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Review Article

Green orthodontics - A review article

Nausheer Ahmed[1], Deeksha YN[1], Abrar Younus A[1]*, Eduru Niharika[1], Ravi Kesari[1]

[1] *Government Dental College and Research Institute, Bangalore, Karnataka, India*

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ABSTRACT

Eco-friendly dentistry often known as green dentistry, is a wellness-based dental practice that uses cutting-edge technology, conserves energy, money, and minimizes waste and pollution. In the course of their work, dentists employ a wide range of materials and tools, some of which could pose environmental risks. It is the duty of dentists to take several safety measures to guarantee that patients, employees, and the surroundings are safeguarded. Green dentistry increases the environmental awareness among dental professionals. This review article identifies the common wastes produced by dentistry and recommendations for reducing the environmental effect that can ensure patients as well as worker safety and prevent the risk of future liability which help in protecting our air, water and land.

1. Introduction

What does "going green" really mean? What does that signify for dentistry as a profession?

The Green color is said to have healing properties and to be the most calming and tranquil color. The color green is associated with rejuvenation, growth, hope, stability, and endurance, as well as improved vision. [1,2]

Whether we are aware of it or not, humans have had a massive impact on environment since our arrival on mother earth. Its delicate equilibrium has been rapidly harmed by our usage of petroleum-based products, chloro-fluorocarbons, and other substances, which has evolved us beyond just being a part of the food chain. In light of this, starting a green movement is a sensible and essential step towards preserving the environment.

Eco-friendly dentistry is a relatively young field of dentistry that places an emphasis on preventative, precautionary, patient as well asglobal-centered treatment philosophy together with least invasive dental procedures. This is a novel idea that benefits patients, clinical personnel, the environment. Thus, the main goals of eco-friendly dentistry, often known as green dentistry, are to raise public awareness of environmental issues and lessen the negative effects that our profession has on the environment. [1]

2. What is the Environmental Impact of Dentistry [3,4]

The ground basis for transforming a dentistry practice from existing state into an environmentally friendly one are,

1. Use of conventional X-ray system
2. Use of materials containing mercury
3. Excessive use of disposable for infection control
4. Use of toxic products for sterilization and disinfection
5. Improper disposal of biohazardous waste
6. Wastage of resources like electricity, water, paper etc.

3. What Should We Do [5,6]

Being eco-friendly is achieved by applying 4 basic rules to our daily activities i.e

* *Corresponding author*.
E-mail address: abrarvounus94@gmail.com (A. Younus A).

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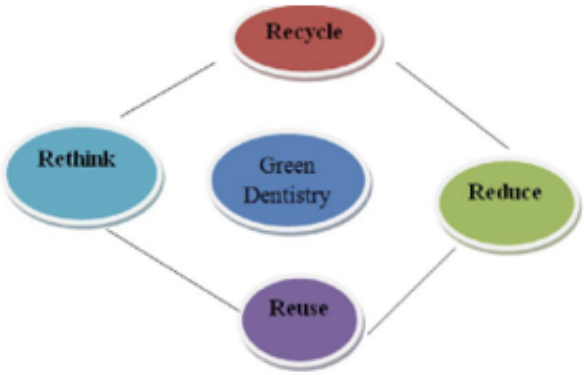


1. ***Rethink*** - Having awareness is the first step towards making a change. Rethinking is just being conscious of the results of all of our daily decisions and their effects on the planet.
2. ***Reduce*** - The best method to preserve the earth's resources is to simply conserve what is left of them. The formula is straightforward: use less, gain more.
3. ***Reuse*** - This step helps to prolong the use of items. Extending the life cycle of an item by re-using it eliminates the need to transport it away. Reuse of materials saves the resources and gives material new life by using it second time in a new way
4. ***Recycle*** - Recycling is the last resort and we ought to be far more diligent in recycling whatever we can.

4. Way to Go Green[3]

The initial step towards practicing sustainable dentistry entails reevaluating consciousness and attitudes, altering how the dental office is perceived, and putting basic adjustments into practice while keeping in mind that it is a constant process. Along with that, the team must be trained, with each member doing their best part and knowing sustainable practices.

