VINCENT RONCO, DDS, MSc

TUNNELING

A Comprehensive Concept in Periodontal Plastic Surgery

QUINTESSENCE PUBLISHING

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Private Practice Limited to Periodontics
and Implant Dentistry
Paris, France

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Contents

Foreword

Dr Vincent Ronco has brought all his experience to bear in producing a work that delivers a clear and educationally focused global concept of periodontal recession treatment. Based on the minimally invasive technique of "tunneling," the treatment concept goes beyond previous modalities. In addition, his treatment philosophy is based on a simple, rational, and effective decision tree. Nothing is left to chance to establish the clinical pathway.

With this richly illustrated publication, the reader has a real manual at their disposal intended to guide their progression. The book offers a detailed presentation of the treatment concept, the chronology of care, the surgical techniques to be mastered, the instruments to be used, and the pre- and postoperative instructions.

One word is enough to summarize this work: *inspiring*! It is up to the reader to make these precepts their own, which are made intelligible and accessible in this book, a true "companion on the road."

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Preface

The growing demand for periodontal plastic surgery, whether motivated by esthetic, functional, or analgesic concerns, has stimulated the development of new therapeutic approaches since the mid 1980s. Unfortunately, the sheer diversity of surgical protocols is likely to confuse clinicians. In addition, these protocols are not equivalent with regard to the management of keratinized tissue, the esthetic result, the range of indications, and especially the risk of complications. This is why I have developed a global treatment concept based on a unique approach that is safe, reproducible, and already in existence: tunneling. The treatment philosophy explored in this book, which encourages minimally invasive microsurgery, is underpinned by the following:

- Specific analysis of the crown-root transition zone
- A segmented surgical approach based on tunneling
- New techniques of suspended sutures
- Revised management of connective tissue grafts

Taken together, this global treatment concept can be applied in a variety of challenging clinical situations involving periodontal recessions. The end result is a harmonized and stabilized gingivopapillary complex, positioned along the cementoenamel junction and preserving soft tissue integrity and vascular potential.

Dedication

To my parents, Stella and Pierre
To my wife, Marie, and my twins, Louise and Théo
To Prof Éric Rompen
To my fellow travelers, Drs Éric David and Emmanuel Gouêt

