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¹ Norton MR, Astrom M. The influence of implant surface on maintenance of marginal bone levels for three premium implant brands: A systematic review and meta-analysis. Int J Oral Maxillofac Implants 2020;35(6):1099-111



Dr Scott D. Ganz

Editor-in-Chief



Cap·ture

—an image capture device is a hardware or electronic device that captures images and converts them into a digital format

The history of photography spans nearly two centuries, beginning with the invention of the camera in the early nineteenth century. The earliest form of photography, known as camera obscura, existed long before the invention of the camera itself. This optical device projected an external scene on to a surface inside a darkened room. It was not until the 1820s that Joseph Nicéphore Niépce captured the first permanent photograph in a process called heliography, using a pewter plate and bitumen of Judea. This pivotal moment marked the birth of photography as we know it.

In 1839, Louis Daguerre introduced the daguerreotype, a process which drastically improved photographic methods by utilising polished silver-plated copper. The image was developed with mercury vapour, creating detailed and vivid portraits that quickly gained popularity. Concurrently, William Henry Fox Talbot developed the calotype, a process which produced negatives on paper, allowing for multiple prints from a single exposure. This innovation laid the groundwork for modern photographic printing methods.

As the nineteenth century progressed, photography evolved rapidly, driven by technological advancements. The introduction of glass plates in the 1850s and 1860s offered better image quality and sensitivity, culminating in the creation of roll film by George Eastman in 1885. Eastman founded Kodak, making photography accessible to the masses with the slogan, “You press the button, we do the rest.” This ushered in the snapshot culture, democratising photography and leading to widespread adoption.

The twentieth century saw great progress, particularly in professional photography. Colour photography emerged in the 1930s, Kodachrome film capturing vibrant hues.

After World War II, innovations such as the introduction of automatic cameras and single-lens reflex systems further transformed the field. Meanwhile, photojournalism thrived, shaping public opinion during pivotal moments in history.

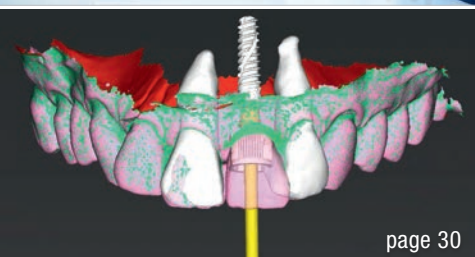
The shift to digital photography in the late twentieth century revolutionised the medium yet again. The first digital camera was developed in 1975 by Steven Sasson at Kodak, but it was not until the 1990s that digital cameras became commercially viable. The subsequent rise of high-megapixel sensors in the 2000s marked a significant leap in image quality. Today, digital cameras often exceed 100 MP, allowing photographers to capture extraordinary detail and enabling new avenues for creativity.

From chemical processes to sophisticated digital technology, the history of photography embodies innovation, artistic expression and the relentless pursuit of capturing reality, 200 years of progress which now allows high-resolution photography on our mobile telephones. The impact on dentistry has been profound, as evidenced by the introduction of the intra-oral scanner to capture and then digitise the oral cavity for diagnostic and restorative purposes. The process of digitisation for dentistry has evolved rapidly, the most recent development being extra-oral photogrammetry to increase speed, precision and accuracy for implant restorations—this has been newly surpassed by the introduction of *intra-oral* photogrammetry! Keep up with the latest advances in the digital workflow with our latest issue. Welcome to the future of dentistry!

Respectfully,
Dr Scott D. Ganz
Editor-in-Chief



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From chairside to cyberspace: Why every dental practice needs cybersecurity

Part 1 of a four-part series on helping practices get prepared

Anne Genge, Canada

Dentistry's cyber problem

The rapid rise of digital dentistry has given dentists worldwide many benefits, but it has also increased risks. Dental teams must learn to leverage these technologies safely to keep sensitive patient information secure. This article is the first in a four-part series designed to help dentists secure their practices in a more connected world. Each part will cover a critical area of cybersecurity: identifying cyber threats, taking proactive measures, and creating a robust disaster recovery plan. Future installments will explore specific threats and solutions tailored for dental professionals. Whether you read one part or all four, this series will provide insights to help protect your practice from cyberattacks and safeguard patient data.

Why cybersecurity matters more than ever

Cybersecurity is one of the greatest challenges of the twenty-first century. It is not just a problem of government or big business; cyber risk affects everyone. Most people now have technology embedded into every part of their lives. Every connection, everywhere, creates some level of risk.