5. Start with Your Clinic: Building Green

Increasing a building's efficiency in the use of materials, water, and energy is known as "green building." Utilising locally sourced, natural materials is the main goal of green building.The changes which can be incorporated includes

1. Place your workspace where it will receive the most sunlight exposure possible.
2. Use of low volatile organic compound paint for walls
3. Make use of energy-saving lights. Light Emitting Diode (LED) and Compact Fluorescent Light (CFL) bulbs can be used to achieve this.[7]
4. Take into account utilising alternatives to traditional power sources, such as water heaters, solar energy panels, and electricity produced by wind mills.
5. Use of movement sensors lightning instead of switches which reduces the electric power consumption
6. Use of office furniture made by recycle or reclaimed wood
7. Adding a green plant to an operatory can enhance the indoor air quality and increase the amount of oxygen accessible in the space.
8. Use sensor-operated faucets or Use low flow faucets and fixtures.

Dentists while protecting of oral health should not limit their responsibility to patient treatment but also include methods to protect environment as well. This can be incorporated in daily practice by following methods.[5]

Going paperless – Going paperless is a new approach. Paper is not only a waste product it's expensive and diminishes natural resources. So, one can use computer system for bills and financial statements like forwarding to email instead of paper receipt. However in situations, paper cannot be avoided completely, in such instances use of chlorine free, recycled paper instead of traditional paper products are advised.

5.1. Reusable items for medical use

-Stainless steel cups are preferable to paper or plastic throwaway cups. Use biodegradable disposable paper cups if using a disposable cup is necessary.

-Employ reusable surgical/endodontic suction tips made of stainless steel.

-When absolutely necessary, use paper or plastic barriers that are disposable otherwise cloth-based items are preferred.

-Avoid one time use burs.

-Choose to purchase goods that come in packaging made of as little as possible resources (such as paper, plastic, aluminium, etc.). It is important to refrain from using PVC plastic containers since they are not recyclable and could emit acid fumes if burned.

6. Sterilization Technique That is Gentle on the Environment

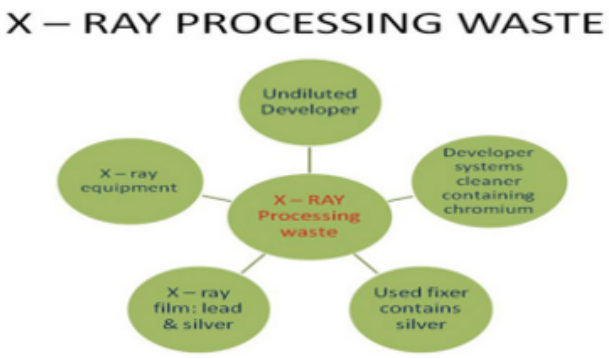
The need of sterilizing and disinfecting equipment cannot be overstated for the sake of our patients' and our own safety. However, it is not necessary to sacrifice the environment in order to protect patients.

6.1. Measures like

1. Utilizing an autoclave is the most environmentally friendly method of sterilization.

2. Replacing your disposable sterilization pouches with reusable ones is an easy, economical and quick way to go green.
3. Avoid Chemical based sterilizing solutions.
4. Use dry vacuum systems over wet ones. Liquid ring vane pumps use water to create suction and are therefore called 'wet' pumps. This leads to use of large amounts of water and electricity, Use instead a dry suction system, which is designed in such a way that excess amount of water is not needed which leads to saving large amounts of water and electricity.

