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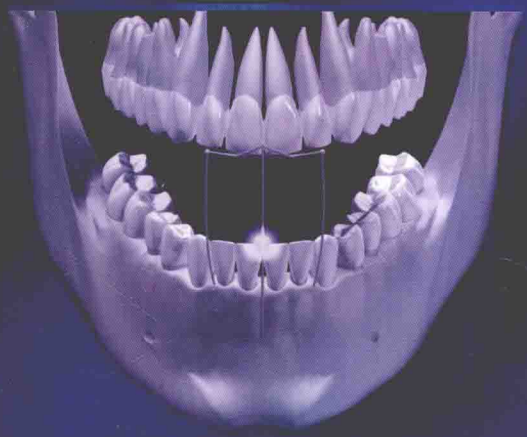
WHEELER'S

Dental Anatomy, Physiology, and Occlusion



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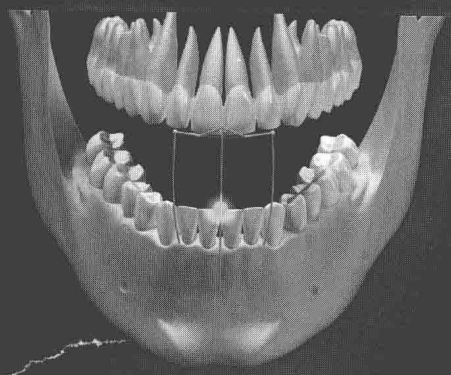

Eighth Edition

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SAUNDERS
An Imprint of Elsevier Science
Philadelphia London New York St. Louis Sydney Toronto

SAUNDERS
An Imprint of Elsevier Science

11830 Westline Industrial Drive
St. Louis, Missouri 63146

DENTAL ANATOMY, PHYSIOLOGY, AND OCCLUSION
ISBN 0-7216-9382-2

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International Standard Book Number 0-7216-9382-2

Publishing Director: Linda Duncan
Executive Editor: Penny Rudolph
Developmental Editor: Jaime Pendill
Publishing Services Manager: Linda McKinley
Project Manager: Rich Barber
Designer: Julia Dummitt

RT/MVY

Printed in the United States of America.

Last digit is the print number: 9 8 7 6 5 4 3 2 1

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To Professor Jose dos Santos, Jr.

Acknowledgments

Special thanks are given to Dr. Jeffrey Ash, an examiner in endodontics for the North East Regional Board of Dental Examiners, for his assistance in making changes to *Chapter 13, Pulp Chambers and Canals.* Also, to Dr. Carolyn Ash, for the use of the material on the relationship of the apices of the roots to the mandibular nerve (canal). This information is of particular interest in the fields of prosthodontics and endodontics for the placement of implants. In addition, special thanks are given to Dr. George Ash for valuable recommendations regarding orthodontic consideration in the development of occlusion. Also to Pat Anderson, librarian, for her assistance with the references. To Dr. Jose dos Santos and Dr. Tom Nowlin, our colleagues, for the support and comments they provided to this work. Also to be acknowledged is Professor William Brudon, who for some 40 years has been our friend and medical/dental illustrator for no small number of publications.

We also wish to acknowledge the following people whose services made this project possible: David Baker, MA, of the University of Texas, San Antonio, and Travis Lippert, of Volition Interactive, for their hard work on the CD-ROM. Also, to Lester Rosebrock for his photographic services. We would also like to acknowledge the insight of Penny Rudolph, executive editor, for suggesting the CD-ROM and making it possible and the work of Jaime Pendill, developmental editor, for transforming our manuscript into the eighth edition of this book.

And always, we acknowledge the valuable assistance of our wives, Fayola and Kym.

MMA
SJN

Preface

It has been a pleasure to work on the eighth edition of *Wheeler's Dental Anatomy, Physiology, and Occlusion* because it has presented an opportunity to bring into focus some of the newer concepts of teaching, as well as reflect paradigmatic shifts in the application of dental anatomy to the practice of dentistry. It is a double pleasure to have Dr. Stan J. Nelson, my former graduate student and colleague, as co-author.