1

Recessions

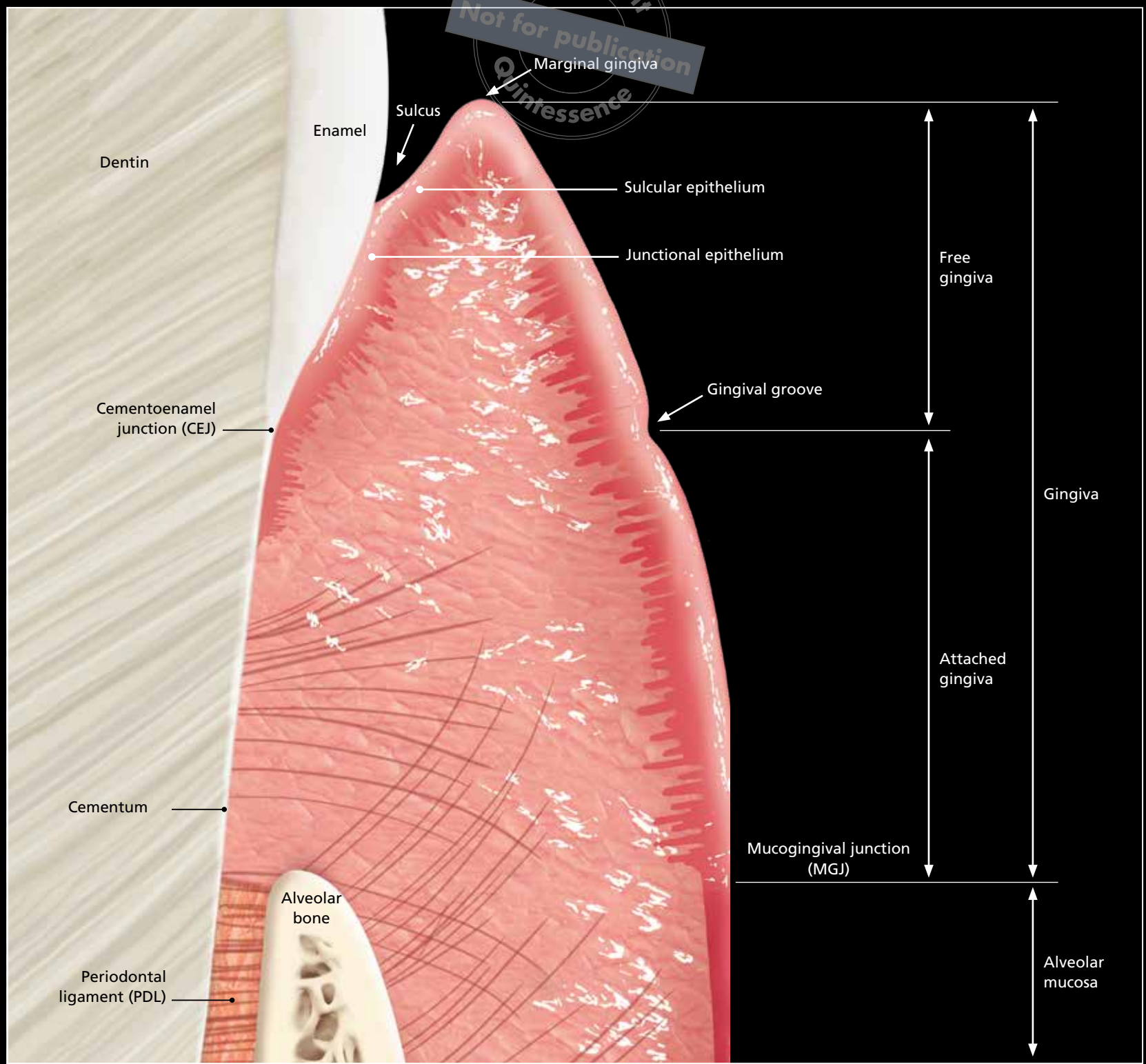


Fig 1-1 Schematic of the periodontium.

Description of the Periodontium

Gingiva

Anatomical and histologic aspects

The gingiva extends from the cervix of the tooth to the mucogingival junction (MGJ) and can be broken down into two overlapping entities: the free gingiva and the attached gingiva (Fig 1-1). Histologically, the gingiva consists of a keratinized epithelium overlying a richly vascularized connective tissue. The thickness and height of the gingiva vary significantly depending on the individual and the site.

Free gingiva

The free gingiva constitutes the terminal part of the gingiva. It surrounds the entire tooth and covers the enamel for 1 to 2 mm, following the path of the cementoenamel junction (CEJ) more coronally. On its external surface, the free gingiva extends from the top of the marginal gingiva to the gingival groove. The gingival groove can sometimes be seen as a slight depression opposite the CEJ. On the inner side of its most coronal portion, the free gingiva is not attached to the alveolar process, and this defines the crevicular zone of the sulcus. This zone, between the enamel and the sulcular epithelium, is immunologically very active as the components of immunity (cells and molecules) are permanently opposed to the microorganisms of the oral environment. Still on its internal surface, but more apically, the free gingiva adheres to the tooth via a so-called junctional epithelium. This epithelium has two atypical characteristics: *(1)* it is the only gingival epithelium that is not keratinized, and *(2)* it has two basal laminae, one facing the tooth and the other facing the gingival connective tissue. The absence of keratinization favors the diffusion of the different components of immunity, from the connective tissue to the sulcus. The presence of the two basal laminae allows adhesion to both the tooth and the connective tissue.

Attached gingiva

Vestibularly and lingually, the attached gingiva extends from the gingival groove (and the free gingiva) to the MGJ located more apically. At the palatal level, the attached gingiva and the masticatory mucosa of the palate are continuous but clinically indistinguishable because of their similarity. As its name indicates, the attached gingiva is not mobile, because it is solidly connected to the bone and cementum by a 3D fibrillar network. This network is essentially composed of type 1 collagen fibers organized in bundles. In addition, inclusions of a brown pigment, melanin, can be observed in correlation with ethnic origin.

