Going (unintentionally) green: The unexpected bonus of switching to CAD/CAM and same-day dentistry

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Introduction

With dentistry as innovative and dynamic as it is, the progress made and the exciting new trends that result are often judged in terms of the technological or financial: We can update our equipment to have a purely digital office, or we can adopt new practices and offer new procedures to our patients that bring in extra revenue.

While these accomplishments are certainly laudable, it is time for dentistry to measure its progress by different standards, ones that affect the profession and the world as a whole. In short, we can examine how our practices and procedures influence the environment and what dentistry as a profession can do to ensure this influence remains positive.

Fortunately, dental professionals no longer have to choose between advances in technology and what is considered “eco-friendly.” In fact, practice owners can assure themselves of the best of both worlds by adopting digital technology, such as in-office CAD/CAM systems such as the Planmeca PlanScan System (E4D Technologies). While the practical and financial benefits of CAD/CAM technology are well established, the environmental benefits — though discussed less often and perhaps not as well understood — abound.

CAD/CAM: Why dive into digital?

Though not ubiquitous, digital technologies, particularly in-office CAD/CAM systems, are making their presence known. Dental professionals who integrate these advanced technologies can offer same-day dentistry to their patients; that is, they condense the restorative process of multiple appointments over several weeks down to one appointment lasting a few short hours. Clinicians can digitally scan the patient’s teeth and design the restoration(s) right then and there. Once approved, the restoration(s) can be milled and seated immediately. Essentially, in-office CAD/CAM systems are revolutionizing how restorative dentistry is practiced.

This CAD/CAM revolution provides almost innumerable benefits to patients. Multiple appointments for one restoration become nonexistent, so patients no longer need to make multiple trips to the dental office. Digital scans eliminate the need for messy, uncomfortable impressions that make patients gag and are prone to errors. Temporary restorations are no longer necessary, removing that extra step from the restorative process and ensuring that patients are not at risk for increased sensitivity or leakage while wearing sometimes uncomfortable provisionals for weeks. Finally, definitive restorations are fabricated...
and placed within hours of scanning and can be adjusted immediately, so patients no longer have to wait for that perfect laboratory restoration.

Clinicians, too, reap several benefits. Digital scans equal easier “impressions” that enable accurate reproductions of patients’ dentition. Restorations can be designed in the office without communication or transfer to a dental laboratory, eliminating back-and-forth exchanges that cause delays or less than optimal results. In fact, restorations can now be fabricated with more patient input, since intuitive CAD software enables dentists to easily design restorations on-screen while remaining chairside, providing patients with that “wow” factor as they see what digital technology is allowing dentists to do. Once designed, the restorations can be immediately milled in the office and tried in the patient’s mouth, so a perfect fit and high-quality esthetics are affirmed at the same appointment.

_Digital practice equal green practices_

Since CAD/CAM technology was first introduced decades ago, early adopters and technology enthusiasts have encouraged integration of these systems for various practical and financial reasons. Though generally a substantial initial investment, practices that upgrade to digital technology find that streamlined procedures and happier patients lead to a significant return on investment.

But switching to a CAD/CAM system provides an unanticipated bonus, one with a far broader impact. Using an in-office CAD/CAM system is one of the most environmentally conscious upgrades a practice can make, offering both concrete and intangible benefits for dental practices, their patients and the greater community.

CAD/CAM systems add to a practice’s green image with the many small changes they allow the office to implement. For example, now that impressions are taken with a digital scanner (PlanScan), traditional impressions — and all their associated materials, such as disposable impression trays, impression material and the water with which it is mixed — are no longer necessary. Clinicians who thought they were only saving money (and storage space) can rest easy at night knowing they’re no longer contributing to the throwaway, disposable culture in many healthcare offices.

Additionally, because digital impressions can be viewed instantly with software that allows users to see potential errors, any mistakes are quickly averted with a second digital scan that requires no extra materials or waste. It is not uncommon for dentists to take a second traditional impression because of errors caused by saliva or air pockets in the impression material or to have a backup on hand in case there are problems down the road. Over time, material waste created using traditional impression methods adds up. Using digital technology not only streamlines the
process but ensures that materials, time and money aren’t wasted.

Moreover, because traditional impressions aren’t needed with a digital workflow, equipment previously used to perform these procedures, such as a mixing gun for impression material, are also no longer necessary. While clinicians may think they are only saving themselves hassle or time by purchasing an easier-to-use piece of equipment, they’re also saving energy — literally. With digital technology, impression-taking instruments no longer need to be run through a wash cycle and sterilized. This saves time, energy and water.

While it seems like saving resources, particularly water, isn’t possible in dental practices, small steps such as these really add up. The Eco-Dentistry Association (EDA) ([www.ecodentistry.org](http://www.ecodentistry.org)) estimates that dental practices use 360 gallons of water per day. This totals 57,000 gallons of water per year, per practice. In the United States alone, dental practice water usage totals approximately 9 billion gallons of water per year. This does not even include dental laboratories, which must use substantial amounts of water when mixing and pouring models in stone and cleaning their equipment.