There are currently over 13 billion records originating from data breaches that are accessible on the dark web, a marketplace for cybercriminals to sell, trade and use stolen data to attack both individuals and organisations.¹ This statistic indicates that nearly everyone has experienced a breach of some kind. Although this does not mean that we will all become victims in a worst-case scenario, it does mean that we are all potential targets.

Since most successful attacks come through e-mail and more than 90% of cyberattacks start with phishing, it is easy to see why anyone with an e-mail address must act to assess the legitimacy of e-mails.² Cybercriminals exploit human weaknesses by using social engineering tactics to trick individuals into granting access or providing login credentials.

Why are dental practices at risk?

Small and medium-sized businesses, including dental offices, often assume that they are too small to be on a hacker's radar, but cybercriminals are aware of this mindset and exploit it. This view-point is understandable, as cybersecurity seems to be a concern only for large corporations. The reality is that dental practices handle sensitive data—patient records, financial information and health histories—all valuable to cybercriminals. This

type of data can be sold on the dark web, used to steal identities or leveraged to extort the practice and its patients. Unlike large companies, many dental practices lack the resources for advanced cybersecurity, and small businesses generally do not have the same defences as larger enterprises, making them more vulnerable.³ Considering that over thirteen billion stolen records are now on the dark web, every organisation, no matter its size, is a target.⁴

The high stakes of a cyberattack

If you are wondering what the worst is that could happen from a hack, consider the following:

- **Financial losses:** The cost of recovering from a cyberattack can be staggering. For the healthcare industry, including dental practices, the average cost per record in a data breach is reported at approximately US\$429 (€412*), according to IBM's *Cost of a Data Breach Report 2024*.⁵ This figure reflects several factors, such as notification, recovery, regulatory expenses and lost business. Healthcare, having stringent data privacy requirements, typically incurs the highest breach costs across industries.
- **Reputation damage:** Trust is the foundation of your relationship with patients. If their personal data is compromised, that trust can be damaged, leading to loss of patients and a tarnished reputation that is challenging to rebuild.
- **Privacy compliance violation:** Privacy regulations vary globally, but healthcare providers universally have an obligation to protect patient data. Non-compliance can result in significant fines and legal issues, particularly regarding the US Health Insurance Portability and Accountability Act of 1996 and Regulation (EU) 2016/679 EU (General Data Protection Regulation).

Operating systems and the cloud—understanding the risks in your technology environment

There is no one-size-fits-all cybersecurity solution for dental practices. Operating systems and the cloud introduce varying cybersecurity risks:

- **Microsoft Windows:** Most dental practices run on Windows, and Windows systems offer flexibility. However, they are frequently targeted by cybercriminals. More than 80% of malware is designed for Windows systems.⁶ Regular software updates, antivirus tools, and robust network defenses including firewalls, safeguards, and security awareness training are essential. Carefully choose your e-mail services as well to ensure proper filtering since a majority of cyber attacks come through e-mail.
- **Apple's macOS:** Though less frequently targeted, macOS is not invincible. As more practices use Apple devices, the potential for attacks will likely rise. Users of macOS should stay updated whenever patches are available, use security tools such as firewalls and safeguards, as well as security awareness training for all team members. Carefully choose your e-mail services as well to ensure proper filtering since a majority of cyber attacks come through e-mail.

- **Cloud:** As dental practices adopt cloud platforms, managing patient records and billing comes with added security concerns. 80% of cloud breaches are caused by misconfiguration such as improper security controls, access management that leaves data exposed, unsecured backups, and lack of two-factor authentication that adds an important second layer of defense in case credentials are stolen.⁷ Using strong passwords and multifactor authentication, as well as regularly reviewing security settings, is critical.

Understanding the variety of risks across different technology environments helps to underscore the need for a comprehensive approach to cybersecurity. Whether your practice uses Windows or macOS or is cloud-reliant, the articles in this series will provide the steps you need to protect patient data, maintain operational continuity, and build a cyber-resilient practice.

What you can do right now

Assess your practice's cybersecurity by asking the following questions:

- Are systems secured with proper defenses and monitored for intrusions?
- Are your staff trained to spot phishing e-mails?
- Do you have a response plan for a cyberattack?

If you are unsure about any of these, do not worry; you are not alone. Most dental practices feel unprepared initially. My goal with this series is to help you take manageable steps to reduce your risk. Cybersecurity can be simplified, and by following the guidance in this series, you will be on your way to significantly enhancing your practice's security. Stay tuned for Part 2, where we will discuss the specific cybersecurity threats dental practices face—such as phishing scams and ransomware—and the tactics cybercriminals use and how to counter them.