Papilla

The papilla occupies the space between two adjacent teeth (Fig 1-2). It consists of both free gingiva in its upper part and attached gingiva in its lower part. The shape of the papilla varies from one individual to another and from one tooth to another. Its anatomy is conditioned by the bony environment (position and shape of the interdental bone septum) and by the dental environment (position and shape of the interdental contact zone, anatomy of the CEJ). Seen from the front, at the level of the incisors and canines, the papilla is pyramidal in shape, while at the level of the premolars and molars, it appears relatively flat. In profile, the papilla forms a sort of neck with two apices, the vestibular apex being always more coronal than the lingual or palatal apex. The difference in height between these apices, which is very significant on the anterior teeth, is reduced as one reaches the molars.

Esthetic aspects

Marginal gingival contour

The gingival contour strictly follows the curve described by the CEJ. It is generally rounded but can adopt other more atypical shapes: parallelepipedal, triangular, or wavy depending on the anatomy imposed by the CEJ. The presence of dental anomalies, such as dentin, cementum, or amyloid spindles, can modify the gingival contour by interfering with the CEJ.

Arrangement of the gingival zeniths

The gingival zenith is the most apical point of the free gingival margin. The arrangement of the gingival zeniths within an arch corresponds to esthetic canons that are relatively consistent from one individual to another.

In the maxilla, the position of the gingival zeniths of the lateral incisors is slightly more coronal than the virtual line through the zeniths of the canines and central incisors. The zeniths of the canines and central and lateral incisors can also be aligned without compromising the esthetics (Fig 1-3). Posteriorly, the premolar zeniths are located coronally to the canine zeniths and often in continuity with the molar zeniths.

In the mandible, the zeniths of the central and lateral incisors are aligned along a straight line, while the cervixes of the canines are positioned apically to this line. Posteriorly, the zeniths of the premolars are located coronally to the canine zeniths and often in continuity with the molar zeniths.

Gingival color

The keratinization of the gingiva gives it its pink, matte, and opaque appearance; the blood capillaries of the connective tissue are in fact completely masked by the accumulation of keratin. The possible accumulation of melanin can nevertheless influence the gingival color by giving it a more or less brownish appearance, depending on the accumulation of this colored pigment. The gingiva is easily distinguished from the alveolar mucosa in the vicinity of the MGJ. Indeed, the absence of keratinization of the mucosa gives it a red, smooth, and shiny appearance, as well as a relative transparency, which allows the underlying blood capillaries to be seen. From an esthetic point of view, the existence of a substantial band of gingiva is essential around the teeth, because the presence of the red alveolar mucosa near the cervixes of the teeth is visually unsightly.

Gingival texture

The gingiva has a more or less stippled texture, also known as an "orange peel" appearance (Fig 1-4). This characteristic texture is explained by the insertion of osteogingival fibers of the connective tissue. These fibers exert traction on the epithelial level, generating areas of depression on the surface. This stippling is particularly identifiable when the gingival biotype is thick and remains discreet when it is thin.

Functional aspects

The gingiva is essentially intended to protect the deep periodontium from mechanical, chemical, thermal, and microbiologic aggressions of the oral environment. Its histologic characteristics, in particular its keratinization and the organization of its collagen fibrillary networks, predispose it to play this role. The alveolar mucosa, which is in continuity with the gingiva at the MGJ and with the mucosa of the cheeks and lips, is not able to fulfill this task efficiently; it is indeed mobile and has a low resistance. These degraded mechanical characteristics are due to its histologic composition: the epithelium of the alveolar mucosa is not keratinized, and its connective tissue does not have an organized fibrillar network. Moreover, the fibers present are mainly elastic and not collagenous.

The scientific literature is disputed but seems to indicate that the periodontium can be healthy and stable despite a low gingival height. However, this implies a particularly rigorous oral hygiene routine. We often observe clinically that this compliance is all the more difficult to obtain, as the keratinized tissue is present in limited quantity. The presence of keratinized tissue at the cervixes of teeth improves the ability and comfort of cleaning. It therefore seems reasonable to think that a substantial gingival band has a favorable impact on overall dental prognosis.