An exciting new feature in this edition is the addition of a CD-ROM to accompany the text. So much of what a dental student needs to learn about dental anatomy and occlusion simply cannot be shown with two-dimensional artwork. The CD-ROM supplements the material in the text and takes it to the next level by featuring interactive QuickTime animations that demonstrate masticatory movements, including tooth contact relationships and temporomandibular joint movements. Additional animations feature the evaluating contours of dental restorations. Another interactive activity allows users to see the maxillary and mandibular teeth from several different angles. The CD-ROM also includes a self-assessment general study questions section, a tooth identification section, and review questions from each individual chapter that reflect what a student might see on licensing board examinations. The program keeps track of the number of correct answers entered in the general study questions and tooth identification sections.

Throughout the book, you will notice two icons in the text margin. When the CD-ROM icon appears, the reader can access the appropriate portion of the CD-ROM identified by the label in the textbook. A question mark icon is featured at the end of each chapter to serve as a reminder about the study questions that can be utilized on the CD-ROM.

Much of the material in several chapters has been completely rewritten or revised, keeping in mind the need to maintain continuity of subject matter. For example, the development of occlusion, both primary and permanent dentitions, has been considered as a continuous theme in *Chapter 16, Occlusion.* Although *Chapter 2, Development and Eruption of the Teeth,* has been rewritten and reformatted to be more user-friendly, recognized standards of tooth formation needed for more detailed studies in dental anatomy have been maintained. The basic information in the chapters on the morphology of each of the teeth in the primary and permanent dentitions has been retained; however, summaries in tabular form for bringing together tooth types and characteristics have been presented for quick review in *Appendix B,* which is a useful tool in preparing for examinations on the state and national levels.

As in the past, specific and general references have been provided for further study. A review of the references should indicate that present-day anatomy reflects a long history of interactions with many clinical and basic sciences—anthropology, endodontics, forensics, orthodontics, pediatric

dentistry, and paleontology, to name only a few. Applications to these fields have been considered; however, an effort to refrain from entering into these areas too extensively detracts from the main purpose of providing a basic introduction to dental morphology, physiology, and occlusion. Hence, much of the outdated material on endodontic therapy has been omitted. In effect, that decrease has made it possible to present a range of applications of dental anatomy to the practice of dentistry.

As with most areas of science, whether biomechanical or highly theoretical, the language of an evidence-based paradigm has become a matter to be considered in dental anatomy and its application to clinical practice. For example, it is no longer possible to state unequivocally that the precise height of contour of the facial or lingual curvature of a tooth is related specifically to the health of the periodontium, e.g., under-contouring leads to gingival trauma or over-contouring increases plaque and hence gingivitis, without first having statically significant evidence from appropriately controlled clinical trials. However, realistically it seems reasonable to restore anatomical crowns with heights of contour approximating that of the tooth structure being replaced. It is reasonable because the operant adaptive capacity of the periodontium may not be a reflection of biological and statistical significant differences. In addition, clinical research involving actual changes to natural tooth morphology is suspect, e.g., changing natural conditions where no disorder exists. Even when there is a need to restore anatomical crowns, it is inappropriate to encroach on the interproximal space in clinical practice. In addition, esthetics is an important aspect of tooth morphology, e.g., height of labial contour that requires consideration. Finally, for example, the relationship of the length and position of maxillary incisors to phonetics requires as yet needed evidence-based research.

Every attempt has been made to consider what is important for the student and practitioner to know, and what may be of use to those from other scientific fields.

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Stanley J. Nelson

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Dental Anatomy, Physiology, *and* Occlusion

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1 Introduction to Dental Anatomy

A study of dental anatomy requires learning about the morphology of the various teeth in the human dentitions and knowledge of how the shape, form, structure, color, and function of the teeth relate to each other in the same dental arch and to the teeth in the opposing arch. Thus the study of dental anatomy, physiology, and occlusion provides one of the basic components of the skills needed to practice all phases of dentistry.

The application of dental anatomy to clinical practice can be envisioned in Fig. 1-1, *A*, where a disturbance of enamel formation (considered briefly in Chapter 2) has resulted in esthetic, psychological, and periodontal problems that may be corrected by an appropriate restorative dental treatment such as illustrated in Fig. 1-1, *B*. The practitioner has to have knowledge of the morphology, occlusion, esthetics, phonetics, and functions of these teeth to undertake such treatment.