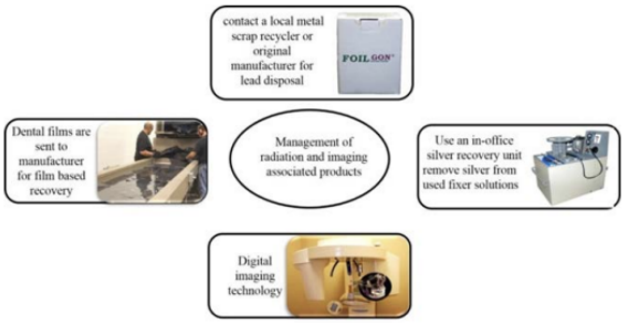
7. Management of Radiation and Its Ssociated Products[1–3]



Lead: lead is a dangerous metal. Seizures, learning difficulties, or even death are possible outcomes. Lead must therefore be disposed of appropriately. In dental operatories, lead foil found in conventional radiography film packets and lead aprons/shields are the most often found products containing lead. Selling lead aprons to a nearby scrap metal recycler is one way to get rid of them.

X ray films: The used and unused old film should not be disposed in the general waste. Toxic unreacted silver can be found in old films. Usually used polyester film can be sent back to businesses for silver and film-base recovery.

Fixer solutions: Dental offices use a very small amount of fixer relative to photographic processing facilities. Fixer solutions often contain silver thiosulphate complexes, which are primarily transformed to silver sulphide throughout the waste-water treatment process and end up settling in the sludge. Silver can be extracted from spent fixer solutions using an in-office silver recovery machine (metallic replacement or electroplating system), and the used cartridge can be recycled. When the gathered silver is sold to a refiner, the silver recovery process could yield a return. A silver recovery cartridge can offer a simple solution for adhering to local discharge laws. Silver also can be recovered from small batches of fixer by pouring the solutions into a silver recovery cartridge. If an arrangement is formed with medical radiology, commercial photographic processing, or silver recovering facilities, fixer solution can be sent to them. Developer can be combined with the desilverized fixer, diluted with water, and then poured down the drain



7.1. Dispose with care

Four phases are listed in the World Bank's advice note on health care waste management: 1. Segregation 2. Transportation 3. Treatment 4. Final disposal.

As the therapeutic and diagnostic procedures performed, all producers of biomedical waste should follow the recommended safety protocols and take universal safeguards. Special non-chlorinated plastic bags that are color-coded according to the waste to be disposed of are used for waste disposal;

8. Management Practices for Amalgam Waste[3,4]

Mercury, a known neurotoxin, nephrotoxin and bioaccumulative element, is found in dental amalgam particles. Mercury is released as vapours and ions which are absorbed through alveoli in the lungs into the bloodstream. Mercury Poisoning is caused when the exposure levels get high and that is quite easy to reach[8]

Best practice for amalgam waste are,

- Switch to pre-capsulated amalgam
- If elemental mercury spills, use a "mercury spill kit."
- Utilize silver alloy to react with leftover elemental mercury to create scrap amalgam.
- It is never appropriate to flush elemental mercury down the drain.
- Keep the scrap amalgam in a sponge-style mercury disposal container.
- When the contact amalgam enters the sewer system, use an amalgam separator on the suction pipes to remove more than 95% of it. The technology used in amalgam separation relies on the removal of dental amalgam particles from waste water by sedimentation, filtration, or centrifugation.

Table 1:

Category	Type of waste	Disposal treatment
I (Yellow)	Human/animal anatomical waste, Sloid waste Expired medicine Chemical waste Microbiological waste	Incineration/plasma pyrolysis/deep burial Yellow colored nonchlorinated plastic bags incineration/encapsulation/plasma pyrolysis incineration/encapsulation/plasma pyrolysis pretreat to sterilize with nonchlorinated chemicals on-site thereafter for incineration
II(Red)	Contaminated waste (recyclable)	Autoclaving or microwaving followed by shredding or mutilation or combination of sterilization and shredding
III(White)	Waste sharp such as blades scalpels and needles	AUTOCLAVING OR DRY HEAT STERILIZATION followed by shredding or mutilation or encapsulation
IV(Blue)	Glassware and metallic body implants	Disinfection pr through autoclaving or microwaving or hydroclaving and then sent for recycling

9. Sustainability in Orthodontics[9]

Adopting techniques that lessen hostility in the environment is also required in orthodontic practice. Due consideration must be given to the potential environmental effects of the materials used in orthodontics.

