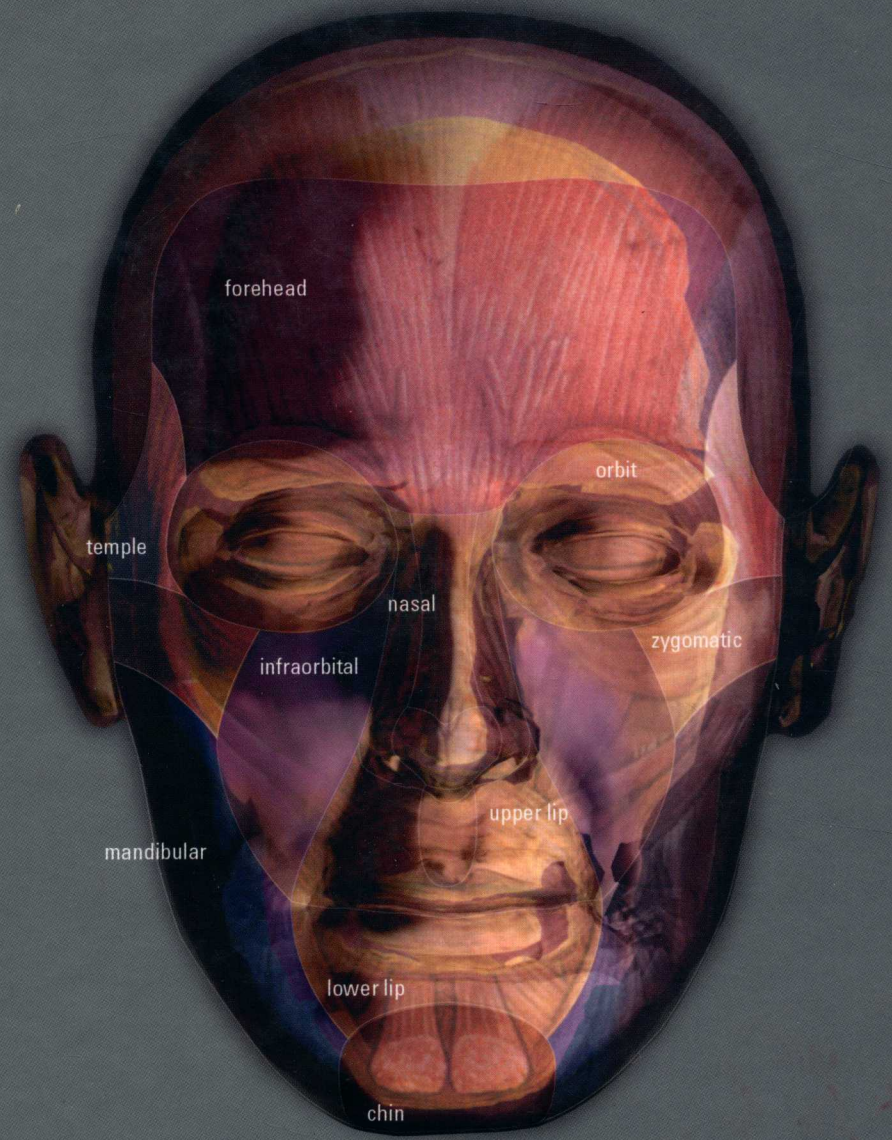
THIRD EDITION

Shan R.

BAKER

Local Flaps in Facial Reconstruction



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LOCAL FLAPS IN FACIAL RECONSTRUCTION

Third Edition

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LOCAL FLAPS IN FACIAL RECONSTRUCTION

To Catherine Belle Baker, Alexander Ray Baker,
and Monica Catherine Baker, and to the thousands
of patients who have trusted me to make their
faces whole

PREFACE

This textbook provides an in-depth discussion of the use of local flaps for reconstruction of the face, scalp, and neck. Like the second edition, it is designed to be a "working man's" manual for repair of cutaneous defects of the head and neck, providing practical and effective methods of reconstructing skin defects of a variety of sizes, configurations, and locations. It is unique in that the contributors are from the medical specialties of otolaryngology, ophthalmology, dermatology, and plastic surgery. The authors are individuals who I believe have exceptional knowledge and experience using local flaps in facial reconstruction. They are some of the most prominent surgeons in their respective specialties.