Formation of the Dentitions (Overview)

Humans have two sets of teeth during a lifetime. The first set of teeth to be seen in the mouth is the *primary* or *deciduous* dentition, which begins to form prenatally about 14 weeks in utero, and completed postnatally at about age 3. In the absence of congenital disorders, dental disease, or trauma, the first teeth in this dentition begin to appear in the oral cavity at the mean age of 6; and the last emerge at a mean age of 28 ± 4 months. The deciduous dentition remains intact (barring loss from dental caries or trauma) until the child is about 6 years of age. At about that time the first *succedaneous* or *permanent* teeth begin to emerge into the mouth. The emergence of these teeth begins the *transition* or *mixed dentition period* when a mixture of deciduous and succedaneous teeth are present. The transition period lasts from about 6 to 12 years of age, or ends when all the deciduous teeth have been shed. At that time the permanent dentition period begins. Thus the transition from the primary dentition to the permanent dentition begins with the emergence of the first permanent molars, shedding of the deciduous incisors, and emergence of the permanent incisors. The mixed dentition period is often a difficult time for the young child because of habits, missing teeth, teeth of different colors and hues, crowding of the teeth, and malposed teeth.

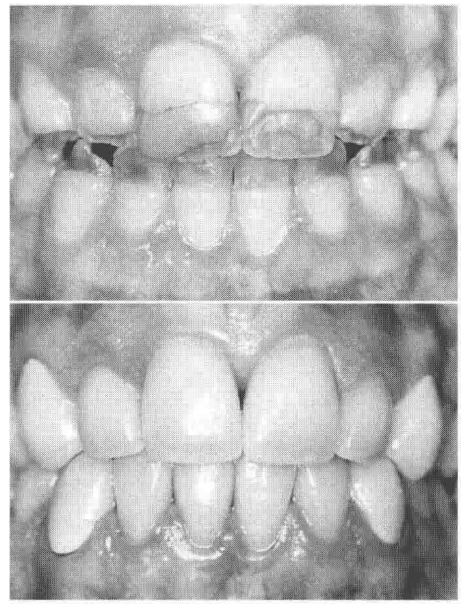


FIG. **1-1 A,** Chronological developmental disorder involving all the anterior teeth. **B,** Illustration of restored teeth just after completion, taking in account esthetics, occlusion, and periodontal health. Note the gingival response is not yet resolved. (From Ash MM, Ramfjord S: *Occlusion,* ed 4, Philadelphia, 1995, WB Saunders Company.)

The permanent, or succedaneous, teeth replace the exfoliated deciduous teeth in a sequence of eruption that exhibits some variance, an important topic that will be considered in Chapter 16. After the shedding of the deciduous canines and molars, emergence of the permanent canines and premolars, and emergence of the second permanent molars, the permanent dentition is completed (including the roots) at about age 14 to 15, except for the third molars that are completed at age 18 to 25. In effect, the duration of the permanent dentition period is at age 12 or older. The completed permanent dentition consists of 32 teeth if none are congenitally missing, which can be the case. See Chapter 2 for the development of the teeth, dentitions, and the craniofacial complex and Chapter 16 for the development of occlusion for both dentitions.

Nomenclature

The first step in understanding dental anatomy is to learn the nomenclature, or the system of names, used to describe or classify the material included in the subject. (NOTE: When a significant term is used for the first time here, it is emphasized in italics. Additional terms are discussed as needed in subsequent chapters.)

The term *mandibular* refers to the lower jaw, or mandible, and the term *maxillary* refers to the upper jaw, or maxilla. Where more than one name is used in the literature to describe something, the two most commonly used names are used initially. After that, they may be combined or used separately as consistent with the literature of a particular specialty of dentistry (e.g., primary or deciduous dentition, permanent or succedaneous dentition). A good case may be made for the use of both terms. By dictionary definition, the term *primary* can mean "constituting or belonging to the first stage in any process."[1] The term *deciduous* can mean "not permanent, transitory." The same unabridged dictionary refers the reader from the definition of *deciduous*

tooth to *milk tooth,* which is defined as "one of the temporary teeth of a mammal that are replaced by permanent teeth. Also called baby tooth, deciduous tooth."[1] The term *primary* can indicate a first dentition, and the term *deciduous* can indicate that the first dentition is not permanent but not unimportant. The term *succedaneous* can be used to describe a successor dentition and does not suggest permanence, whereas the term *permanent* suggests a permanent dentition, which may not be the case because of dental caries, periodontal diseases, and trauma. All four of these descriptive terms appear in the professional literature.

Formulae for Mammalian Teeth

The denomination and number of all mammalian teeth are expressed by formulae that are used to differentiate the human dentitions from that of other species. The denomination of each tooth is often represented by the initial letter in its name (e.g., *I* for incisor, *C* for canine, *P* for premolar, *M* for molar); each letter is followed by a horizontal line and the number of each type of tooth is placed above the line for the maxilla (upper jaw) and below the line for the mandible (lower jaw). The formulae include one side only with the number of teeth in each jaw being the same for humans.