Fig 1-2 **Schematic of the interdental papilla.**

The papilla occupies the space between two adjacent teeth. It is made up of both free gingiva in its upper part and attached gingiva in its lower part. The shape of the papilla varies from one individual to another and from one tooth to another. Its anatomy is conditioned by the bony and dental environment. In profile, the papilla forms a kind of neck overhung by two peaks, the vestibular peak always being more coronal than the lingual or palatal peak. The difference in height between these apices, which is very significant on the anterior teeth, is reduced as one reaches the molars.

Fig 1-3 **Arrangement of the gingival zeniths.**

The gingival zenith is the most apical point of the marginal gingiva. The arrangement of the gingival zeniths within an arch corresponds to esthetic canons that are relatively consistent from one individual to another. In the maxilla, the position of the gingival zeniths of the lateral incisors is either slightly more coronal than or in contact with the virtual line passing through the zeniths of the canines and central incisors.

Fig 1-4 **Gingival texture.**

The gingiva has a more or less stippled texture, also known as an "orange peel" appearance. This characteristic texture is explained by the insertion of osteogingival fibers of the connective tissue. These fibers exert a traction on the epithelial level, which generates areas of depression on the surface. This stippling is particularly pronounced on this image, because the gingival biotype is thick.

Anchoring tissues

Anatomical and histologic aspects

Periodontal ligament (PDL)

The PDL is a very dense connective tissue located between the cementum and the alveolar bone. It contains a very large number of fibers, mainly of collagen, called *Sharpey fibers*. These fibers connect the acellular cementum with extrinsic fibers of the dental root to the bone of the alveolar process. They are organized in bundles whose distribution and orientation allow them to absorb and diffuse the mechanical stresses to which the teeth are subjected. The PDL also hosts quiescent progenitor cells.

Cementum

Cementum is a mineralized connective tissue in which collagenous fibers and cells can be embedded. There are several types of cementum, classified according to the existence of cellular inclusions and the presence and orientation of collagen bundles. The cementum that occupies most of the root surface is acellular with extrinsic fibers. It does not contain any cells but hosts one end of the Sharpey fibers of the ligament, the other end being anchored in the bone of the alveolar process.

Alveolar process

The alveolar process is an extension of the maxillary or mandibular basal bone. Its structure forms one or more alveoli, in which the root(s) of each tooth are lodged. On its external surfaces, the alveolar bone is composed of compact cortices: one vestibular, the other lingual or palatal. The internal surface of the alveolar bone is made up of compact bone, also called *cribriform plated*, because of its cribbed aspect. The observation of a deserted alveolus shows a structure with small holes that correspond to the points of passage of the Sharpey fibers of the ligament and blood capillaries. Between the compact bone and the cortices, there is spongy bone, whose density and abundance vary according to individual and site. In the same individual, the thickness of the vestibular alveolar bone follows a double decreasing gradient: from anterior to posterior, on the one hand, and from apical to coronal, on the other hand. When the alveolar process is intact, the marginal bone boundary is located approximately 4 mm apical to the CEJ and reproduces its scalloped path.

