

# Innovation and Entrepreneurship

## *Introducing Innovations Into Dental Practice: Why the Dental Industry Should Focus on the Dental Student*

**M**ajor innovations are either revolutionary or evolutionary, and both types can have significant effects on industry and the economy. There are 2 major groups within the revolutionary class of innovations. Innovations in the first group are so novel, and applications so obvious, that they are immediately accepted into the marketplace and usually create an industry where none existed before. Innovations within the second group do not create an industry. Rather, their introduction into the market eventually displaces or replaces an existing industry. Acceptance of these types of innovations is often not immediate, but once accepted, these innovations usually drive out the preexisting industry or product from the market.

The second major class of innovations is evolutionary. Again, there are 2 types: those that improve on existing products or technologies, and those that transform an existing product or service. An important distinction is that innovations that improve do not necessarily expand the scope of an existing industry. Those innovations that transform a product usually result in a new product or service for the company. Regardless of how unique or inspired the innovation might be, if the public for which it is intended fails to embrace the product, the innovation is useless.



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This column will deal with the different types of innovations and give examples relevant to the dental industry. It will also focus on the dental profession and its frequent failure to accept innovative products and technologies, and on the consequences to the profession when it fails to accept innovation. Interestingly, a competitor rapidly acquires an obviously useful innovation rejected by another.

The column concludes by challenging the dental industry to develop ways to collaborate with dental schools to introduce new products and services to dental students, who will most likely be the best customers for the next generation of innovations. This cooperation is important to the success of dental companies and critically important to the survival of the dental profession.

### **Revolutionary Innovations**

In December 1903, the innovators Wilber and Orville Wright changed the world. At the time, their innovation, the airplane, was revolutionary. Since that first flight, just over 100 years ago, the airplane has undergone countless evolutionary changes and its impact on transportation and on the world's economy has been profound.

Similarly, in the last 100 years innovators and their innovations have had a profound effect on the practice of dentistry and on the economy of dental practice. Many of these innovations were, like the airplane, revolutionary. For example, it is difficult to imagine dental practice without Roentgen's discovery of X-rays, the introduction of local anesthesia by Einhorn, the invention of dental floss by Parmly, or the invention of the collapsible toothpaste tube by Sheffield. While these

innovations were made in the late 1800s and early 1900s, they remain a staple of dental practice today because, like the airplane, they evolved into new and better versions of the original. For example, while x-rays remain an integral part of dental practice, the traditional film-based x-ray has evolved into digital radiography.

### **Innovations that Displace**

Some innovations have not remained because they were displaced by another wave of innovations. This was the case with the typewriter. Even though the typewriter went through numerous evolutionary changes, including becoming electrified, the emergence of the computer and the success of word processing software spelled its demise. In dentistry, the introduction of nitrous oxide by Wells and ether by Morton for general anesthesia were spectacular innovations. Nevertheless, and despite the success of this triumph over pain, ether does not remain and nitrous oxide is at the periphery of today's dental practice. Agents that are safer and more efficient replaced nitrous and ether as general anesthetics. Another example is the use of vulcanization for processing dentures, a technique introduced by Evans. Again, the discovery of methylmethacrylates, a superior innovation, displaced vulcanization as the method of choice for denture construction.

Innovations that are perceived as superior continue to displace existing technologies. Today we are witness to the replacement of the amalgam restoration by ceramic and composite restorations. For ether, nitrous oxide, vulcanization, and now amalgam, no amount of evolution could protect these once innovative products or technologies from extinction.

### **The Revolutionary Effect of Implants**

Sometimes the revolutionary impact of an innovation is of such magnitude that it creates a new industry. The innovation of the airplane had such an affect on the transportation industry. The Wright Brothers success went beyond a demonstration that man had conquered flight; their success created the airline industry. Some revolutionary innovations in dentistry also create new industries. One example is the successful introduction of implants into dental practice. This long-awaited technology had an

immediate effect on the profession, producing a new industry within the practice of periodontics, prosthodontics, and oral surgery. The revolutionary success of implants, however, was not without effect on the practice of endodontics. The success and relative ease of using implants has all but eliminated the need for extensive endodontic procedures and services. Thus, in the case of implants, we see how a revolutionary innovation can produce a new industry that benefits one group but has a negative effect on another.

### **Barriers to the Acceptance of Innovations**

Not all innovations enter dental practice quickly – some creep slowly into the dental office. For example, contrary to expectation, the introduction of dental x-ray technology in 1896 by Kells was opposed and condemned. As pointed out by the studies of Parashos on the diffusion of innovations, there are many barriers to the acceptance of a new product or technology. In dental practice, of the many possible barriers that might exist, unpublished studies conducted at the Center for Research and Education in Technology Evaluation (CRETE), suggest 3 as most important: financial, educational, and procedural.<sup>1</sup>

A financial barrier exists when the magnitude of the investment is beyond what the practicing dentist can comfortably afford. Some examples in which financial investment could be a barrier include the CAD/CAM restorative technique and the laser. While the acceptance of both technologies is accelerating, the significant cost involved in their acquisition presents a barrier that will take time to overcome.

