Peri-Implant Soft Tissue Management

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Editor

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A Clinical Guide

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Introduction: Dental Implants and Soft Tissues: Roles and Challenges

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Mohamed Hassan

Dental implants have become a widely accepted modality for replacing missing teeth to fulfill both the functional, aesthetic, and other needs of patients. Adequate supporting structures (bone and soft tissues) are essential to achieving high implant success rates. While adequate quantity and quality of bone play a major role in the short and long-term implant support, proper soft tissue management contributes to both functional and aesthetic outcomes.

This book highlights different modalities and techniques for handling soft tissues from the surgical phase and through and beyond the restorative phase. The aim of the book is to provide dentists who are involved in dental implants with an overview of how to deal with challenges they may face regarding soft tissues as related to supporting the placement of implants.

1.1 Multi-Stakeholder and Multifactor Approaches to Supporting the Management of Soft Tissues

Tooth loss can pose a challenge to patients and negatively affect many aspects of their lives, including social, physical, and mental health. Due to the importance of the presence of teeth to facilitate chewing food, phonetics, and aesthetics, edentulism may negatively impact the quality of life.

Dentists across specialties and other dental professionals (e.g., hygienists, dental assistants) ongoingly need to expand our knowledge base in order to meet patients' priorities and circumstances in manners that fit their lifestyle and maintain an acceptable quality of life throughout the process. Patients expect their dental care

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providers to be able to discuss different treatment options with them and help them make choices that best fit their needs.

For dentists to effectively meet patients' needs, they should be familiar with different methods of tooth replacement and the advantages and limitations of each option as pertaining to the circumstances of each patient. Currently, dental implants are considered the option that most patients and dental health care providers consider the closest match to natural dentitions.

If patients opt to have implants replace their missing teeth, it becomes essential to establish a dialogue to discuss how to implement logistical steps to promote success. Patients and members of the dental team need to be familiar with all the treatment steps involved in order to avoid misunderstandings, lack of coordination, and other unsatisfactory outcomes for all parties. Successful outcomes are a shared responsibility between patients and their dental care team.

Promoting a high success rate of implants is a multifactorial process. Some factors are related to the patient's medical, dental, anatomical, and functional conditions. Other factors are related to the ability of the dental team to prepare and deal with clinical findings during different stages of implant placement. One of the most important factors that significantly affects the success rate of dental implants is the presence of adequate and healthy hard and soft tissues. This textbook focuses on the soft tissues around dental implants and varied techniques of dealing with their lack of quantity or quality. Bringing together medical doctors and dentists, we provide a holistic perspective on how all members of the dental team can collaborate across the surgical, restorative, and even maintenance phases to support positive outcomes and increase the success rate of dental implants.

1.2 Overview of Chapters

The chapters outline ways to deal with multiple aspects of soft tissue deficiencies to ensure the proper quantity and quality surrounding dental implants. In addition to helping correct existing problems, the chapters address ways to maintain healthy conditions once achieved in order to prevent potential future deformities. Achieving and maintaining healthy soft tissues will help increase the implant success rate with increased longevity.

In particular, Chap. 2 (Hassan, A) describes that in order to make a sound and clear treatment plan, practitioners need to familiarize themselves with the histology and anatomy of different types of oral soft tissues. Without adequate and correct anatomical and histological knowledge, clinicians may face challenges in how to diagnose and manage the clinical situation based on a patient's needs and circumstances.

The overview of histology and anatomy provides the foundation for Chap. 3 (Jeong), which focuses on the role of soft tissues in long-term success of dental implants. Long-term implant success depends on the unique characteristics of each type of soft tissue.

To achieve long-term success, dentists need to manage short-term challenges, as described in Chap. 4 (Hassan, M.), which describes soft tissue management during different stages of surgical placement of implants. Once dentists determine a deficiency in either the quality and quantity of soft tissues, clinicians usually have multiple chances and phases to augment the quantity and/or improve the quality of existing soft tissues surrounding the site of the implant before, during, and after its placement. Chapter 4 reviews multiple methods and techniques that can be utilized in various stages in case an aspect of supporting soft tissues is not completed at a particular stage. Having a range of methods and opportunities to implement them, including the surgical or even after loading the implants, allows practitioners to choose the most applicable or appropriate method based on clinical evaluation and timing of the procedure.

