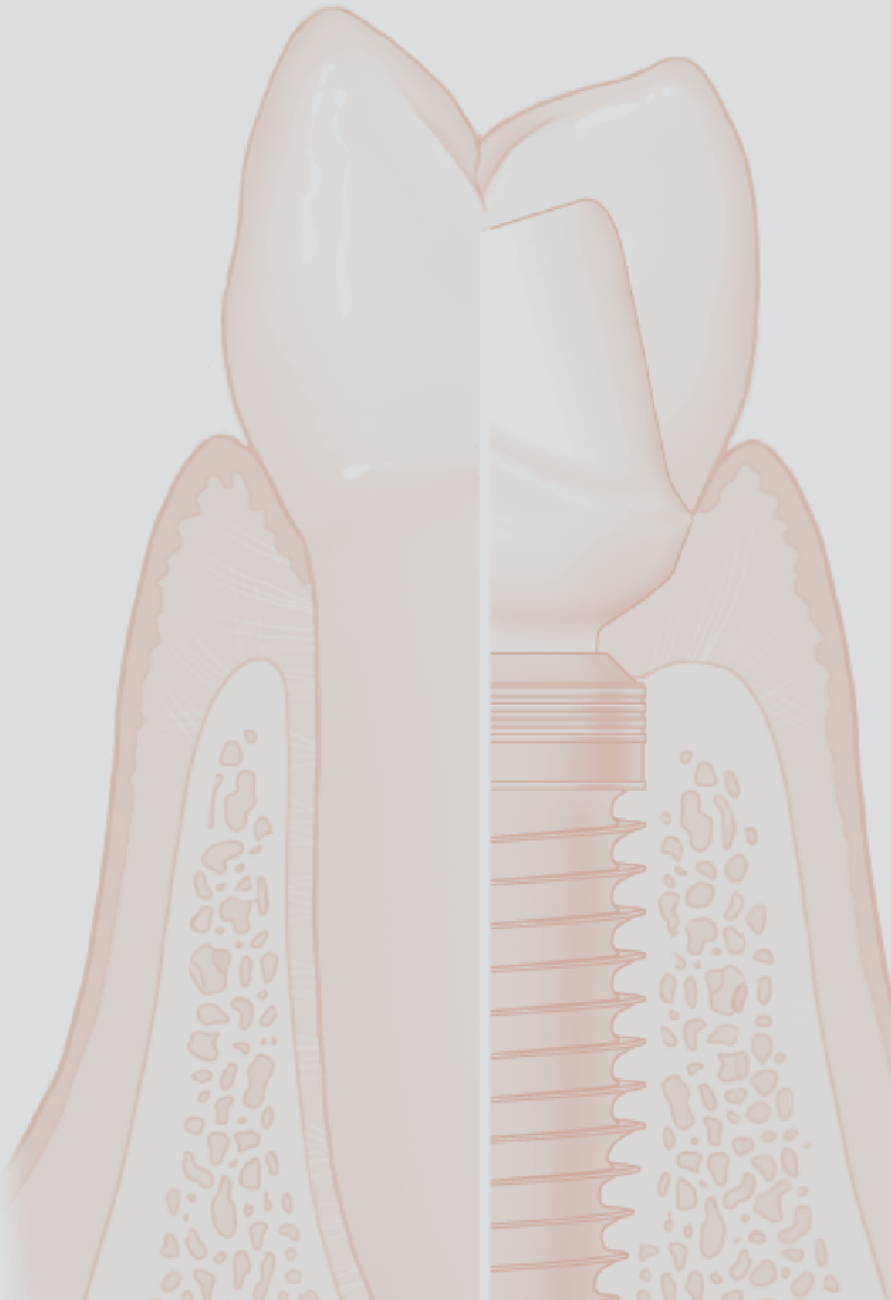
PERIODONTICS

The Complete Summary

Edited by

Fernando Suárez, DDS, MS

STUDY GUIDE



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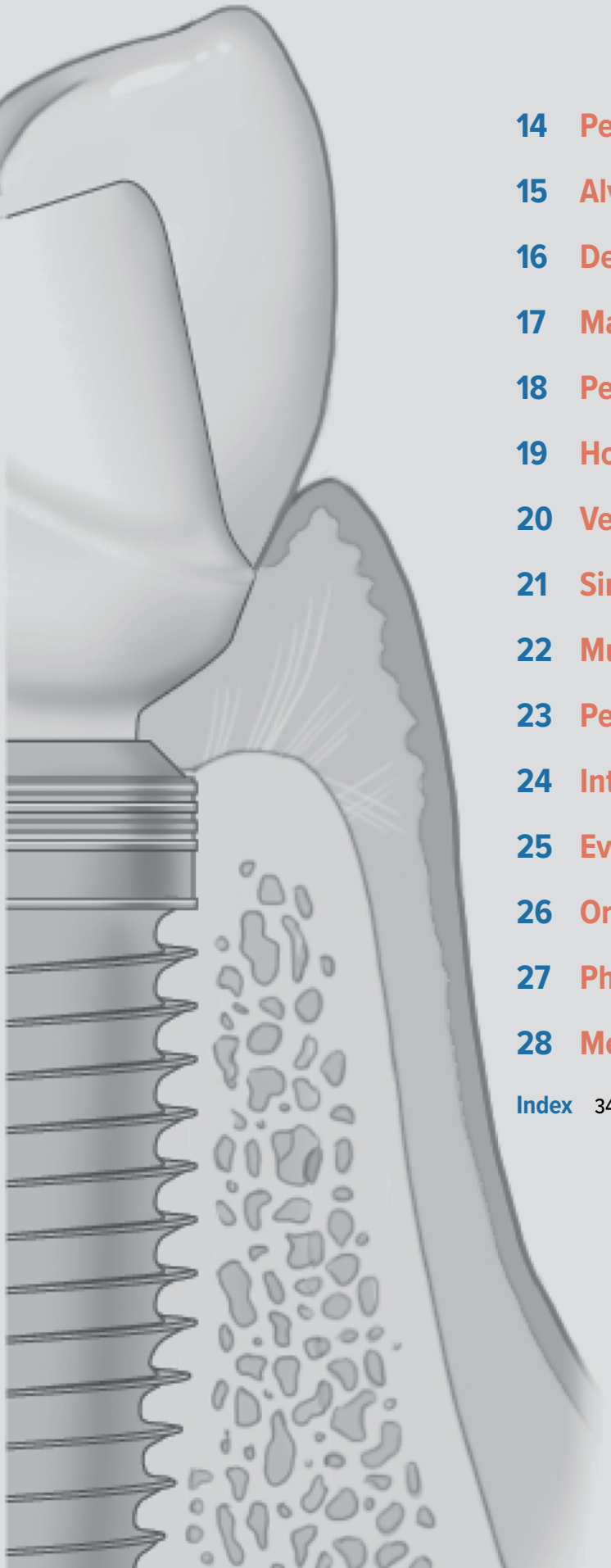

FOREWORD

In this day and age, an overwhelming influx of information is flooding the scientific literature. Separating wheat from chaff can be an arduous and demanding task for any oral health care professional, expert or novice, when reviewing the best available evidence in the fields of periodontics and oral implantology. A well-curated and comprehensive compilation of essential knowledge can be an invaluable compass to navigate what may seem to be an insurmountable ocean of data and concepts.

That is why I enthusiastically applaud Dr Fernando Suárez López del Amo for his vision and dedication in leading the efforts that have culminated in making this book, *Periodontics: The Complete Summary,* a reality. Knowing Fernando for more than a decade now, I have truly enjoyed witnessing his development and inexorable growth in becoming an excellent clinician, outstanding scholar, and tremendously effective teacher. It is rare for an individual of such virtues to also seek to engage and elevate the profession by generating quality didactic materials. This textbook is a clear representation of Fernando's commitment.

Spanning from the anatomy of periodontal and peri-implant structures to the management of medical emergencies, this book contains a cleverly weaved sequence of meticulously selected topics covering the most relevant literature pertaining to the diagnosis, prevention, and treatment of common periodontal and peri-implant diseases and conditions. Readers will notice that a great deal of attention was paid to scrupulously select and present pertinent information stemming both from classic and contemporary literature sources, providing it in a succinct and understandable manner. Although this book is primarily geared to serve as a guide for students throughout their formal training and in their preparation for standardized exams, more experienced professionals will also find it an excellent reference or "refresher" resource.

While Fernando is responsible for its genesis, organization, and successful completion, it must be acknowledged that this book is also the result of a collective endeavor carried out by a marvelous bunch of young and emerging clinicians, researchers, and educators from different geographic locations across the globe. It is exciting to see such a talented group coming together to generate an up-to-date and valuable compendium of foundational knowledge germane to periodontics and oral implantology. Congratulations to all of them for this superb contribution!