Orthodontic material package destined for the trash

Some strategies for delivering orthodontic care in a sustainable way that improves the environment without sacrificing the effectiveness of the treatment include

10. Dental Impressions

1. Dental alginate is a commonly used impression material in dentistry because to its ease of manipulation, low equipment requirements, flexibility, accuracy, and affordability.

2. Thirty percent of the solid waste produced in dental practices is made up of impression materials.

3. This waste from alginate impressions can be recycled by washing, drying, and meshing it until it is around 2-3 mm in size and the recycled alginate shows sufficient quantity to add nutrients associated with soil fertility and crops.

4. The high calcium content can be utilised as a calcification material to enhance the quality of the soil, and additional nutrients obtained from the waste dental alginate, such as nitrogen, nitrate, phosphate, potassium, manganese, and sulphur, can effectively encourage crop yields.[10]

Table 2:

How it is done	Sustainable practice	Benefit
Use of disposable cups	Use of corn starch or glass cups	Less production of solid residues
Use of incandescent or fluorescent lamps	Use of LED lamps	Lower electrical power consumption up to 80%
Use of switches	Use of movement sensors in less frequently used areas.	Lower electrical power consumption
Use conventional paper for printing	Use recyclable paper	Making best use of resources
Furniture made of synthetic, non-recyclable materials	Use of furniture made of reforested wood	Lower emission of gases into the atmosphere, and these are biodegradable
Printing in normal mode	Use draft mode	50% saving of ink
Magazines and newspapers on paper or plastic	Tables with access to Internet so patients can entertain themselves before being attended to	Elimination of solid residue
Throw paper into the garbage can together with other types of materials	Throw paper away in selective trash collectors	Reduction of solid residues and possibility of recycling
Throw paper into the garbage can together with other types of materials	Use of electronic appliances with low energy consumption	Lower electrical power consumption
Artificial plants and ornamentation	Use real plants	Avoids the use of plastic materials and promotes transformation of CO2 into O2 through photosynthesis by plants

Figure 1. Dental Alginate Wastes Preparation

11. Gypsum and Plaster

1. The dental industry produces a significant amount of gypsum waste
2. This gypsum waste is dumped in landfills, where it breaks down and releases hydrogen sulphide, which has a smell like rotten eggs.
3. Currently, incineration—which is highly problematic and environmentally unfriendly because of release of hazardous gases and heavy metals—is used to dispose gypsum waste.

• Treatment with a 20% concentration of ammonium bicarbonate solution can facilitate the quick and environmentally beneficial disintegration of such gypsum waste.

• In 24 to 36 hours at room temperature, this solution breaks down the waste into high-value, non-toxic chemicals like calcium bicarbonate and ammonium sulphate, forming a sludge.

• Ammonium sulphate is useful as a fire-extinguishing powder and as nitrogen fertiliser, as well as in the wood pulp, textile, and pharmaceutical industries.

• The metallurgy sector can employ calcium carbonate, primarily in the steel making process.[11]

12. Hi Tech Dentistry

The last component of green dentistry is high‑tech practice.[10–13]

In the 1990s, the field of orthodontics was significantly impacted by the introduction of personal computers. A new era in office management has been brought about by digital orthodontics. The novel methods of the twenty-first century stand in stark contrast to the orthodontic practice of the 1970s and 1980s. As computers became more dependable and active, orthodontists started to rely on them for treatment planning and diagnosis. Some recent advances where digitalization seen in field of orthodontics are

13. First is Going Paperless

The main hurdle today for discussing future in orthodontic practice is getting rid of paper from daily operations. Nevertheless, a lot of orthodontists have come to realise that paperless operations are feasible. Changing practices to high-tech operations can help to achieve this.[14]

A central, computerised practice management system has replaced all manual and paper record methods. These records include

1. Demographic data
2. Diagnostics data (health history, photographs, models, x-ray)
3. Treatment plan
4. Scheduling (appointment book)
5. Finance bills

So by creating E- records usage of papers can be greatly reduced and this can be considered as one of the way for green practice.