Once the implant is placed and/or loaded, Chap. 5 (Kim and colleagues) stresses the importance of maintenance to help continue its success. Routine maintenance visits and proper oral hygiene measures are needed to maintain healthy soft tissue around dental implants and promote the longevity of the implant. Maintenance of dental implants includes periodic clinical and radiographic evaluations to facilitate early detection of and dealing with potential failure or negative signs or symptoms. Periodic visits also allow dental care providers to achieve adequate patient compliance and knowledge of home care and oral hygiene instructions with the use of different brushing techniques and hygiene instruments. These nonsurgical measures minimize the need for more invasive surgical techniques.

Despite all the measures taken to ensure healthy and adequate soft tissues, practitioners who are involved in dental implant work may encounter soft tissue pathology, which may affect the longevity and success of the implants. Chapter 6 (Alaskar) offers an overview of the most common pathologic lesions and proper surgical and nonsurgical measures to manage them. In cases of soft tissue pathology, treatment planning should be determined through consultations between clinicians (e.g., general dentists, pathologists, and implantologists).

Implants may show signs and present symptoms of failure and or adverse outcomes and different stages during the complete treatment journey. While the surgical team is mainly responsible for the first stage of surgical preparation of implant placement, the restorative team will complement the surgical phase by fabricating and inserting a well-fitted, functioning, and aesthetically accepted restoration. In order to provide patients with a comprehensively determined treatment plan that is implemented in a coordinated manner, sound communication between different practitioners is essential throughout the stages of implant placement and its restoration. Assuming the surgical phase is completed, Chap. 7 (Khamis) reviews the prosthetic role in peri-implant during the treatment planning phase. In particular, the chapter outlines relevant theory or rationale and the corresponding methods of prosthetic contribution to peri-implant soft tissue management. The chapter reviews a range of factors that need to be taken into consideration in relation to patient selection, aesthetic treatment planning and implant positioning, and emergence profile while achieving a properly contoured final restoration.

Adequate knowledge is necessary to help make an educated decision to select between all the available types of restoration. Chapter 8 (Khamis) presents the steps involved in the selection between various prosthetic designs and their effects on peri-implant soft tissues, whether it is screw or cement-retained restoration.

Finally, once the implant has been restored, Chap. 9 (Hassan, M) emphasizes the effects of occlusion on the long-term success and health of dental implants. Inadequate consideration of the effects of occlusion may lead to implant failure in the long term as it may contribute to excessive bone loss and soft tissue inadequacy. After reviewing different types of occlusion, the chapter focuses on traumatic occlusion as a common factor to show its negative effects on implants and their surrounding hard and soft tissues.

This volume confirms how implant success requires multifactorial management of soft tissues and other relevant factors by knowledgeable members of the dental team who collaborate effectively with one another and communicate clearly with the patient to set and work towards reasonable expectations about the case. Without adequate knowledge about the role of each member and coordination between them, the results may be compromised, and the outcomes may be unsatisfactory to all dental providers and patients. The high cost to manage and correct undesirable outcomes or to meet the patient's demands can often be avoided if the patient's expectations are adjusted to reflect the current situation.

Accordingly, this volume highlights different modalities and techniques for handling soft tissues from the surgical phase and through and beyond the restorative phase in order to provide dentists with an overview of how to deal with challenges regarding soft tissues as related to supporting the placement of implants.

Histology and Anatomy of Different Types of Oral Mucosa

2

Abdelghany Hassan Abdelghany

2.1 Anatomy of the Oral Mucosa

The human oral cavity is lined by a mucous membrane (the oral mucosa) that seems to be more complicated than it first appears. The oral mucosa is made up of a stratified squamous epithelium, which may or may not be keratinized. It varies from site to site within the oral cavity, but everywhere the epithelium is protective stratified squamous [1, 2] (Fig. 2.1).

