

ORAL PATHOLOGY

T H I R D E D I T I O N

DONALD A. KERR/MAJOR M. ASH, JR.

ORAL PATHOLOGY

Copyright © 1971 by Lea & Febiger. Copyright under the International Copyright Union. All rights reserved. This book is protected by copyright. *No part of it may be reproduced in any manner or by any means, without written permission from the publisher.*

First Edition, 1960

Second Edition, 1965

Reprinted December, 1967

Third Edition, 1971

Reprinted October, 1973

ISBN 0-8121-0339-4

Library of Congress Catalog Card Number 72-135686

Printed in the United States of America

• Preface

As in prior editions this book is intended as an introduction to general and oral pathology for the dental hygienist. The material covered is based on the recognized special needs of the hygienist in relation to her part in total patient care. The title and nature of the contents of the book indicate the significant body of information required for the scope of responsibility enjoyed by the dental hygienist. With the ever-increasing demands for dental care it is obvious that this responsibility is becoming increasingly important and that the science of pathology is becoming one of the most essential prerequisites to clinical practice.

Although the general format of this book remains the same, new and pertinent material has been added to keep abreast of changes in the concepts of disease. In light of an almost explosive increase in knowledge in that part of biology called cell theory, owing to the use of the electron microscope and the work of biochemists, the cellular basis for disease has been expanded. Also, because of recent contributions to genetic theory and disease, a more detailed account of hereditary disease will be found in this edition than in the former editions.

In keeping with the principle that a good illustration can always be improved, many illustrations have been replaced and many new ones added. All references have been reviewed in the light of their contribution to present-day concepts; none have been deleted or added for the sake of having the latest copyright date. Considerable emphasis has been placed on providing at least one or two references in each chapter for the reader who has had little or no training in the basic sciences.

We are greatly indebted to many individuals for assistance in preparation of the third edition. We wish to thank Miss Betty Sundbeck, our secretary, for her assistance; Miss Sally Holden for her suggestions and planning of the revision; Dr. J. Philip Sapp for his suggestions and provision of the ultrastructure photographs; and Mr. Edward Crandell, senior photographer at the School of Dentistry, for preparation of photographs.

DONALD A. KERR
MAJOR M. ASH, JR.

Ann Arbor, Michigan

• Preface to the Second Edition

THE guiding principles for writing the first edition of this book have also served in the preparation of the second edition. These principles include providing an account of the processes of disease, and the essential background for the recognition and prevention of disease within the scope of responsibility and practice of the dental hygienist.

To facilitate the use of this book in the classroom, some revision of the sequence of the material presented has been undertaken. Although the coverage in the first edition proved to be adequate in most respects, it has become apparent that additional topics should be included for those hygienists and students and teachers of dental hygiene who desired more information on specific disease states than was present in the first edition. For these reasons additional chapters on endocrine diseases and blood dyscrasias have been included in the present edition. These chapters have been placed at the end of the text so that they need not be read for a basic concept of disease. This arrangement does not detract from the orderly arrangement of the subject matter since there are references to these chapters in the course of the book and the material may be smoothly incorporated into the basic approach to disease found earlier in the book if desired. The objectives of the second edition have also been emphasized in the additional chapters in that the significance of endocrine and blood diseases has been related to oral disease, especially periodontal disease.

Many areas of the first edition have been revised and expanded to account for recent research and interest. However, the reader and teacher of the first edition will be on familiar ground since the new inclusions have been incorporated largely within the organization of each chapter of the first edition. Because of the importance and emphasis placed on nutrition, the section on malnutrition has been expanded and established as a chapter on Nutritional Disturbances. Although the general manifestations of nutritional deficiencies have been included, the emphasis on oral manifestations has been maintained in light of presently acceptable evidence.

We are greatly indebted to many individuals for assistance in the preparation of the second edition. We wish to thank Miss Betty

Sundbeck, our secretary, for secretarial assistance; Mrs. Ellen Hall, librarian of the School of Dentistry, for library services; and Edward Crandell, senior photographer at the School of Dentistry, for the preparation of the photographs.

DONALD A. KERR
MAJOR M. ASH, JR.

