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The Teeth and Their Environment

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The Teeth and Their Environment

Physical, Chemical and Biochemical Influences

Volume Editor

Ralph M. Duckworth Wirral

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Preface

Tooth enamel is the hardest tissue in the human body. Many aspects of the oral environment have evolved to aid the stability of the teeth in order to preserve their natural function throughout life. Despite this underlying strength and supporting environment, a variety of factors conspire to ensure that almost everyone suffers damage to their teeth at some time. The aim of this monograph is to provide an overview of intrinsic and extrinsic factors that influence the state of the teeth, with emphasis on those factors that have received either comparatively little attention in the literature or justified an updated review in the opinion of the authors. Thus, the scope of this monograph is caries, calculus, tooth wear and erosion, and the roles of pellicle, saliva and plaque in inducing and/or moderating these conditions. A contribution on tooth structure underpins much of what is discussed elsewhere. In the interest of space and to maintain focus, the content is restricted to physical, chemical and biochemical aspects.

Each chapter is written by experts in their respective fields. In describing their chosen topics, authors have sought wherever possible to illustrate major points with examples from their own work.

Chapter 1 provides an update on salivary and plaque factors in the aetiology and control of caries and calculus, that builds on earlier reviews. Particular emphasis is given to the inverse association between caries and calculus often observed in clinical studies. Whilst this relationship is intuitively reasonable from the perspective of the chemistry involved, few researchers have been able to demonstrate links to putative common causative factors. The present authors first establish that the inverse association is based on sound clinical data,

utilizing the database of the large-scale toothpaste clinical trials sponsored by Unilever Oral Care Research over decades. The authors then seek to identify significant causative factors from the extensive published literature on saliva, plaque and their constituents.

In *Chapter 2* the structure and function of the acquired enamel pellicle are discussed. Recent work, aided by advances in analytical methodologies, has increased our understanding of pellicle formation and maturation, and how pellicle composition relates to saliva. The authors emphasize the important role played by pellicle in plaque attachment, tooth protection and stain formation. The authors also describe research on the potential effects that dentifrices can have on pellicle.

Continuing the theme of saliva function, *Chapter 3* describes environmental factors that affect the mineralization of hard tissue. The author describes *in vitro* investigations by himself and others on the relative roles of saliva and plaque fluid, and how the presence or absence of a biofilm affects the efficacy of anticaries agents. Other work focuses on the effects of lesion composition and of lesion proximity to dentine on subsequent enamel de- and remineralization behaviour. The author also discusses the importance of how the characteristics of pre-formed artificial lesions can influence subsequent mineralization behaviour in both *in vitro* and *in situ* studies.

A topic of increasing interest is tooth wear. *Chapter 4* describes recent research on the influence of dental product use, diet and other natural factors, and the inter-relationship between abrasive wear and chemical erosion. After describing the various physical and chemical mechanisms implicated in tooth wear, the author discusses the laboratory, *in situ*, and clinical approaches used to investigate the condition, illustrated with selected examples.

Chapter 5 concerns the mechanical properties of tooth mineral, with particular emphasis on the use of nanoscale hardness measurements to elucidate the variations across the tooth surface and how they may be associated with tooth function. The influence of environmental factors, such as those described in Chapter 4, are also discussed. In addition, the authors present very recent studies, employing a variety of state-of-the-art techniques, on pellicle-coated enamel and on the early carious lesion, which complements the work described in Chapters 2 and 4, respectively.

The important role of plaque as a reservoir for active agents, such as fluoride from dental products and calcium and phosphate from saliva, is reviewed in *Chapter 6*. Recent findings on the dependence of the concentration and retention of these agents on plaque location are included. The relationship between plaque fluid chemistry and tooth mineral is the key to caries formation and control. This interdependence is also discussed in Chapter 3. Here both the thermodynamic approach of Margolis and coworkers and the kinetic approach of

Dawes, Dibdin and coworkers are contrasted. Of special interest, the authors present recent plaque data from subject groups in China, who have experienced different life histories to those from communities normally investigated.

Many of the studies reported in this monograph were either conducted by scientists of Unilever Oral Care Research at Unilever Research & Development Port Sunlight UK or were sponsored by Unilever. On behalf of the various contributors to this monograph, I thank Unilever Oral Care Research for permission to publish that work and for financial support to Karger AG, Basel to facilitate publication.

Ralph M. Duckworth, Monograph Editor, March 2005