The oral cavity has sometimes been described as a mirror that reflects the health of the individual [3]. Changes indicative of disease are seen as alterations in the oral mucosa lining the mouth, which can reveal systemic conditions, such as diabetes or vitamin deficiency, or the local effects of chronic tobacco or alcohol use [4].

Oral mucosa can be divided into three main categories based on function and histology: masticatory, lining, and specialized mucosa.

1. ***Masticatory mucosa***, keratinized stratified squamous epithelium, found on the dorsum of the tongue, hard palate, and attached gingiva [6] (Figs. 2.2, 2.3, 2.4).

   The **hard palate** has a partially-keratinized epithelium, much of which is firmly attached by a fibrous submucosa to underlying bone. This epithelium is partially keratinized on gums and hard palate [6] (Figs. 2.1, 2.4).

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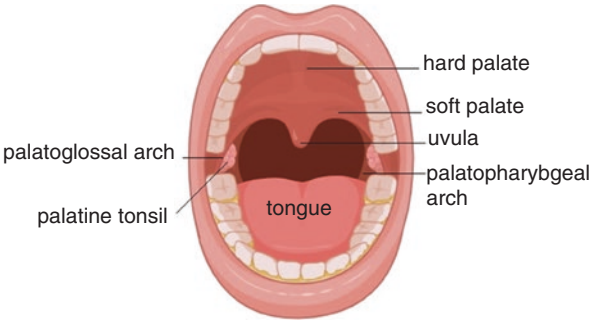

Fig. 2.1 Mouth cavity

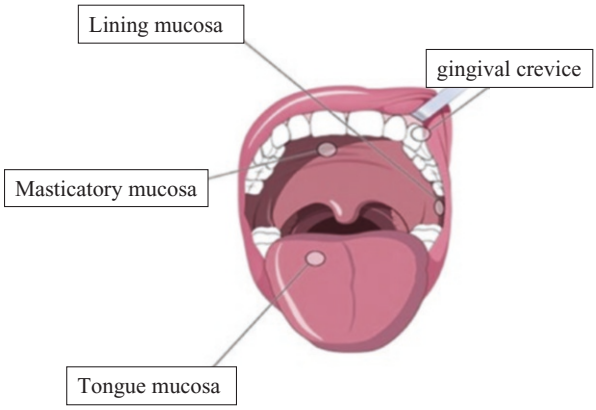

Fig. 2.2 Mouth cavity [5]