With my best wishes,

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PREFACE

The fields of periodontics and oral implantology have greatly advanced and evolved over the last decades. Numerous investigations and developments have redefined the instruments, materials, and techniques used in daily practice, and we, the scientists and clinicians, should always be at the forefront of this continuous evolution. However, while remaining up to date is imperative to provide the best possible patient care, it is of utmost importance to acknowledge and understand the scientific discoveries and investigations previously performed. It is critical to appreciate the lessons learned decades ago to continue with the progression of the periodontal and dental implant fields. For this reason, I decided to embark on this project, and along with the outstanding contribution of a talented group of friends and colleagues, we have created this summary aimed at describing the underlying scientific basis and rationale for the numerous challenges and decisions that periodontists face in clinical practice. Special attention was given to provide the fundamental classic literature as well as newer and more current evidence.

The information presented in this book is a comprehensive review of the most essential knowledge pertaining to the different aspects of periodontics and oral implantology. From anatomy to medical emergencies, the 28 chapters summarize topics related to diagnosis, nonsurgical and surgical therapy, guided tissue regeneration, dental implants, and oral pathology. Students in the dental and periodontal fields will find this book of utmost value during their training. Nevertheless, this book was also conceived with the objective of being a source of information and consultation guide for more senior professionals, including investigators and clinicians.

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First, I would like to thank my parents, Antonio and Mónica, for their unconditional love, endless support, and encouragement. For showing me that with passion and sacrifice, everything is possible. I also want to thank Morgan for her love, patience, and support throughout these years from when the idea of creating the book first originated until the final chapter was proofread. I would most like to thank my mentors in Spain and at the University of Michigan, who instilled in me the love for this profession. I have been tremendously fortunate to have mentors throughout my career who have not only taught me dentistry and periodontics, but also served as inspiration and role models. Last but not least, I deeply thank all the authors and coauthors that have collaborated on this project. Their hard work and dedication have made the completion of this book possible. I also want to thank the staff of Quintessence Publishing and particularly Bryn Grisham, as well as Marieke Zaffron for her excellent work editing this book.

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ANATOMY

Miguel Romero Bustillos, DDS, PhD

The **periodontium** comprises the supporting structures of the dentition. It is composed of four main elements: gingiva, cementum, periodontal ligament (PDL), and bone. Understanding this dynamic network of tissues is pivotal for the proper performance of the many procedures related to periodontal therapy. This chapter describes the different structures of the periodontium from microscopic and macroscopic points of view.

The **attachment apparatus**, also known as *periodontal attachment*, is an aggregate of tissues with the main function of anchoring teeth to the alveolus. It consists of cementum, alveolar bone, PDL, and gingiva. Several terms are highly relevant with this regard and are described by the American Academy of Periodontology (AAP) *Glossary of Periodontal Terms* (see sidebar).[1]

Periodontium: Attachment Apparatus

PERIODONTAL LIGAMENT

The **PDL** is a specialized connective tissue located between the bony walls of the dental socket and the dental root. It surrounds the majority of the dental root and attaches the teeth to the alveolar bone. In the most coronal portion, the PDL is continued with the lamina propria of the gingiva. Characterized by its hourglass shape, this specialized connective tissue narrows at the middle part, with an average width ranging from 0.2 to 0.4 mm.[3] The PDL space decreases with age and increases under excessive load.

Origin

The PDL develops in a cell population from the dental follicle. As the crown approaches the oral mucosa, fibroblasts produce collagen fibrils without organized orientation. Later, prior to tooth eruption, the fibroblasts adopt an oblique orientation adjacent to the cementum. Finally, after this fibroblast arrangement, fibers with organized orientation are developed at the cementum surface as well as at the alveolar bone proper. These fibers will continue elongating until they reach each other at the middle portion of the

DEFINITIONS AND TERMINOLOGY

Alveolar bone proper: Compact bone that composes the alveolus (tooth socket). Also known as the *lamina dura* or *cribriform plate*, the fibers of the periodontal ligament insert into it.

Alveolar process: The compact and cancellous bony structure that surrounds and supports the teeth.

Attached gingiva: The portion of the gingiva that is firm, dense, stippled, and tightly bound to the underlying periosteum, tooth, and bone.

Attachment apparatus: The cementum, periodontal ligament, and alveolar bone.

Biologic width: The dimension of soft tissue composed of a connective tissue and epithelial attachment extending from the crest of bone to the most apical extent of the pocket or sulcus. This term was recently redefined as "supracrestal tissue attachment."[2]

Bundle bone: A type of alveolar bone, so-called because of the "bundle" pattern caused by the continuation of the principal (Sharpey) fibers into it.