The dental formula for the primary/deciduous teeth in humans is as follows:

$$\mathrm{I}\ \frac{2}{2}\ \mathrm{C}\ \frac{1}{1}\ \mathrm{M}\ \frac{2}{2} = 10$$

This formula should be read as: Incisors, two maxillary and two mandibular; canines, one maxillary and one mandibular; molars, two maxillary and two mandibular, or 10 total on one side, right or left (Fig. 1-2, *A*).

A dental formula for the permanent human dentition is as follows:

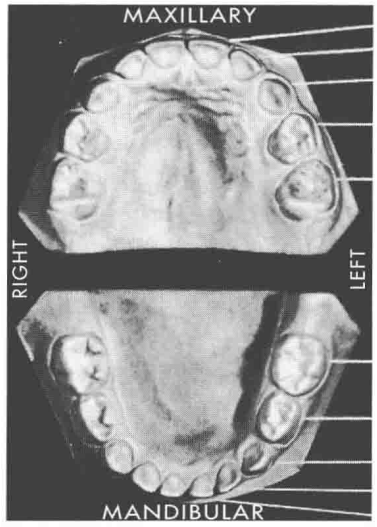
$$\mathrm{I}\ \frac{2}{2}\ \mathrm{C}\ \frac{1}{1}\ \mathrm{P}\ \frac{2}{2}\ \mathrm{M}\ \frac{3}{3} = 16$$

Premolars have now been added to the formula (two maxillary and two mandibular), and a third molar has been added (one maxillary and one mandibular) (see Fig. 1-2, *B*).

Systems for scoring key morphological traits of the permanent dentition that are used for anthropological studies are not considered here. However, a few of the morphological traits used in anthropological studies[2] are considered in the following chapters (e.g., shoveling, Carabelli's trait, enamel extensions, and peg-shaped incisors). Some anthropologists use di_1, di_2, dc, dm_1, dm_2 notations for the deciduous dentition, and I_1, I_2, C, P_1, P_2, M_1, M_2, M_3 for the permanent teeth. These notations are generally limited to anthropological tables because of keyboard incompatibility.

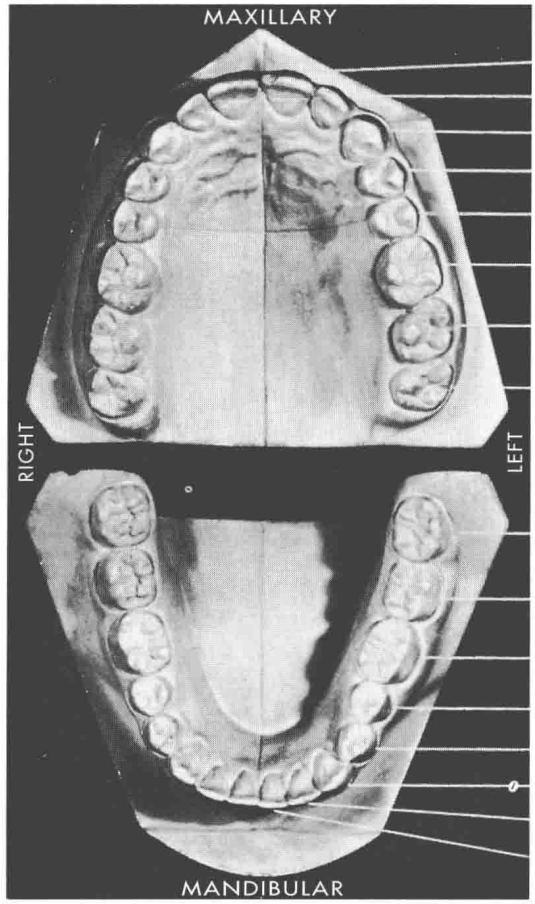
Tooth Numbering Systems

In clinical practice, a "shorthand" system of tooth notation is necessary for recording data. Several systems are in use in the world, but only a few are considered here. In 1947 a committee at the American Dental Association (ADA) recommended the symbolic (Zsigmondy/Palmer) system as the numbering method of choice.[3] However, because of difficulties with keyboard nota-



A

III-C, D



B

FIG. **1-2** **A,** Casts of deciduous, or primary, dentition. **B,** Casts of permanent dentition.