

Commentary on: The Biologic Aspects of Endodontics

M. Lamar Hicks, DDS, MS

In a review of the endodontic literature of the last 50 years, 5 papers published as a series in the journal *Oral Surgery, Oral Medicine, Oral Pathology* from September 1966 to November 1969 under the heading "The Biologic Aspects of Endodontics" are unusually noteworthy. They garner quick attention for the genius of the scientific question posed; the suitability of the experimental models; the methodical and technically elegant collection and processing of the experimental material; and the conservative yet insightful interpretation of the observations. Dr. Samuel Seltzer was the driving force behind these and other studies that propelled the endodontic specialty's quest for more scientifically sophisticated research. The design and conduct of this series of studies, the quality of the experimental material, and the honesty of reporting the data and interpretations epitomize the true meaning of the term *classic*.

From an historical perspective, the newly gained status in 1963 of endodontics as a recognized specialty caused Dr. Seltzer and his colleagues to realize immediately the necessity of conducting more scientifically creative and valid investigations into the biologic consequences of the procedures used in endodontic treatment. This prompted them to develop and articulate the following question: What are the biologic reactions of the periapical tissues to endodontic procedures? This fundamental question would provide the springboard for the design and conduct of a series of studies that would ultimately surprise and then challenge the endodontic community worldwide.

The first article in the series centered on a study to establish what is normal for the anatomic and morphologic characteristics of human root apices and adjacent periapical tissues of nonperiodontally and periodontally involved teeth. This information was essential to separate out normal tissue reactions in the apical radicular/periapical tissue complex from those caused by discrete or combinations of procedures used in the practice of endodontics. Armed with the knowledge of what was normal (control), Dr. Seltzer and his colleagues used the second article to report on the reactions produced in the periapical tissues by the extirpation of vital, normal human and subhuman primate pulps. Subsequently, the third and fourth articles reported on the periapical tissue reactions in the same experimental models to root canal instrumentation confined to the root canal system or intentionally extended into the periapical tissues. In the final article, Dr. Seltzer reported on the periapical tissue reactions to root-filled teeth whose canals had been instrumented short of their apices. A much-abbreviated list of significant findings from these studies follows.

1. The long-term effects of extirpation of the pulp alone were different in humans from those observed in animals. Chronic

inflammation generally persisted for at least 1 year in the apical–periapical tissue complex of humans, whereas complete repair occurred in animals when the apical pulp stump remained vital. (Thus, extrapolation of animal findings to humans rather than direct comparison of 2 identical model systems could lead to erroneous conclusions.)

2. Repair of periapical tissues did not occur in human or animal teeth that had necrotic pulp stumps.
3. Tissue reactions after pulp extirpation and instrumentation short of the apex were milder than those reactions produced by pulp extirpation followed by instrumentation beyond the apex.
4. Periapical granulomas developed and persisted after pulp extirpation and instrumentation beyond the apex. In many lesions, there was a profuse growth of stratified squamous epithelium and proliferation of cell rests.
5. When the apical pulp stump remained vital, complete repair occurred periapically.
6. Regardless of whether a root canal filling was placed short or long in teeth instrumented short of the apex, an acute inflammatory response occurred in the apical pulp and periapical tissues. This acute inflammation gradually evolved into chronic inflammation over the duration of the study. [This writer is quick to relate these findings with the contemporaneous post-mortem study of the condition of human periapical tissues by Ingrid Brynolf in which she found only 7% of periapical areas of root canal-treated teeth were completely healed (free of inflammation)].
7. Resorption of alveolar bone and the root end occurred when periapical inflammation was present.

These and other findings from this series of studies forced the world endodontic community to ponder possible implications for the success or failure of root canal treatment, the development or elimination of postoperative pulpal or periapical pain, and the establishment of a defined set of treatment procedures for teeth needing root canal treatment.

Although one could quibble over the scientific merit of studies in which each experimental group was questionably small (1–7 samples), the magnitude and complexity of the studies as a group are undeniably impressive, especially in light of the experimental models used. Today, we marvel that such investigations using block sections in a human model could be done at all. We marvel further that concurrent parallel studies could be carried out so readily in subhuman primates. It is unlikely during the lifetime of readers of this journal that identical or similar *in vivo* studies in the human and subhuman primate models will be feasible or possible within the economic or

ethical context of our society. Even the most sophisticated computer modeling or other predictive methodologies are doomed to fall short of providing the kind and quality of biologic information gleaned from this singularly important series of studies collectively known as the *The Biological Aspects of Endodontics*.

Although space only permits the republication of 1 article from this extraordinary series in this special issue of the journal, which celebrates the life and work of Dr. Samuel Seltzer hopefully its appearance will provide the impetus and the motivation for the reader to retrieve, study, and appreciate the entire group of articles. They comprise a most extraordinary series of in vivo investigations into the biologic effects of endodontic procedures

on the periapical tissues. Because of their uniqueness in the rapidly expanding library of endodontic research and the significant contributions they made to advance the science of endodontics, even today they retain the much revered and coveted title of *classic*.

Dr. Hicks is Chair, I.B. Bender Division of Endodontics, Maxwell S. Fogel Department of Dental Medicine, Albert Einstein Medical Center, Philadelphia, PA.

Address requests for reprints to Dr. M. Lamar Hicks, I.B. Bender Division of Endodontics, Maxwell S. Fogel Department of Dental Medicine, Albert Einstein Medical Center, Philadelphia, PA. Email: hicksl@einstein.edu.