Fibroblast: The predominant connective tissue cell; a flattened, irregularly branched cell with a large oval nucleus that is responsible in part for the production and remodeling of the extracellular matrix.

TABLE 1-1 Principal periodontal ligament fibers[4,5]

	Location	Origin	Insertion	Orientation	Function
Alveolar crest fibers	Between CEJ and alveolar bone crest	Cementum	Alveolar crest	Mostly bucco-lingual but also mesiodistal	Prevent extrusion of the teeth and resist lateral tooth movements
Horizontal fibers	Directly apical to the crest	Cementum	Alveolar bone proper	Horizontal across the PDL	Prevent lateral tooth movement
Oblique fibers	Middle two-thirds of the PDL	Cementum	Alveolar bone proper	Oblique in a coronal direction	Resist apically directed chewing forces
Apical fibers	Apical portion of the PDL	Apical portion of cementum	Apical portion of alveolar bone proper	Irregular fashion in horizontal or vertical dimension	Resist forces of luxation
Interradicular fibers	Furcation region	Interradicular cementum	Interradicular coronal portion of alveolar bone proper	Vertical and horizontal	Resist tooth tipping, torquing, and luxation
Transalveolar fibers	Primarily crestal region	Cementum	Cementum of adjacent tooth	Horizontal	Provide support and stability, prevent tooth movement

CEJ, cementoenamel junction.

Free gingiva: The part of the gingiva that surrounds the tooth and is not directly attached to the tooth surface.

Gingival groove: A shallow, V-shaped groove that is closely associated with the apical extent of free gingiva and runs parallel to the margin of the gingiva. The frequency of its occurrence varies widely.

Gingival papilla: The portion of the gingiva that occupies the interproximal spaces. The interdental extension of the gingiva.

Hertwig epithelial root sheath (HERS): An extension of the enamel organ (cervical loop) Determines the shape of the roots and initiates dentin formation during tooth development. Its remnants persist as epithelial rests of Malassez in the periodontal ligament.

PDL. The orientation of the fibers will be determined by the location within the PDL (Table 1-1).[4,5]

Composition

The PDL is formed by different cell types. The fibroblasts are the most abundant as they are responsible for the metabolism of the extracellular components. Within this heterogeneous population of fibroblasts within the PDL, osteoblast-like fibroblasts are also present, and these are rich in alkaline phosphatase.[6,7] In addition, the PDL contains stem cells, epithelial cell rests of Malassez, cells from the blood vessels, and cells associated with the immune and nervous systems.

The extracellular matrix of the PDL consists of collagenous and noncollagenous proteins. Collagen type I is the most abundant, and it is also the primary constituent of the Sharpey fibers, together with collagen II, V, VI, XII, and XIV.[8] Other noncollagenous proteins present in the PDL are tenascin, fibronectin, vitronectin, elastin, and glycoproteins. In addition, hyaluronate, heparan sulfate, chondroitin sulfate, and dermatan sulfate are the glycosaminoglycans identified in the PDL. Dermatan sulfate is the principal glycosaminoglycan, while versican and decorin are the main proteoglycans.[8,9]

ALVEOLAR BONE

One of the two mineralized tissues that comprises the attachment apparatus is the alveolar bone. Just like any other type of bone in the human body, it is composed of a mineralized matrix and a nonmineralized connective tissue. Within the mineralized tissues, calcium is the most prevalent mineral in the form of hydroxyapatite. The alveolar bone, also known as **alveolar process**, consists of spongy bone, cortical plates, and the **alveolar bone proper** (Table 1-2). The crest of the alveolar bone refers to the most coronal portion of it, and its distance from the cementoenamel junction (CEJ) in a healthy periodontium is within the range of 1 to 3 mm.

The alveolar bone is created following an intramembranous ossification with ectomesenchymal cells from the dental follicle intervening in the developmental process. The presence of teeth is essential for the development of the alveolar bone. As such, in absence of a PDL, the alveolar bone proper will not develop.[5]

The alveolar bone houses the teeth, providing protection and support and allowing proper functioning during mastication, absorbing and distributing the occlusal forces. The primary function of the alveolar bone is to provide a structure where the Sharpey fibers of the PDL anchor to keep the tooth in position and function.

The chemical composition of alveolar bone is 65% hydroxyapatite and 35% organic material such as collagen and noncollagenous proteins (eg, osteocalcin, bone sialoprotein, phosphoprotein, osteonectin, and bone morphogenetic proteins).