Ann Arbor, Michigan

• Preface to the First Edition

To most hygienists and students and teachers of dental hygiene previously published textbooks of oral and general pathology have represented a formidable coverage of disease unlikely to be encountered as a responsibility of the hygienist in clinical practice. This book has been written especially for the practicing hygienist and the student of dental hygiene to provide a simple and understandable account of the processes of disease and to provide the essential background for the recognition and prevention of diseases within the scope of responsibility and practice of the dental hygienist. An attempt has been made to establish a proper balance between the principles of pathology and the coverage of specific diseases in order to bridge the gap between general pathology and applied oral pathology. Such a balance is possible because the hygienist does not have the responsibility for the diagnosis and treatment of oral disease, and therefore much of the details of diagnosis and treatment of specific diseases found in standard texts of general and oral pathology can be omitted. The omission of such details should not minimize the role of the hygienist in the prevention of disease. The hygienist performs various services in the presence of systemic and oral diseases. These services will be of greater value and more ably carried out if the hygienist understands the principles of pathology. Furthermore the responsibility of the hygienist in the prevention of periodontal disease will be more adequately appreciated, if the hygienist has an understanding of the disease which she is trying to prevent. For example, the hygienist is responsible for the removal of stains, plaque, and calculus from the teeth and as such is as important as any other part of dental practice, since accretions on the teeth are the most important etiologic factors in periodontal disease. In this respect the hygienist is practicing preventive periodontics. Thus a basic understanding of the pathogenesis of accretions is essential for their prevention and removal as well as an understanding of the pathogenesis of periodontal disease.

It is important that the hygienist understand some of the aspects of general pathology; not only as the foundation for its application to the mouth, but as a basis for recognizing those departures of the patient from good health which may have an important bearing on

what is done for the patient. For example, scaling procedures may result in a transient bacteremia leading to subacute bacterial endocarditis. An understanding of the relationship between scaling procedures and endocarditis provides the hygienist with an interesting lesson and an enlightened interest in the cause and prevention of disease.

It is hoped that this book will stimulate an interest in pathology and provide an adequate foundation for its appreciation in clinical practice. An appreciation for the processes and prevention of disease by the hygienist is becoming an increasingly important consideration with our rapidly expanding population and failure to keep abreast of the expanding needs of detecting disease. Thus one of the objectives of this book is to provide the foundation for the expanding role of the hygienist in assisting the dentist in the detection and prevention of disease.

We wish to thank those who contributed greatly to the preparation of this text: Mr. Edward Crandell, photographer at the School of Dentistry, for the preparation of the photographs; Miss Rose Grace Faucher, librarian at the School of Dentistry for library services; and Miss Betty Sundbeck, secretary, who contributed many hours of secretarial assistance.

DONALD A. KERR
MAJOR M. ASH, JR.

Ann Arbor, Michigan

• Contents

Chapter 1

<i>INTRODUCTION</i>	1
Definition of Pathology	1
Cellular Basis of Life and Disease	2
Summary	10

Chapter 2

<i>CAUSES AND MECHANISMS OF DISEASE</i>	13
Intrinsic Factors	13
Genetic Principles	15
Inborn Errors of Metabolism	16
Chromosomes and Abnormalities	16
Inheritance of Traits	17
Radiation and Heredity	19
Extrinsic Factors	20
Oxygen	20
Heat	22
Water	23
Food	23
Mechanical Injury	24
Chemical Injury	24
Irradiation	25
Microorganisms	28
Psychologic Causes	29
Developmental Factors	29
Summary	31

Chapter 3

<i>DEVELOPMENTAL DISTURBANCES</i>	33
Embryology of the Face	33
Disturbances of the Upper Face	35
Clefts	35
Fissural Defects	37

Disturbances of the Tongue	41
Disturbances of the Jaws	45
Embryology of the Teeth	46
Disturbances of the Teeth	51

Chapter 4

<i>REACTION TO INJURY</i>	67
Inflammation	67
Healing: Repair and Regeneration	76
Repair	77
Regeneration	79
Infection	80
Viruses	82
Cocci	83
Bacilli	84
Spirochetes	85
Fungi	86
Progressive Tissue Changes	87
Hyperplasia	87
Hypertrophy	90
Hyperkeratosis	90
Metaplasia	93
Blastomatoid Processes	94

Chapter 5

<i>NEOPLASIA</i>	111
Definition	111
Epidemiology	111
Etiology	112
Hereditary Factors	113
Extrinsic Factors	113
Developmental Factors	116
General Characteristics	116
Benign Neoplasms	116
Malignant Neoplasms	117
Classification	119
Neoplasms of Epithelial Origin	120
Neoplasms of Mesenchymal Origin	125

Chapter 6

<i>RETROGRESSIVE CHANGES AND METABOLIC DISTURBANCES</i>	133
Types of Retrogressive Changes	133
Atrophy	136
Degenerations	138
Infiltrations	141
Necrosis	142
Metabolic Disturbances	144
Mineral Metabolism	144
Pigment Metabolism	148