Functional aspects

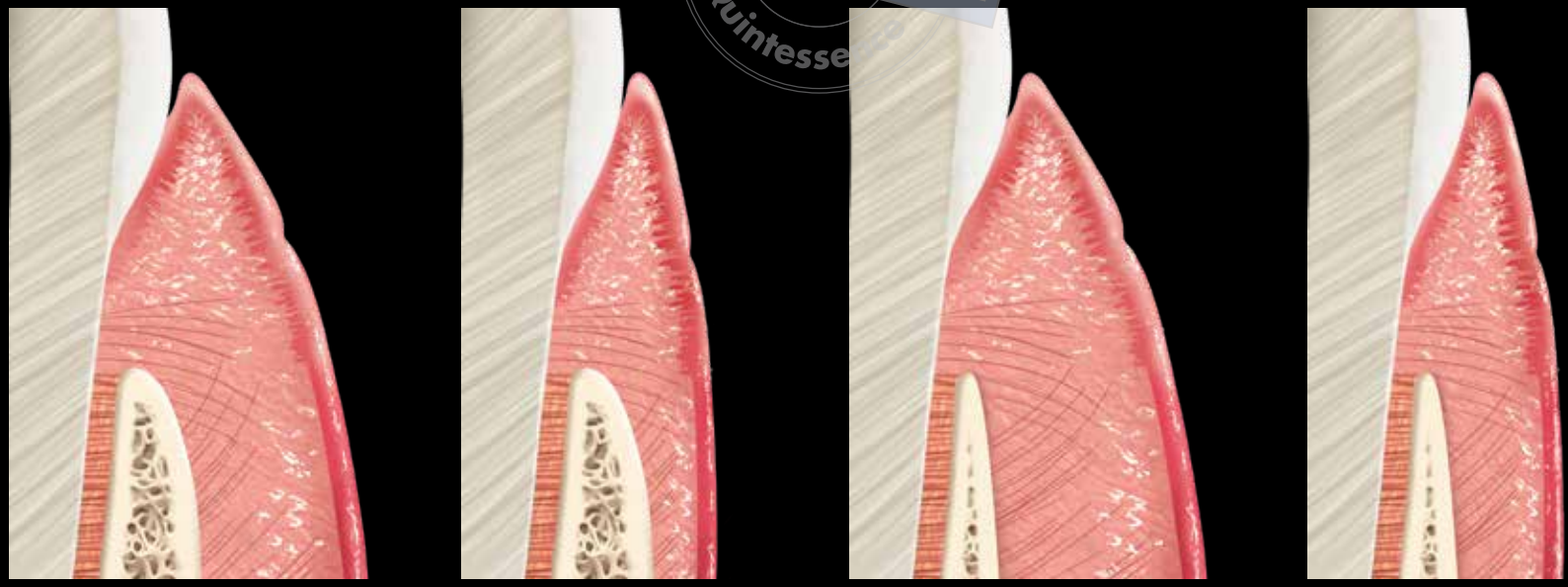
Dental anchorage is ensured by the combined action of the three tissues that make up the deep periodontium: the cementum, the PDL, and the alveolar bone. In addition to this mechanical function, there is also a biologic role. The PDL harbors a number of progenitor cells that can, under certain conditions, be induced to differentiate. These pluripotent cells are involved in the phenomena of tissue homeostasis but also of repair and even regeneration, particularly in a postsurgical context.

Biotypes

A biotype defines an anatomy by an association of characteristics frequently encountered concomitantly. This notion of biotype can be applied to the periodontium as a whole, as well as to the gingiva in particular.

Periodontal biotype

The most commonly used classification is that of Maynard and Wilson (Fig 1-5). It compiles data related to gingival thickness, vestibular alveolar process thickness, and height of keratinized tissue. The type I biotype, called thick, is the most resistant: it associates thick bone, thick gingiva, and a significant gingival height. On the other hand, the type IV biotype, called thin, is the least resistant, as it presents thin bone, thin gingiva, and reduced height of gingiva. Type II and III biotypes have intermediate characteristics. None of the biotypes is pathologic; they simply reflect physiologic anatomical variations.



Type I Type II Type III Type IV

Biotype	Thickness		Gingival height
	Bone	Gingiva	
Type I	Thick	Thick	3 to 5 mm
Type II	Thick	Thin	≤ 2
Type III	Thin	Thick	3 to 5 mm
Type IV	Thin	Thin	≤ 2

Fig 1-5 **Periodontal biotypes.**

A periodontal biotype defines a periodontal situation by an association of characteristics. Biotype I, called thick*, is the most resistant. It associates thick bone, thick gingiva, and significant gingival height. At the other extreme, biotype IV, called* thin*, is the least resistant. It is characterized by thin bone, thin gingiva, and minimal gingival height. Biotypes II and III have intermediate characteristics (according to Maynard and Wilson, 1980).*

Gingival biotype

The concept of biotype is also applicable to the gingiva alone. This is much more meaningful clinically than the periodontal biotype, which is difficult to assess because of the lack of data on the thickness of the alveolar processes. The gingival biotype can be estimated (Fig 1-6) with a simple periodontal probe by observing the following:

- Visibility of the probe inserted in the sulcus
- Visual effect induced by moderate pressure on the marginal gingiva

When the gingival biotype is thick, the tip of the periodontal probe is not visible, and the pressure exerted on the marginal gingiva does not cause any visual change of the surrounding gingiva. When the gingival biotype is thin, the probe is clearly visible, and the same pressure exerted on the tissues leads to their blanching due to the induced ischemia. Apart from these extreme situations, which are easily identifiable, the notion of gingival biotype remains very subjective. Therefore, only three gingival biotypes can be distinguished: thick, intermediate, and thin.