An educational barrier exists when the product or technology is outside the scope of the practitioner's dental education. Imagine how difficult it would be to sell sterilization products or technologies to a dentist who had no knowledge of the germ theory of disease. In the same way, the absence of an educational background can prevent the acceptance of a new technology. Many new products on the verge of entering the marketplace rely on knowledge of biochemistry and molecular biology. These biotechnology products include vaccines, bioscaffolds, and teeth grown in the laboratory from stem cells. Acceptance of such

products in dental practice can be difficult unless, as dental students, practitioners are exposed to the basic science underlying these innovations.

In many cases, educating the dentist is not sufficient. In unpublished studies conducted in 2004, CRETE investigators found that anyone in the dental office can affect the acceptance of a new dental product. Continuing education courses are needed to update all those in the dental office including dentists, hygienists, dental assistants and office managers.

Procedural barriers also exist within the dental office. For example, the dental office team will reject new products if patient flow is compromised. Any innovation, regardless of its effectiveness, will be unacceptable if it impedes the flow of patients through the dental office. Similarly, the dental office team will reject any new product that compromises cash flow.

As an educator, my bias is that all of these barriers can be overcome with appropriate educational effort. Courses are needed not only for dental students but for dentists and office personnel as well. While many dental companies, both manufacturers and distributors, sponsor continuing education courses for dentists and office personnel, few offer courses for dental students to prepare them to deal with these barriers. Such courses are not currently taught because the curriculum is already filled with courses perceived by the dental school faculty as absolutely necessary to establishing competency in its graduates.

### **Innovations that Expand the Scope of Practice**

When innovations create new industries they allow general practitioners the opportunity to expand their scope of practice. Implant procedures not only created a new industry for specialists, but became a service offered by the general dentist. The introduction of computerized orthodontic tooth movement technology has had a similar effect. Once restricted to orthodontists, this innovation has now been adopted by general dentists, expanding their scope of practice.

New innovations are on the verge of entering the dental marketplace. Some will improve our diagnostic capabilities, while others, like vaccines, represent significant advances in oral health prevention. Still oth-

ers will improve our ability to restore damaged tooth structure, and in some cases regenerate a replacement tooth or bone structure. However, as with some of yesterday's innovations, tomorrow's innovations may not be readily accepted by practitioners. In this case, the barriers to acceptance will not be financial, educational, or procedural. Rather the resistance will come from a lack of interest or knowledge resulting from complacency.

For example, incorporating the new biotechnology diagnostics into dental practice requires some knowledge on the part of the dentist and office personnel of the polymerase chain reaction and the "gene chip" technology. The incorporation of biotechnological methods to restore damaged teeth and bone using biological materials requires knowledge by the dentist and office personnel of the biogenesis of a tooth and bone from stem cells and bioscaffolds. While the basic science underlying these biotechnologies is incorporated into the mandatory curricula of a few dental schools, it remains outside the clinical experience of many dental students. In fact, most dental schools do not include a competency in implantology as a requirement for graduation.

### **The Consequences For Dentistry to Accept Biotechnological Innovations**

There are consequences if a profession fails to incorporate a new product or service into practice. Consider the innovative vaccine technologies for caries and periodontal disease that are gradually making their way into the market. It is not entirely clear whether dentists will use these vaccines or administer them as a service to their patients when they become available. In fact, a more likely scenario is that physicians, especially pediatricians, will administer these vaccines at the time of administration of other childhood vaccines. While some dentists might argue that they would rather not administer these vaccines, the entry of the physician or other health professional into the oral health area, may be the beginning of a trend in which dentists are likely to be displaced.

This example is not so farfetched. Consider the case of saliva testing. Many companies provide saliva-testing services. However, dentists rarely, if ever, perform saliva testing even though

saliva tests are available for caries, periodontal disease, oral cancer, HIV, alcohol, hormones, and substances of abuse, just to name a few. Why dentists do not make use of saliva tests is unclear, but what is clear is that this diagnostic vacuum is filled by a variety of health professionals, including naturopaths. If dentists feel that saliva tests are outside their scope of practice, it is not unrealistic to expect they will fail to embrace caries and periodontal disease vaccines.

With the example of saliva tests as prologue, it is not difficult to understand why dental manufacturers and distributors are reluctant to financially support the development of biotechnology-based products.

### **Cooperation Between the Dental Industry and Dental Academics**

While I can understand their reluctance to provide financial support, I would ask those decision makers in the dental industry to reconsider. My request is based on 30 years of teaching dental students and comparing the dental student of today with those of 20 or even 10 years ago. Today's dental student enters with a background in the sciences and information technology. Many dental schools require laptop computers; 30 years ago they required pens and pencils. Today's dental students sit in classrooms that are "hot-zones", meaning that they are connected to the Internet at all times. Thirty years ago the sound of turning newspaper pages, usually the sports pages, would divert my attention. Today it's the sound of fingers tapping on laptop keyboards.

Today's dental students are technologically savvy and biologically educated like never before, and are eager for new and innovative technologies, products, and services that they can use in their future practices. I would ask those in the dental industry to seek out this generation as their future customers.

### **Reference**

1. Parashos P, Messer HH. The diffusion of innovation in dentistry: A review using rotary nickel-titanium technology as an example. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. In press.