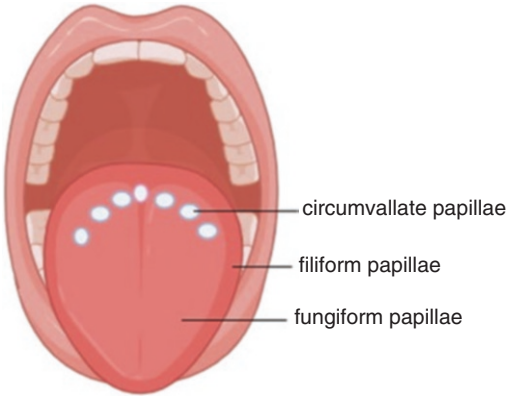

Fig. 2.3 Lingual mucosa

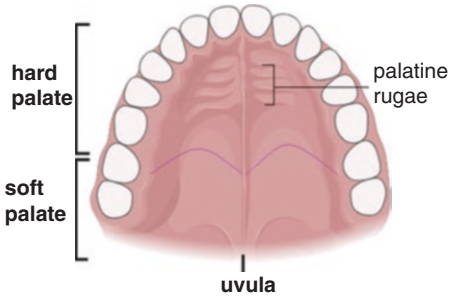

Fig. 2.4 Masticatory mucosa

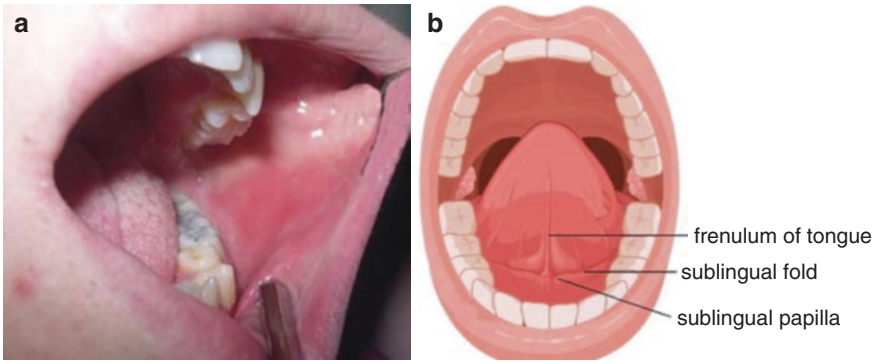

Fig. 2.5 Buccal mucosa on the cheek (**a**) and floor of the mouth (**b**) [8]

2. ***Lining mucosa***, nonkeratinized stratified squamous epithelium, found almost everywhere else in the oral cavity, including the buccal, labial, and alveolar mucosa [6, 7].
   (a) ***Buccal mucosa*** refers to the inside lining of the cheeks and floor of the mouth [7] (Fig. 2.5).
   (b) ***Labial mucosa*** refers to the inside lining of the lips. It is the moist internal portion of the lip [7] (Fig. 2.6).
   (c) ***Alveolar mucosa*** refers to the covering of the alveolar process of the maxillae and mandible. It is continuous with the mucosa of the cheek, lips, and palate and is loosely attached to the underlying bone [6, 7] (Fig. 2.7).
      - It is easily distinguished by its bright red color due to many blood vessels and its smooth shiny surface [6].
3. ***Specialized mucosa*****,** specifically in the regions of the taste buds on lingual papillae on the dorsal surface of the tongue that contains nerve endings for general sensory reception and taste perception [7] (Figs. 2.3, 2.8).

Fig. 2.6 Labial mucosa [9]

Fig. 2.7 Alveolar mucosa [9]. (**a**) Attached gingiva. (**b**) Alveolar mucosa. (**c**) Interdental papilla. (**d**) Free gingiva. (**e**) Labial frenulum. (**f**) Mucogingival junction

A. Attached gingiva.
B. Alveolar mucosa.
C. Interdental papilla.
D. Free gingiva.
E. Labial frenulum.
F. Mucogingival junction.

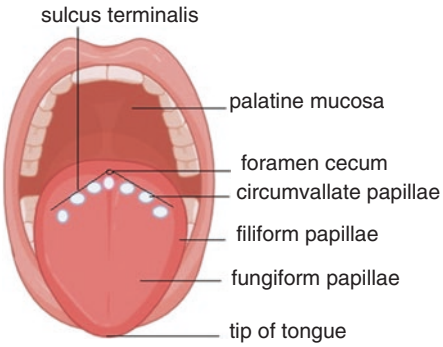

Fig. 2.8 Specialized mucosa

2.2 Histology of the Oral Mucosa

The human buccal mucosa is made up of various layers and levels. It contains four independent layers and an underlying connective tissue layer, the lamina propria. The surface is kept moist with mucus produced by the major and numerous minor salivary glands. The oral mucosa is well supplied with nerve endings and, on the dorsal surface of the tongue, special sensory endings for taste [1].

2.2.1 Layers of the Oral Mucosa

2.2.1.1 Stratum Basale

The stratum basale (also called the stratum germinativum) is the deepest of the layers of the buccal mucosa. The stratum basale is formed of a continuous layer, usually only one cell thick, of short cuboidal to columnar stem cells. The basement membrane of the cells of this layer is represented by intertwining collagen fibers that help bind these cells to the deeper layers.

The cells of the stratum basale, basal keratinocytes, are considered the stem cells of the buccal mucosa. The primary function of these keratinocytes is to divide by going through successive mitotic divisions, generating new cells that migrate superficially to the next superficial mucosal layer, stratum spinosum, in the process of renewal of the mucosal cells.

