

# What if Michael Buonocore Had Been Unsuccessful in His Mission?

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Having been extensively involved in research in restorative dentistry for more than 20 years, I have come to realize that this area of dental research is not always fully appreciated by some members of the profession. For many, restorative dentistry continues to be perceived as a branch of dentistry where one drills, fills and bills without much respect for how restorative techniques can be further developed for better dental care.

In 1955 Michael Buonocore<sup>1</sup> made a very important scientific breakthrough, which proved over the years to be as significant to the profession as the introduction of rotary instruments. Before his discovery, few dentists used resins in esthetic restorations because of their excessive polymerization shrinkage, which resulted in undesirable sequelae. In his mission to improve the attachment of resins to tooth structure, Dr. Buonocore<sup>1</sup> noticed that some industries, including automobile manufacturers, used phosphoric acid to treat metal surfaces in order to obtain better adhesion of primer to the metal. He felt that a similar treatment of the enamel surface of teeth might render the surface more receptive to adhesion.

In his experiment, Dr. Buonocore used 2 different acidic formulations to treat enamel surfaces before bonding, one of which was 85% phosphoric acid. Using extracted teeth, Dr. Buonocore applied the phosphoric acid solution to the teeth for 30 seconds, after which the enamel was rinsed. He then placed mixed acrylic resin drops on the tooth surfaces and allowed them to set before replacing the teeth in water. By periodically testing the adhesion of the resin drops using thumbnail pressure, Dr. Buonocore soon realized that the bond strength of the resin to the treated enamel surfaces was superior to the bond strength to the untreated surfaces (control group). The average adhesion time for the experimental group was 160 hours, compared to only 6 hours for the control group.

These results prompted Dr. Buonocore to conduct in vivo testing on volunteer subjects. The second part of his

historic study confirmed the in vitro findings: average adhesion time for the experimental group with treated enamel surfaces was 1,070 hours, compared to only 11 hours for the control group with no surface treatment. It is interesting to note that about 50% of the resin drops placed in the experimental group had to be removed mechanically upon the request of some of the volunteers, as they lasted much longer than originally anticipated.

Dr. Buonocore's findings resulted in the rapid adoption of resin composites for a number of applications in dentistry. Originally, they were used for anterior restorations, including treatment of traumatic fractures of incisors, which, in the past, could only be treated with crowns. Currently, resin composites are routinely used for direct and indirect restorations of anterior and posterior teeth. They are also used as cements for cementation of porcelain inlays, onlays, crowns and veneers. Research has indicated that resin cements can be extremely useful when combined with bonding agents in situations where retention of a crown or a fixed partial denture is compromised because of a lack of height or because the preparation taper is less than ideal.<sup>2</sup> Resin composites can also help dentists avoid crown-lengthening surgery in some selected situations.<sup>3</sup> In prosthodontics the resin-bonded fixed partial denture (Maryland bridge) was based on the concept of attachment to the abutment teeth by means of acid etching of enamel and use of a resin cement for bonding.<sup>4,5</sup> In preventive dentistry the application of fissure sealants, which are used worldwide as a very effective method to prevent fissure caries in permanent molars, relies on acid etching and bonding to enamel. In orthodontics the technique of bonding brackets to surfaces of etched enamel with a resin cement, which was developed in 1968, has become an integral part of the fixed orthodontic treatment regimen.<sup>6</sup> Orthodontic and periodontic retainers are also bonded in place on the enamel using acid-etching and bonding procedures.

If Michael Buonocore had been unsuccessful in his mission, dentists today would be using cast gold to restore Class IV cavities. Amalgam would be the only direct posterior restorative material used, with no potential rival in sight (not even bonded amalgam). Porcelain veneers and many other non-metallic restorations would be a far-off dream of the profession. The incidence of fissure caries in children's molars would be relatively high, as fissure sealants would not be available. Resin-bonded fixed partial dentures would never have been developed. Orthodontists today would be using metallic bands on anterior teeth and periodontal splinting would not be possible.

The important research findings that Dr. Buonocore presented to the profession in 1955 helped to expand dentistry's horizon and contributed to the development of a considerable number of innovations. His results made it possible for us to offer our patients new preventive measures and alternative treatment options that have helped to enrich and enhance the quality of dental care being provided today. With researchers like Dr. Buonocore conducting clinically oriented work, our profession will continue to raise the standard of dental care to higher levels. However, while many dental institutions in Canada house the brains and the ideas to fuel this research, it is unlikely that such research will be initiated without appropriate funding. General dental practitioners need to better understand the necessity of establishing a special fund to support independent research in restorative dentistry. A fund to support clinically oriented research in restorative dentistry will enable researchers to conduct unbiased testing of new products (materials and equipment) and perhaps develop new clinical treatment techniques. Dentists will benefit from this research as it will provide them with important and useful information about dental products that they can apply in their daily practice. While such funding arrangements may already exist south of the border, we need to put in place our own such arrangements here in Canada. ♦

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*The views expressed are those of the author and do not necessarily reflect the opinions or official policies of the Canadian Dental Association.*

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