* Calculated on the OANDA platform for 24 November 2024.



Editorial note: Please scan the QR code for the list of references.

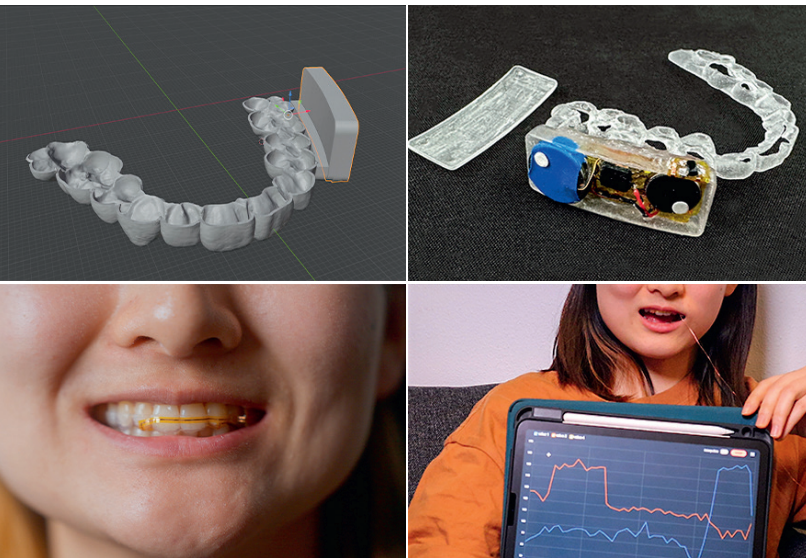
about



Anne Genge is a multi-certified privacy and cybersecurity expert who has won global awards for her work in cyber risk management, ransomware prevention, and cybersecurity education for healthcare providers. For more than 20 years, she has been a technological innovator and educator in Canada, working closely with practice owners, dental teams, and IT providers to protect patient and practice data and to enable compliance with privacy regulations.

New interactive mouthpiece with hands-free control paves way for advances in health data

Dental Tribune International



The new MIT MouthIO interactive mouthpiece. (Images: © Sebastian Krog; MIT CSAIL)

Most wearable electronics are worn on the skin, and intra-oral devices are rare. Researchers at Massachusetts Institute of Technology's Computer Science and Artificial Intelligence Laboratory and Aarhus University have created MouthIO, a dental appliance with sensors and feedback systems that allows for hands-free device control and health monitoring via in-mouth interactions. Unlike traditional voice-activated devices, this retainer-like appliance allows users to control technology using their mouths, a potential breakthrough for those with motor impairments.

The transparent MouthIO is customised from a dental scan and modelled using a special plug-in in the design software Blender. This plug-in allows users to create a personalised device and integrate electronic components like batteries, temperature sensors, accelerometers and touch detectors. Once designed, the appliance is 3D-printed in dental resin for a snug, customised fit.

Key features of MouthIO include its ability to monitor oral activity such as bruxism and to control devices by registering tongue taps on sensors embedded in the appliance. For instance, tongue taps can transmit commands

to scroll a webpage, using the mouth for hands-free interaction.

According to Dr Michael Wessely, senior author of a paper on the appliance and head of the Interactive Matter Lab at Aarhus University, MouthIO represents an opportunity to integrate wearables in the mouth—a challenging but largely unexplored space owing to the mouth's complex shape and moisture. The device's potential for real-time health insights, like monitoring jaw movements or detecting bacteria, makes it promising for healthcare applications, as dentists are interested in exploring these new possibilities.

MouthIO's modular design provides two main formats: a full-coverage appliance and an open-bite version that leaves teeth partially exposed. This open-bite design avoids speech issues like lisping, making the device comfortable for extended wear. During testing, participants favoured this format, and one experiment showed that it could warn users with a vibrational alert when a beverage exceeded a safe temperature.

Producing MouthIO costs around US\$15 and takes just 2 hours to print. Dr Wessely and his team are further refining the appliance, including creating a lingual or palatal version for greater comfort and invisibility and exploring additional placements in the mouth, such as on the cheek or palate. They also plan to integrate wireless charging and communication.

Through its user-friendly design, affordability and adaptability, MouthIO showcases the potential of wearable technology in non-traditional hands-free spaces. The researchers aim to conduct longer studies to optimise it for everyday use and further establish its place among assistive and health-monitoring technologies.

Editorial note: The study, titled "MouthIO: Fabricating customizable oral user interfaces with integrated sensing and actuation", was published online on 11 October 2024 in UIST '24: Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology.



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