Microscopically, two different types of mature bone can be observed based on the organization: *(1)* the lamellar bone, containing osteons which consist of a blood vessel surrounded by concentric lamellae, and *(2)* the **bundle bone** where PDL fibers (Sharpey fibers) anchor. In the bundle bone, lamellae can be found parallel to adjacent marrow spaces, and the disposition is parallel to the tooth surface.

CEMENTUM

Cementum is the second mineralized tissue of the attachment apparatus. It is an avascular mineralized connective tissue that surrounds the dentin at the level of the dental root. Its primary function is to allow for the anchorage of Sharpey fibers that will keep the tooth in the alveolus as well as to adapt and protect during tooth wear and movement. The thickness of cementum increases with age. Also, apical portions of the dental root present with thicker cementum than the coronal counterparts.[5] The CEJ is the anatomical area where the crown meets the root. Schroeder and Scherle[10] described three types of relationships between cementum and enamel: edge to edge; cementum covering the enamel; or a gap between both structures where dentin is exposed. The most prevalent interrelation is cementum covering the enamel, followed by edge to edge and gap.[11]

Based on the presence of cementocytes embedded in its extracellular matrix, the cementum can be classified as cellular or acellular. In addition,

Lamina propria: In the mucous membrane, the connective tissue coat just beneath the epithelium and basement membrane. In skin, this layer is known as the *dermis*.

Mucogingival junction: The junction of the gingiva and the alveolar mucosa.

Osseointegration: A direct contact, at the light microscopic level, between living bone tissue and an implant.

Periodontal ligament (PDL): A specialized fibrous connective tissue that surrounds and attaches roots of teeth to the alveolar bone. Also known as the *periodontal membrane*.

Periodontium: The tissues that invest and support the teeth, including the gingiva, alveolar mucosa, cementum, periodontal ligament, and alveolar supporting bone. Also known as the *supporting structure of the tooth*.

Rete pegs: Ridge-like projections of epithelium into the underlying stroma of connective tissue that normally occur in the mucous membrane and dermal tissue subject to functional stimulation.

TABLE 1-2 Features of alveolar bone

	Location	Thickness	Composition	Characteristics
Alveolar bone proper	Wall of the socket	0.1 to 0.4 mm	Lamellated and bundle bone	• Perforated, carrying interalveolar nerves and blood vessels. • Radiographically identified as cribriform plate or lamina dura.
Spongy bone	Between alveolar bone proper and cortical plates	More volume present in maxilla at interdental and interradicular septa. Very limited in buccal sites followed by lingual and palate sites.	Trabeculae surrounded by marrow that contains adipocytes and pluripotent stem cells	• Highly vascularized. The amount and organization will determine the classification. • Regular or irregular orientation of trabeculae can be identified based on the location.
Cortical plates	Outline the alveolar process	Variable from posterior to anterior sites. Buccal thinner than lingual.	Osteons and interstitial lamellae	• Poor intrinsic vascularization. Highly remodeled in the most coronal portion after tooth extraction.

TABLE 1-3 Features of the different types of cementum

	Location	Thickness	Contain cells	Intrinsic collagen fibers	Extrinsic collagen fibers	Developed by
Acellular afibrillar cementum	Coronal part, covering enamel surface. One of the components of acellular extrinsic fiber cementum.	1 to 15 µm	No	No	No	Cementoblasts
Acellular extrinsic fiber cementum	Cervical third of the root	30 to 230 µm	No	No	Yes (composed of bundles of Sharpey fibers)	Cementoblasts and fibroblasts
Cellular mixed stratified cementum	Apical third of the root and furcation. Tip of the apex.	100 to 1,000 µm	Yes	Yes	Yes (composed of bundles of Sharpey fibers)	Cementoblasts and fibroblasts
Cellular intrinsic fiber cementum	Filling resorption lacunae of the root	Varies	Yes	Yes	No	Cementoblasts

the fibers that form the cementum will contribute to the classification of the different types[5] (Table 1-3).

As in the formation of the PDL, cementum starts developing in a prefunctional stage prior to the eruption of the tooth. After the crown is formed, the cells of the inner and outer enamel epithelium that constitute the cervical loop will proliferate deeper into the ectomesenchyme driving the development of the dental root. This structure is known as the **Hertwig epithelial root sheath (HERS)**. The most apical portion of the HERS, which encloses the dental papilla, is known as the *epithelial diaphragm*. Cells from the HERS induce the differentiation of the dental papilla cells in a coronoapical direction to become odontoblasts that will form the dentin of the root. The number and morphology of the dental roots will be determined by the disposition of the HERS. The cementum, the mineral portion of the root