Chapter 7

<i>NUTRITIONAL DISTURBANCES</i>	153
Deficiencies of Basic Foods	153
Carbohydrates	154
Fats	154
Proteins	155
Deficiencies of Vitamins	156
Vitamin A	157
Vitamin B Complex	157
Vitamin C	161
Vitamin D	162
Vitamin K	163
Nutrition and Periodontal Diseases	163

Chapter 8

<i>DENTAL CARIES</i>	167
Epidemiology	167
Etiology	168
Acids and Plaque	169
Microorganisms	170
Carbohydrates	170
Modifying Factors	170
Clinical Aspect	172
Pathology	175
Treatment	178
Sequelae	179
Prevention	179

Chapter 9

<i>DENTAL PULP DISEASE</i>	183
Etiology	183
Pulpitis	184
Sequelae	188

Chapter 10

<i>STAINS AND ACCRETIONS</i>	193
Physiology of Oral Hygiene	194
Stains	196
Exogenous Stains	196
Endogenous Stains	199
Soft Accretions	200
Calculus	202
Formation of Calculus	205

Chapter 11

<i>PERIODONTAL DISEASE</i>	209
Periodontium	209
Epidemiology	217
Etiology	218
Initiating Factors	219
Modifying (Contributory) Factors	222
Classification	226
Gingivitis	227
Simple Gingivitis	227
Hyperplastic Gingivitis	231
Hyperplastic Gingivitis with Modifying Factors	233
Hormonal Gingivitis	235
Atrophic Gingivitis	236
Periodontitis	237

Chapter 12

<i>STOMATITIS</i>	245
Traumatic Stomatitis	245
Mechanical Injury	245

Thermal Injury	248
Chemical Injury	249
Stomatitis Due to Microorganisms	254
Stomatitis and Systemic Disease	258
Oral Manifestations of Dermatologic Diseases	259
Allergic Stomatitis	261

Chapter 13

<i>ENDOCRINE DISEASES</i>	263
Pituitary Dysfunction	264
Hypopituitarism	265
Hyperpituitarism	266
Adrenal Dysfunction	267
Hypoadrenalism (Hypocorticalism)	268
Hyperadrenalism (Hyperadrenalcorticism)	269
Stress and Disease	269
Thyroid Dysfunction	270
Hypothyroidism	270
Hyperthyroidism	271
Parathyroidism Dysfunction	272
Hypoparathyroidism	272
Hyperparathyroidism	273
Pancreatic Hormone Dysfunction	274
Gonadal Dysfunction	275
Hypogonadism	276
Hypergonadism	277

Chapter 14

<i>BLOOD DYSCRASIAS</i>	279
Components of Blood	279
Plasma Alterations	281
Blood Cell Alterations	282
Red Blood Cells	282
White Blood Cells	286
Platelets	289
Blood Coagulation Factors	291
<i>INDEX</i>	295

• Chapter 1

INTRODUCTION

DEFINITION OF PATHOLOGY

Pathology is the phase of biology dealing with the causes and mechanisms of disease of all living things. Living things are composed of units called cells that are united in various arrangements to carry out the functions of harmonious and coordinated activity which allow the organism to adapt to its environment and to react to it in a manner suitable for the survival of the species. Cellular activity and reaction to environment are the essence of life. When changes in environment alter the normal response or function of the cells or the organism as a whole the alteration is termed disease. Thus, any change in form or function of the living organism or of its unit parts, so that life exists outside the range of normal, is considered disease. Pathology, then, should be considered the study of life and the attempt to understand life as it exists under abnormal conditions. The aim of pathology is an integrated knowledge of altered form and function. Understanding the interrelationship between altered form and function provides the cornerstone for the study of all the health sciences.

An alteration in form or function of one part of the body may affect the existence of the entire organism or only the part that is altered. This broad scope of pathology requires the investigation and understanding of the interrelationship between the types of alterations in all body areas. On this basis there are many approaches to the study of pathology: it may be *morphologic*, in which alterations in form are emphasized (gross and microscopic pathology); it may be *physiologic*, in which the alterations of function are considered (physiologic pathology); it may be *experimental*, in which attempts are made to investigate the cause of specific alterations, to produce changes previously observed or to find means to prevent or correct tissue alterations (experimental pathology).

Pathology is the study of life outside the range of normal—from death of a few cells to death of the whole body. Disease is always antagonistic to the survival of the organism, and the complete in-

ability of the organism to adapt to an unfavorable environment results in its death. A study of pathology is necessary in order to understand the significant alterations in form and function which are considered to be disease and to learn how such alterations may be changed to establish health.