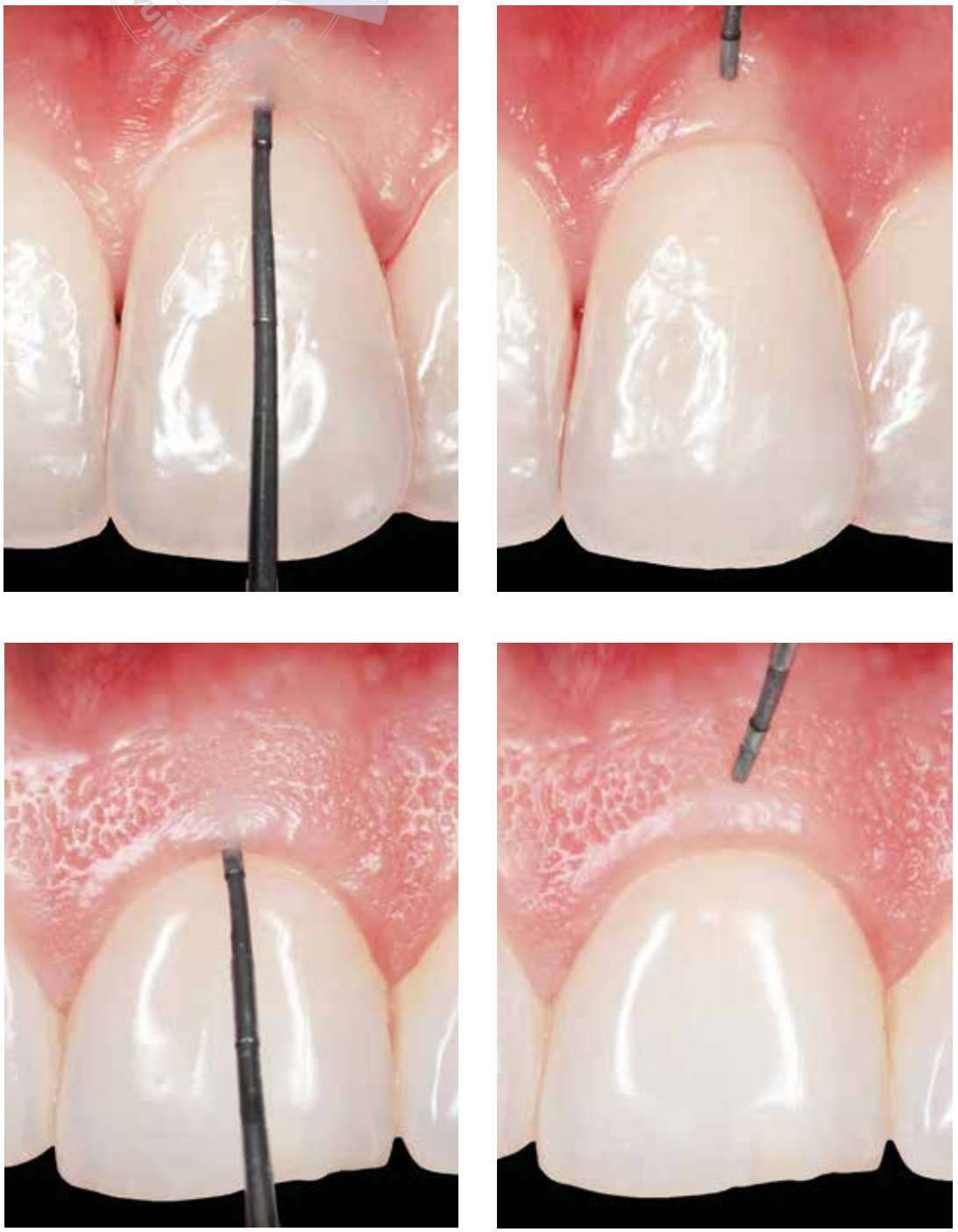


Fig 1-6 Clinical assessment of the gingival biotype.

