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Cohen: Pathways of the Pulp, 9th ed., Copyright © 2006 Mosby, An Imprint of Elsevier

Introduction

James L. Gutmann

Mortal Prudence, handmaid of divine Providence, hath inscrutable reckoning with Fate and Fortune: We sail a changeful sea through halcyon days and storm, and when the ship laboureth, our steadfast purpose trembles like as the compass in a binnacle. Our stability is but balance, and wisdom lies in masterful administration of the unforeseen.

—*A Testament of Beauty, 1929, Robert Bridges*

Since the last edition of *Pathways of the Pulp*, the art of Endodontics and the science of Endodontology have taken multiple traveled and untraveled roads in their quest for excellence. Concomitantly, there appears to have been a greater reliance in the clinical aspects of endodontics than on biological advances—and this in itself may have opened new roads to travel. As we begin this new edition of *Pathways of the Pulp*, let 's explore some of these roads, not from the standpoint of closure and the establishment of defining principles, but rather from the viewpoint of vision, redirection, and excitement for our future within this discipline of dentistry.

One axiom that we can all agree upon in endodontics is that microbes cause pulpal and periradicular disease. While over 500 species of bacterial have been cultivated from the oral cavity, as few as 3 to 12 species are identified in the infected root canal or periradicular abscesses. However, virulence and the ability to express it are key in the disease processes that we encounter in endodontics. In that respect and with the health of the entire person as our foremost concern, there has been a tremendous vanguard of research activities that have sought to identify the specific species along with the mechanisms of diseases that are caused by these rapidly, genetically adapting bacteria that cause dental caries and its extension to the supporting tissues. Interestingly, while the spectrum of the bacteria involved with pulpal and periradicular disease are limited, the profiles of those involved in the primary disease process appear to be vastly different from the emerging profiles of those involved in secondary infections. This raises questions, creates challenges to our treatment paradigms, and establishes new pathways for investigation. Coupled with the advanced techniques of polymerase chain reaction methods, SDS-PAGE analysis, ELISA systems, DNA-DNA homology analyses and checkerboard hybridization techniques, and species-specific oligodeoxynucleotide probe analysis, specific relationships in the microbial populations of pulpal and periradicular disease states are being clarified and codified. As a reader of this introduction, however, do not be misled into thinking that the source, incidence, and devastation of dental caries, or periodontal disease for that matter, has been eradicated; these goals are still not within our grasp.

Recent and exciting research advances have explored the uniqueness of the pulpal cells that define the uniqueness of the dental pulp—pulp cells that have already been called upon to express their wide range of phenotypic capability. These cells have actually been characterized as potential *stem cells* that might play a role in future regenerative studies. These studies have focused on the use of growth factors, such as bone morphogenetic proteins, ultrasound-mediated gene therapy, chondrogenic inducing agents, sialoproteins, and bioactive phospholipids to stimulate tissue repair and regeneration in the dental pulp. What is not known however, and what will be an exciting new pathway to explore is the impact that the ravages of diseases of the pulp will have on the remaining cell populations and whether or not it will alter their ability to “be all that they can be” in the future? Or, will their future expressions be less than ideal or non-existent? Do we have to re-engineer the pulp cells that have been challenged to ensure regenerative responses? Furthermore, as patients age pulps age too, and will those dental pulps that have received multiple and varied challenges, while in their infant stages, be able to withstand the insults that challenge their health during the patient 's lifetime? Should these ideas and musings begin to identify a road less traveled that we must explore *now* for the future?

Integrating the biological with the clinical, we now recognize that the removal of the smear layer is quite beneficial to our goals and the use of chlorhexidine and solutions such as BioPure™ (MTAD™) will serve as enhanced antimicrobials to ensure canal disinfection. Removal of the smear layer has also opened up new pathways for advances in resin bonded root canal filling materials. These achievements are within our grasp and further developments in this arena should be expected and encouraged. While initial inroads into this dimension have come very fast it is hoped that long-term outcome studies will validate the promising findings of the investigations published to date. The dental profession must envision that even this new pathway will begin to expand laterally and vertically in the superhighways of tomorrow's obturation techniques.

In light of some of these clinical and biological advances our patients have been well served. Digital radiographs and dental computerized tomography have added a new enhanced dimension to patient education and assessment. The application of higher magnification when appropriate also allows us to better educate and treat our patients at a higher level, providing we clinicians understand that we can only treat what we can see. These choices have enabled the endodontist or general dentist of today and tomorrow to follow pathways that encourage success. One-visit procedures are commonplace and successful, even with teeth containing necrotic dental pulps and periradicular lesions! Canal systems are cleaned and shaped much better and patients experience minimal to no discomfort. Teeth can be restored sooner and placed into function rapidly. The patient's desire for tooth retention is enhanced. Revision of traditional root canal procedural concepts have achieved an all time level of acceptance and success in our desire to retain teeth. Recent epidemiological data would suggest that we are situated on the "right" pathway, as percentages of teeth that can be retained through contemporary endodontic therapy are rising well above the traditional 90%.

The challenges are there and should we opt to explore them newer pathways to our future will become emerge. Can we diagnose reversible changes in the dental pulp before signs or symptoms appear? Can we use molecular markers to diagnose the presence of an irreversible pulpitis? Can we develop methods to alter the aggressive development of a periradicular abscess? Can we reverse, completely, the ravages of dental caries? Can we re-grow a dental pulp? Can we stimulate dental pulp cells selectively to differentiate and alter their environment once challenged? Can we re-grow dentin to strengthen teeth? Can we eradicate completely, bacteria (and perhaps viruses) from the root canal system? Can we achieve a complete cemental regeneration with insertion of Sharpey's fibers over the apical foramen following a root canal procedure? Can we identify and prevent the unknown causes of specific resorptive processes? Can we bond, predictably, the root canal walls into a single functional unit? Can we eliminate coronal leakage as an etiological factor in "failure" of even the best-executed root canal procedure? Can we strengthen roots with our treatment methods? Can we repair or prevent vertical tooth fractures? Can we envision the use of tooth bud implants? These pathways are only the beginning—yet they invite those with imagination, determination and persistence to pursue them with undaunted courage!

Yes, many new avenues of investigation and challenge have been placed before us— "new pathways" that are both challenging and innovative. We have responded to some of these challenges and have taken the road less traveled. Many pathways have been introspective and have resulted in a resolute pursuit of evidence-based concepts. Some pathways have resulted in codifications and clarifications of our contemporary treatment parameters—pathways that were opened to us with the dawn of nickel titanium technologies. Finally, in line with this "good news on outcomes" some appropriate and introspective pathways have allowed us to take a long, hard look at success and failure and have enabled us to develop realistic methods of appraisal and a new lexicon of terms.

We would like to leave the reader with one concept or one pathway that needs a louder voice and a more receptive audience—and that is the need for all endodontists and general dentists alike to make choices that follow an ethical pathway—one of integrity and one that allows us as professionals to take responsibility for our actions. Furthermore, we must never fail to treat our patients with compassionate excellence. Having opened this new edition of Pathways ... you have taken the first step on these new and exciting pathways that will give us both success today and vision for tomorrow—thus allowing us to have a "masterful administration of the unforeseen."