CELLULAR BASIS OF LIFE AND DISEASE

The body is composed of small units called cells. Each cell has a boundary (cell membrane) enclosing a semisolid-like material called the cytoplasm, which contains various organelles, and a more solid body called the nucleus. Although all cells are basically alike, they vary in shape, size, and consistency in various parts of the body, depending on the function they are to perform.

The *cytoplasm* is important in the multiplication of cells, the elimination of waste products, the assimilation and storage of food, and the secretion of enzymes. Within the cytoplasm of most cells is a complicated system of structures called *organelles* (Fig. 1). These internal components of the cell are the plasma membrane, endoplasmic reticulum, ribosomes, mitochondria, Golgi apparatus, lysosomes, centrosome, and centrioles. In addition, inclusions, such as fat, glycogen, proteins, starches, and secretory products, are found in the cytoplasm. The *nucleus* of the cell is concerned primarily with the growth and development of the cell, the metabolic processes inside the cell, the control of reproduction, and the transfer of hereditary

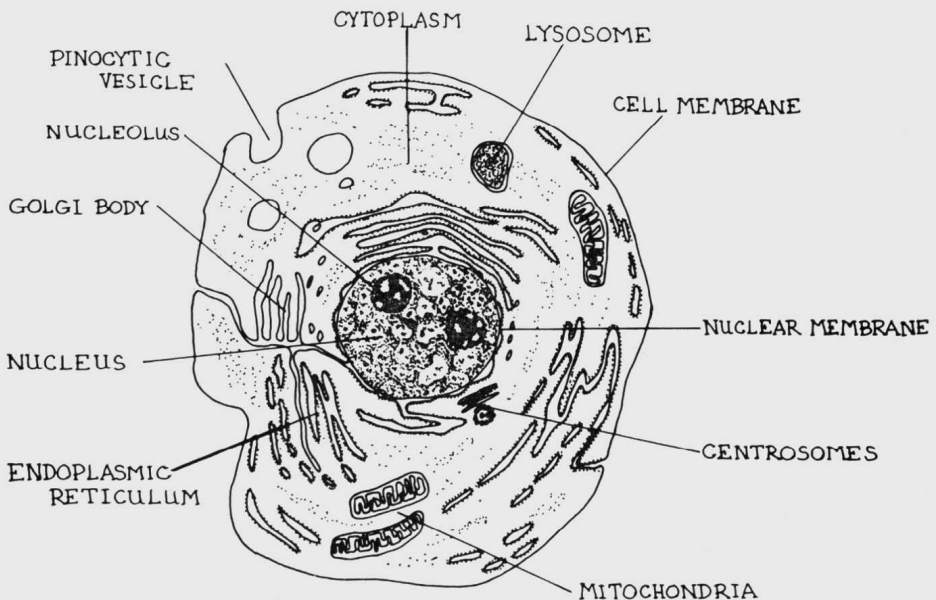


Figure 1. Schematic representation of a cell showing organelles.

characteristics. The *plasma membrane* defines the boundary of the cell and is a dynamic structure of lipoprotein having a highly selective permeability. It is functionally sensitive to the molecular size and biochemical nature of substances as well as to electrical charges. The functional activity of the plasma membrane is important in maintaining the cell as a functional unit and is an essential part of the internal structure of the cell. It is not difficult to appreciate the complexity of the functions of the components of the cell or that disease may be the result of dysfunction of any of the components even at the molecular level. Although Rudolf Virchow, in 1858, changed the concepts of disease by proposing that the cell was not only the unit of life but was also the indivisible unit of disease, it would have been impossible for him to have foreseen the current extension of his concept to cellular subunits.

Of particular interest in periodontal pathology is the nature of the attachment mechanisms among gingival epithelial cells and between the gingival epithelium and the tooth surfaces. Although it is apparent that the attachment apparatus among epithelial cells is in part the desmosome (Fig. 2) and that there is a hemidesmosome-basement lamina complex between the epithelium and the subadjacent connective tissues, the role of the hemidesmosome in the attachment of the gingiva to the tooth is still obscure. The mode of attachment is important in relation to disturbances in the attachment associated with injury to the gingiva (gingivitis) owing to the presence of bacteria, plaque, and calculus on the teeth.