The newly formed cells will undergo a progressive maturation called keratinization as they migrate to the surface of the mucosa [1] (Fig. 2.9).

2.2.1.2 Stratum Spinosum

The stratum spinosum (or spinous layer or prickle cell layer) is the layer of buccal mucosa found superficial to the stratum basale and deeper to the stratum granulosum [1, 3]. As the name implies, this layer is spiny in appearance due to the presence of desmosomes, which are protruding cell spiky microfilament projections that join the cells in close contact (Figs. 2.9, 2.10).

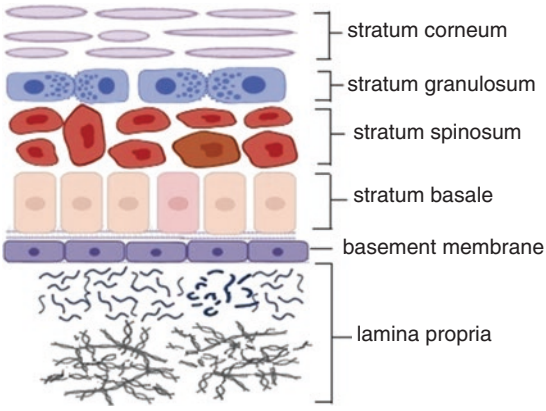

Fig. 2.9 Schematic illustration of the layers found in the keratinized oral mucosa

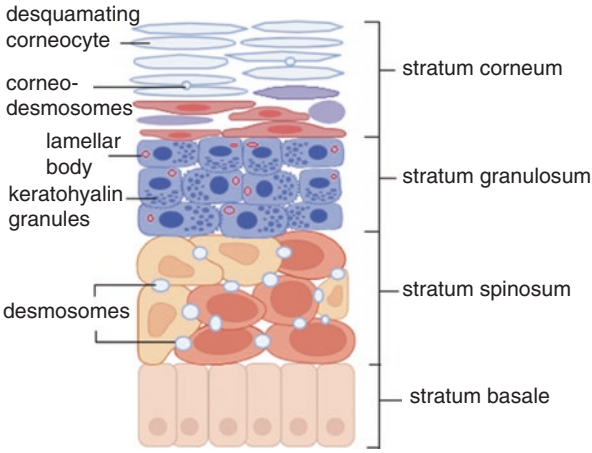

Fig. 2.10 Layers of the oral mucosa

The stratum spinosum is composed of 8 to 10 layers of polyhedral keratinocytes which are formed as a result of successive cell division in the stratum basale. These cells are active in synthesizing fibrillar proteins, known as cytokeratin, which builds up within the cells, aggregating together and forming prominent bundles of keratin microfilaments that go on to form the desmosomes, which allow for strong connections to form between the adjacent keratinocytes. These desmosomes interlock with each other and strengthen the bond between the cells. Therefore, the process of keratinization starts in the stratum spinosum [4, 9].

These spine-like structures are believed to serve as the underlying structural reinforcements that provide strength, elasticity, and flexibility to the layers of the oral mucosa and to better withstand the effects of friction and abrasion. Moreover, the keratinocytes in the stratum spinosum release a water-repelling glycolipid, rendering the mucosa relatively waterproof. As new keratinocytes are produced in the stratum basale, the keratinocytes of the stratum spinosum are pushed upward to the stratum granulosum [4, 9].

2.2.1.3 Stratum Granulosum

It is considered a transitional layer sandwiched between the metabolically active layers beneath, stratum basale and stratum spinosum, and the non-viable layer, stratum corneum (containing dead cells) above.

It is a thin layer of 3 to 5 cell layers thick. When the keratinocytes are pushed from the stratum spinosum, they become flatter, their cell membranes thicken, and they generate large amounts of the protein keratin, which is fibrous. It is chiefly involved in providing waterproofing function. It also contributes to the keratinization process of the mucosa [4, 9].

It is referred to as the granular layer, as the cells contain irregularly shaped granules. There are two types of granules formed in this layer: the basophilic keratohyalin and the lamellar granules formed by the lamellar bodies (Figs. 2.9, 2.10).