13.1. Digital imaging technique

Cadent created the first orthodontic digitation system in 1999, and since then, the technology has advanced significantly. Using this technique, a dentist can scan the oral cavity directly or use plaster models or impressions to obtain a three-dimensional image of the dental arches, either separately or in occlusion. When compared to their conventional counterparts, the digital study models have a few benefits, such as increased comfort, reduced risk of allergic reactions, improved tolerance, and ease of recovery, storage, and peer-to-peer data sharing.[15]

14. 3D Printing

In this new era, orthodontics is moving towards a more advanced technological viewpoint. The field of dentistry and medicine is seeing a significant expansion in the use of additive manufacturing, a relatively new technology. The transition from gypsum laboratory to 3D printing has involved a conceptual change.

When combined with computer-aided manufacturing (CAD-CAM), 3D printing can be used to create even more precise orthodontic appliances. Digital dental models also significantly reduce the need to obtain plaster models and alginate impressions, which helps to avoid the disadvantages of traditional methods.

As far as we are aware, study models have always been a crucial component of the orthodontic procedure. Traditionally, they have been cast from stone or plaster, and their primary purposes have been to:

Provide data for diagnosis and treatment planning;

Provide a three-dimensional (3D) record of the initial malocclusion, any stages of correction, and the therapy's result.

They do have certain disadvantages because they are cast in stone or plaster, including:

Storage and retrieval

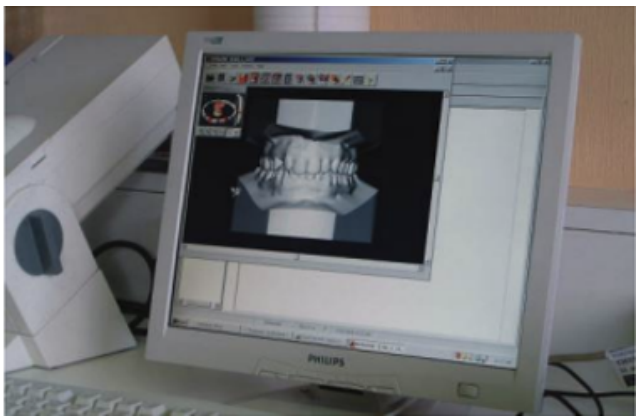
Diagnostic versatility

Transferability

Durability.

The introduction of 'virtual study models' may allow the use of a fully electronic patient record for the orthodontic patient.

The company CADENT, Ind (Computer-aided Dentistry, Fairview, NJ, USA) developed the OrthoCADTM software.



With the exception of being able to hold the casts "in your hand," OrthoCADTM models offer the clinician the following benefits over plaster models:

- an easier and more efficient way to measure and store data from the "virtual" model;

- an easier way to store and integrate the digital photos, x-rays, and clinical notes into the patient's "digital" file;

-easy distribution to other members of the patient's healthcare team via printouts or email attachments;

-simpler retrieval and viewing with the patient's other clinical data, particularly at the chairside; [15]

So by following HI TECH dentistry one can greatly reduce the waste generated by usage of impression materials, gypsum products, study models along with that it has added advantage of high patient comfort, less time consuming and easy retrieval and storage.

15. Conclusion

An environmentally conscious dentist only needs to be a rethinker, not an environmentalist. Two significant factors impeding trash management are lack of information and rising costs. Reducing waste, changing patterns of consumption and limiting the amount of adverse chemicals entering the breathable air of dental office are achievable and realistic goals. The field of dentistry is one of healing profession because we work in the field that promotes smiles, it is therefore imperative that we stop ignoring sustainability and transform our dental office into an eco-friendly one in order to contribute to a more sustainable future. Being 'green' in dental practice will make one feel better about oneself and what we are doing for humankind.

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17. Conflict of Interest

None.

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Author biography

Nausheer Ahmed, Professor and Head

Deeksha YN, PG Student

Abrar Younus A, Assistant Professor https://orcid.org/0000-0002-5720-9185

Eduru Niharika, PG Student

Ravi Kesari, PG Student

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