

Preface

Biofilms are recognized as one of the earliest ecosystems on earth. They are composed of aggregates of microbial cells enclosed in a self-produced matrix adherent to a surface. Root canal biofilms are complex polymicrobial structures adherent to the root canal surface that are formed by microorganisms invading the pulpal space of teeth. Important histopathological studies published several decades ago first noted the presence of adherent cells on root canal surfaces. However, it was not until the introduction of advanced microscopy and molecular biology techniques that they were recognized to be the dominant form of microbial life in the root canal system. Similarly, it was only in the past decade that root canal infections were acknowledged to be biofilm infections. Subsequently, recent studies have shown that root canal biofilms are associated with persistent endodontic infections and as such are likely to be significant contributing factors determining the outcome of endodontic treatment.

Concerted efforts to study root canal biofilms have been made in the past decade resulting in the publication of observational and experimental studies that detail the morphology and biology of these structures in infected root canals. In addition to confirming that bacteria in root canals do not exist in free-floating planktonic states as previously assumed, this new information on root canal biofilm infections has provided an opportunity to reevaluate conventional clinical protocols and improve endodontic therapeutic measures.

The aim of this volume is to provide a current understanding of the basic scientific aspects of root canal biofilm biology within a clinically applicable context. This volume is divided into three sections. Part I discusses the basic biology of root canal biofilms and addresses key questions about the ecological and physiological aspects that play a role in the formation and resistance of biofilms in root canals (chapter “Ecology and Physiology of Root Canal Microbial Biofilm Communities”). The last two chapters of this section review the general mechanisms of biofilm adhesion (chapter “Molecular Principles of Adhesion and Biofilm Formation”), and the mechanisms of antimicrobial resistance in endodontic-related pathogens (chapter “Antimicrobial Resistance in Biofilm Communities”). In Part II,

attention focuses on observational and experimental evidence of root canal microbial biofilms. Part II starts with an overview of observations of biofilms in root canals using scanning electron microscopy (chapter “The Use of Scanning Electron Microscopy (SEM) in Visualizing the Root Canal Biofilm”). Evidence for biofilm formation in histopathological preparations, and a review of novel molecular techniques to identify bacteria in biofilm populations in clinical samples, is provided in chapter “Bacterial Biofilms and Endodontic Disease: Histobacteriological and Molecular Exploration”. Part II closes with a description of common experimental approaches utilized to study root canal biofilms including in vitro biofilm modeling techniques (chapter “Laboratory Models of Biofilms: Development and Assessment”) and examines the challenges behind anatomic complexities in root canals as these may play a role in root canal disinfection (chapter “Root Canal Anatomy: Implications in Biofilm Disinfection”). The final section, Part III, considers how infections caused by root canal biofilms are clinically treated and review the implementation of novel anti-biofilm approaches. An overview of the outcome of persisting root canal biofilm infections and appropriate treatment options is first presented (chapter “Biofilm-Associated Infections in Root Canals: Treatment and Outcomes”). This is followed by an explanation of the influence of clinical irrigation techniques (chapter “Root Canal Irrigation”) and the importance of inter-appointment medication on root canal biofilms (chapter “Inter-appointment Medication with Calcium Hydroxide in Routine Cases of Root Canal Therapy”). Finally, innovative methods and devices directed towards the removal of biofilms from root canals are discussed (chapter “Advanced Therapeutic Options to Disinfect Root Canals”).

This volume will be of interest to a wide range of endodontics-related professionals, including basic microbiologists, clinical microbiologists, and clinicians, and should be useful to undergraduate, postgraduate, and postdoctoral scientists working at the frontier of a new understanding of the role of microbial biofilms in endodontic disease.

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