

Minimally Invasive Dentistry and the Dental Enterprise

Abstract

Improvements in understanding the process of remineralization have resulted in a reappraisal of repair of damaged tooth structure and call into question the principles of cavity preparation of GV Black and his principle of “extension for prevention.” From this reappraisal has emerged the idea of minimally invasive dentistry (MID). The goal of MID is to remove as little of the sound tooth structure during the restoration phase as possible. This goal is in our reach in part because of availability of products that promote mineralization and of dental excavation instruments, like the dental laser, that can be managed to remove only damaged tooth structure. It is critical that the leaders of the dental enterprise endorse MID. Delay could allow new products to move from the dental profession to other health care providers. For example, a caries vaccine will soon enter the market place. Will dentists expand the scope of their practices to include the application of this vaccine, or will they ignore this new product and allow the new technology to enter the scope of practice of other health providers?

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Science and Technology Together Change Dental Practice

In 1891, WD Miller published the results of experimental studies that showed dental caries were produced by oral microbes.¹ His study, titled “The Microorganisms of the Human Mouth,” allowed the germ theory of disease, already a keystone for the practice of medicine, to become part of the foundation for the dental profession and the practice of dentistry in the 20th century. In the late 1800s and early 1900s, a dental drill was introduced that was powered by an electric motor and operated by a foot pedal. In 1895, GV Black introduced the concept of “extension for prevention,” a principle that was quickly adopted and became the second foundational stone for the practice of 20th century dentistry. In 1957, John Borden had perfected the high-speed dental drill, and by 1971, this instrument was used by most dentists in the United States.

The advances in dental drill technology paralleled the advances in the understanding of the cavitation process caused by dental microbes. For example, the results of research studies on the early stages of the caries lesion revealed that remineralization could occur.² This finding fostered the development of new products that supported the remineralization process, suggesting that if a carious lesion was detected in its earliest stage, the treatment of choice could be remineralization therapy and not excavation and removal of the tooth structure. This finding promoted the development of technology to assist in the diagnosis of the early lesion.

During the late 20th and early 21st centuries, the results of research on the caries process began to accumulate, and 2 findings became clear: (1) the margins of restorations provided access to oral flora and the site for additional caries lesions; and (2) if dental decay was detected early, remineralization therapy was a viable option. As a result of these findings, clinicians began to rethink their treatment protocols, especially the application of the principle of extension for prevention.

Based on what was known in the early 19th century, this principle made perfect sense. At the time, a dentist might have explained the removal of intact tooth

structure as follows: “My visual and x-ray examinations show decay in a pit on the occlusal surface of the lower left first molar. In dental school, I was taught that dental decay is a result of microbes lodging in the pits and fissures of the teeth. While the decay is not yet detectable in all the pits and fissures on the occlusal surface of this tooth, with time, microbes will no doubt lodge in these locations and cause decay. Therefore, it makes sense to remove these pits and fissures now and avoid the necessity to repeat the treatment of this tooth at some future date.”

With the patient already anesthetized and the availability of high-speed drilling, this explanation was the standard of care for the time and was in the best interest of the patient. As we now understand, the problem is the imperfect nature of filling materials with leakage and secondary decay at their margins. Clearly, extension for prevention increases the areas for access of microbes with the result that even more tooth structure must be removed to eliminate this secondary decay. As the 20th century ended and research on the caries process began to accumulate, it became clear to many dental scientists and clinical dentists that perhaps the principle of extension for prevention was not in the best interest of the patient, and its application should be reconsidered.

Science and Technology Again Change Clinical Dental Practice

As a result of several studies and reviews that were published in the early years of the 21st century, the concept of minimally invasive dentistry (MID) began to gain favor, the goal being to conserve tooth structure.^{3,4} Those practicing MID use technologies for the accurate diagnosis of caries, caries risk assessment and prevention, and new technical procedures for the placement and repair of restorations.

It is interesting to note similarities between the application of the principle of extension for prevention in the early 20th century and the introduction of MID in the early 21st century. At both times, new scientific studies about caries became available, and new technologies and products were marketed. Dentists now have available products and technologies for prevention techniques such as fluoride, sealants, caries detection software to evaluate caries risk, and technologies for treatment including air abrasion, lasers for removal of decay, and products to promote remineralization. This array of instruments has allowed for the contemporary understanding of caries to be treated in a more effective way.

The Future of Caries Prevention

Research on caries prevention will continue, and we should expect new replacement therapies and a caries vaccine to become available. However, the question for the dental industry is how quickly these therapies will replace the drill and fill therapies currently used. In

other words, how quickly will replacement therapy and a caries vaccine become the standard of care for controlling this infectious disease?

For clinical dentists to adopt a new standard of care, the cooperation of all components of the dental enterprise is required. Changes need to be made in clinical dental education, in what products and technologies are marketed to the profession, and in the attitudes of provider groups and associations. The dental industry manufacturers and distributors must take a risk, dental educators must encourage students to use these new products and technologies, and dental associations must endorse the use of these new products and technologies. Otherwise, the scientific foundation for treating caries will either be lost through the lack of technology in the form of marketable products or hindered by dental students' inability to quickly adopt products because of lack of proper education.

Dental students exposed to these new concepts, products, and technologies are more than willing to embrace their use. For example, biodontic dentistry is the practice of dentistry that promotes the diagnosis of dental diseases using genomic based bio- and nanotechnology and the repair, restoration, and replacement of dental, oral, and craniofacial structures using natural biological materials of cellular origin. Biodontic dentistry is replacing the existing xenodontic dental practice, which uses foreign materials such as metals and plastics for this purpose. Dental students who have taken the biodontics course will no doubt be the first to use these products and approaches in their practices, ensuring quality care for patients.

The Dental Profession Cannot Afford to Miss This Opportunity

It is critical that the leaders of the dental enterprise do not delay in endorsing the MID philosophy and treatment options. A delay could allow the new products to move from the dental profession to other health care providers. Currently, there are new products emerging from the discovery pipeline including a caries vaccine. At this time the question is: Will dentists expand the scope of their practices to include the application of this vaccine, or will they ignore this new product and, by default, allow the new technology to enter the scope of practice of other health providers?

References

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