²⁶

CONCLUSION

Eco-friendly dentistry is not merely a “feel good” endeavor. There is overwhelming evidence of global climate changes and the finite capacity of our planet’s eco-system to absorb further depletion and degradation. Reducing waste, changing patterns of consumptions, and limiting the amount of adverse chemicals entering the breathable air of the dental office are achievable and

realistic goals. A student initiation for environmentally responsible dental practice should start from the dental education stage, so that awareness of disposal of dental waste can be carried out in future. Although the effect of these practices on the planet cannot be measured, attempts should be made toward an eco-friendly approach. It is time we stop overlooking sustainability and make our dental practice eco-friendly—for a greener future.

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