Disturbances in the formation and maintenance of the connective tissue of the periodontal membrane are also of interest in periodontal pathology. The cells that produce the fibers and ground substance of the periodontal membrane are the fibroblasts, which are descended from primitive mesenchymal cells (Fig. 3). The connective tissue, the primary constituent of the periodontal membrane, chiefly is composed of a protein called collagen. The formation of collagen involves the nucleus and ribosomes, which are in contact with and adjacent to the endoplasmic reticulum of the fibroblast. The nucleus initiates the process of collagen formation, but the process is transferred to the ribosomes in the cytoplasm of the cell for continuation. DNA (deoxyribonucleic acid), localized in the nucleus, presides over the synthesis of RNA (ribonucleic acid), which is responsible for the transfer of processing information to the ribosomes. The messenger RNA acts as a template and arranges the proper amino acids into chains, an intermediate process in the formation of collagen. The completion of mature collagen and its formation into functional fibers in the periodontal membrane are completed outside of the cell. A disturbance in the process can result in disease; for example,

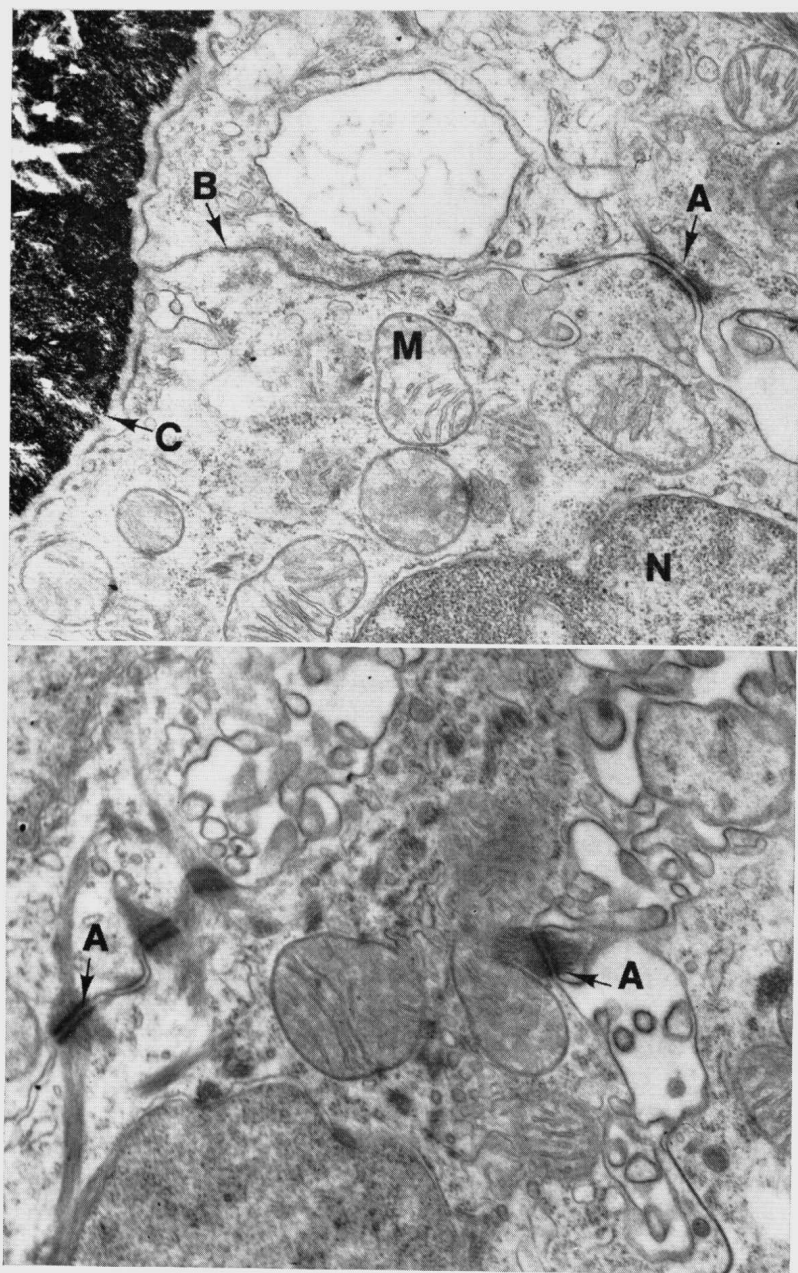


Figure 2. *Upper, Ultrastructure of an odontogenic cell.* Desmisome (A), cell membranes of adjacent cells (B), outer surface of tooth (C), mitochondria (M), nucleus of cell (N). *Lower, There are four desmisomes (A) present in the part of the cell represented. Two of the four desmisomes are indicated.*