The gingival biotype can be estimated with a simple periodontal probe by observing the visibility of the probe inserted into the sulcus as well as the visual effect induced by moderate pressure on the marginal gingiva. When the gingival biotype is thick, the tip of the periodontal probe is not visible, and the pressure exerted on the marginal gingiva does not cause any visual change of the surrounding gingiva. When the gingival biotype is thin, the probe is clearly visible, and the same pressure exerted on the tissues leads to blanching by ischemia.

Anatomopathology

Recessions are defined by the apical recession of all periodontal tissues (Fig 1-7): the gingiva, cementum, alveolar bone, and PDL are progressively resorbed. Recessions may involve all tooth surfaces. In the absence of sequelae of periodontal disease, they tend to affect the vestibular surfaces and more rarely the lingual or palatal surfaces.

Visually, the gingiva, theoretically located coronally to the CEJ, recedes and exposes the dental root. Therefore, a recession is characterized when the CEJ, identifiable by its curved anatomy, and the root, discernible from the crown by its more saturated hue, appear clearly.

Prevalence

Recessions are the most common periodontal disease, as they affect an extremely wide range of people. Of course, all patients with periodontitis, or who have had periodontitis, have recessions. But many patients with no history of periodontal disease may also have recessions. Recessions are also prevalent because their occurrence is the result of a combination of diverse and frequent factors, as we will see later. There is no large epidemiologic study that would allow us to precisely define the contours of this condition. However, a certain number of realities appear: recessions affect men as much as women, and the teeth most frequently affected are located in the anterior sector.

Clinical consequences

Recessions are harmful because they promote dentinal hypersensitivity, abrasions, and root caries, as well as gingival inflammation due to hygiene complications. Recessions also have an unfavorable esthetic impact, as the affected teeth take on an unsightly elongated appearance.

The main reason for consultation resulting from their occurrence is the concern, most often unfounded, of tooth loss. Esthetic concerns are second in importance. The demand for esthetic gingival reconstructions has changed significantly in recent years and is no longer limited to the areas visible on smiling. Finally, the reduction of dental sensitivity is also a regular reason for consultation.

Fig 1-7 **Characteristic recessions in the maxilla and mandible of the same patient.**

The gingiva is receding, which exposes the dental root. As a result, the patient complains of dentinal hypersensitivity, presents root wear, and has developed marked demineralization, especially on teeth 11 and 21. Furthermore, the receding gingiva and the formation of areas of abfraction along the affected roots encourage plaque formation in a patient who otherwise has good oral hygiene. Finally, the esthetics of her smile is clearly affected by the elongated appearance of her maxillary teeth.

Classification

A recession is generally described by the classification established in the 1980s by Miller (Fig 1-8). This internationally accepted classification divides recessions into four Classs:

- Class I: The recession does not reach the MGJ and does not involve the proximal surfaces.
- Class II: The recession reaches or exceeds the MGJ but does not involve the proximal surfaces.
- Class III: The recession may not reach or may reach or even exceed the MGJ but is characterized solely by its involvement of one or even both papillae. The papillary involvement may be more or less advanced. The result is a varying degree of scalloping between the degraded papillary apex and the base of the recession.
- Class IV: The gingival recession may not reach or may reach or exceed the MGJ. Papillary involvement is significant, with the apex of the papilla apical to the vestibular CEJ and often abutting the base of the recession.

Miller's classification not only gives a general idea of the anatomy of a recession but also defines its prognosis for recovery. If the procedure and its aftermath are successful, class I and II recessions are fully recoverable, class III recessions partially recoverable, and class IV recessions not recoverable at all, regardless of the surgical technique used. As examples, the clinical illustrations presented after the classification attest to this biologic determinism (Figs 1-9 to 1-13).

Fig 1-8 Schematic of the different classes of periodontal recessions (Miller, 1984).

Class I

Class II

Class III

Class IV