In addition to the above in-office water issues, along with laboratories and their respective procedures that will always require water, these staggering statistics spell out the clear need for water conservation whenever possible, and in-office CAD/CAM supports this effort.

**Greener materials: Using all ceramics instead of amalgam**

Amalgam restorations had been the standard of care in restorative dentistry for decades. With material science advancements, however, there are new contenders for that title. In particular, the use of all-ceramic materials has significantly increased in recent years, and when coupled with in-office CAD/CAM systems, their advantages are economical and ecological, in addition to esthetic, biocompatible and functional.

The majority of the materials for same day CAD/CAM dental procedures are generally composite or all-ceramic blocks, so there is no metal involved. These metal-free restorations can often be used without reservation for various indications, including single-unit restorations, inlays and onlays. While the benefits of these materials have been expounded upon (e.g., esthetics, ease of use, wear, optical properties), they provide tangible environmental benefits as well.

For example, the longevity of all-ceramic restorations such as in-office CAD/CAM designed inlays is well documented. In addition to a highly esthetic restoration, patients receive restorations that will last for many years, without the concerns associated with amalgam, such as cracks, failures or potential mercury toxicity. This potentially saves patients and clinicians time, money and wasted resources that would be spent traveling to and from the dental practice, taking more impressions and fabricating new restorations.

Perhaps of greater consequence is removing toxic metal from this equation. All-ceramic and metal-free restorations mean that dental practices no longer have to worry about amalgam disposal and its accompanying mercury toxicity.

The Environmental Protection Agency (EPA) estimates that nearly 50 percent of all mercury entering local wastewater treatment facilities originates in dental offices.
Using CAD/CAM compatible materials such as all-ceramics lessens or eliminates the contribution of your dental office to environmental mercury. It also means that dental practices needn’t worry about using an amalgam separator.

Currently, the American Dental Association (ADA) does not have national regulations in place for amalgam separators, so many dental practices and laboratories aren’t compelled to use them. Although designing and milling all-ceramic materials still requires energy and results in some waste materials, can they really compare with the toxic byproducts of metal-based restorations?

_Crunching the numbers: CAD/CAM math_

In-office CAD/CAM systems provide more than just a clear conscience about saving the environment. There are real, tangible benefits and savings that can easily be estimated to demonstrate the immense value of this digital technology.

Because same-day in-office CAD/CAM dentistry reduces the number of appointments from two (or possibly more, if the restoration does not fit) to one, it stands to reason that every dentist who incorporates these procedures would positively impact the environment by reducing the number of automobile trips patients make to the practice. This would result in a 50 percent reduction in gasoline and oil product use.

With a carbon content of 2,421 grams, one gallon of gasoline produces approximately 19.4 pounds per gallon of carbon dioxide emissions. This is calculated by multiplying the carbon content (2,241) by the amount of carbon that remains unoxidized (0.99) by the ratio of the molecular weight of CO₂ (44) to the molecular weight of carbon (12).

Using the state of California as an example, where approximately 10 percent of the 100 million laboratory dental restorations are completed in the United States every year, we can calculate an approximate savings. If four gallons of gasoline are used for a round trip to the dentist, a restoration needing two appointments to complete would require eight gallons of gasoline. But if these dental practices adopted same-day in-office CAD/CAM dentistry, that number could be cut in half, saving four gallons of gasoline per restoration. Four gallons of gasoline multiplied by 10 million restorations would equal a savings of 40 million gallons of gasoline for restorative procedures in the state of California alone. This, in turn, would equal a reduction of carbon dioxide emissions by 776 million pounds per gallon each year (assuming the previously calculated 19.4 pounds per gallon measurement).

If we extrapolate to the United States as a whole, we can calculate that this would equal 400 million gallons of gasoline saved and 7,760 million pounds per gallon of carbon dioxide emissions eliminated, per year. This would all be due solely to a reduction in patient automobile trips to and from the dentist for restorative procedures. While same-day dental procedures may not save the world, their potential impact, even estimated, is undeniable.

_Conclusion_

In-office CAD/CAM systems’ advantages are limitless. In addition to the clear financial and practical benefits they bring, their positive impact on the environment makes the decision to upgrade even better. They remove toxic, wasteful and disposable materials and practices from the equation, replacing them with greener practices that have a tangible influence. While the clinical advantages of CAD/CAM systems and same-day dentistry continue to be rightfully celebrated, their ecological advantages should not be overlooked.

_References_


_about the author_

Dr. Joel Strom is a former president of the California State Dental Board and former course director of “Ethics in the Practice of Dentistry” at USC School of Dentistry. He graduated from UOP School of Dentistry in 1979 and completed an NIH post-doctoral fellowship at Columbia University in 1983. He has owned an E4D milling machine and camera for five years and practices general dentistry in Beverly Hills and provides consultation and litigation support in the dental health area, including corporate clients, governmental agencies and individual dentists.