I am fully cognizant of the political and philosophical differences among various surgical specialties involved with reconstructing the face. However, it is important to set aside any conflicts of interests and disagreements in order to promote an interchange of ideas and knowledge that will be both educational to physicians and beneficial to patients. This textbook represents an example of mutual interest and cooperation among a diverse group of surgeons. This is the third edition of a textbook originally published in 1995 and is printed in three languages. Although the majority of the illustrations used in this edition are the same as those appearing in the second edition, all of the chapters have been upgraded by introducing new concepts or additional information. In the majority of chapters, new clinical cases and photographs have been added or used to replace previous cases and photographs. As with the second edition, a number of chapters have been authored by myself. This is due to a conscious effort on my part to present personal surgical techniques and my philosophy of using local flaps in facial reconstruction. To impart my philosophy toward surgical repair of Mohs defects, I have authored or co-authored 11 of the 28 chapters comprising this edition. Neil A. Swanson, MD, a colleague and friend, and I edited the first edition. Because of my desire to impart a more personal approach to the current work, I chose to edit this edition entirely on my own as I did with the second edition. Although this may have restricted the diversity of surgical approaches available for discussion, it enables a textbook with a more homogenous narrative and consistent message. Similar to the second edition, there are videos available, in this case at the ExpertConsult website. The videos demonstrate the design and transfer of a multitude of local flaps. Included in the videos are actual surgical procedures performed in the operating room. In addition to showing uncomplicated cases using simple cutaneous flaps, very complex defects requiring multiple flaps and grafts are included.

This work represents the culmination of 36 years of cooperative interaction between me and the dermatological surgeons at the University of Michigan. During this interval, we have shared the care of a few thousand patients, which I believe was to the patient's benefit. This cooperative arrangement facilitated the interchange of knowledge and experience, which led to a hybrid of surgical approaches for the repair of facial cutaneous defects. This cross-fertilization of ideas was a direct benefit to me and my ability to care for patients and is the source of my desire to edit this textbook.

This book would not have been possible without the cooperation of all of the dermatological surgeons in the Department of Dermatology at the University of Michigan. For this reason, I express my sincere gratitude to all of them for their continued support and confidence in me.

Shan R. Baker, MD, FACS

Acknowledgments

Although many people have indirectly contributed to the creation of this book, I would like to thank those who had major roles in assisting me in its preparation.

Foremost, I am grateful to all of my patients who through their misfortune of being afflicted with skin cancer have enabled me to learn and perfect reconstructive surgical techniques. A particular gratitude is offered to those patients who have allowed me to publish their photographs in this book.

I would like to thank Deborah DeGuire for assistance with preparation of the manuscript and Mary Hambright for her assistance with procuring photographs.

I am grateful to Marcia Stuursma and Deborah DeGuire for their friendship and support and serving as my ambassador to patients and colleagues over an interval that spans nearly my entire professional career.

I am most grateful to Kathy Herman for her unfailing optimism and unflinching support and for never considering a task too great or too small to perform. I would like to thank Lily Wu for providing excellent nursing care and being such a successful liaison to my patients.

A special thank you goes to James Bruce for his friendship. Mr. Bruce has assisted me for many years by preparing hundreds of photographs and video clips used in all of the lectures that I have prepared and books I have published.

I would like to thank Fred Bobrow for editing the videos that accompany this book.

I thank Timothy M. Johnson, MD, director of dermatological surgery at the University of Michigan, and his colleagues Darius J. Karimipour, MD; Christopher K. Bichakjian, MD; Jennifer L. Schwartz, MD; Sandra C. Paek, MD; Marcus Frohm, MD; and Jeffrey S. Orringer, MD. Thank you all for referral of your patients throughout the many years we have been professionally associated. Without your support and trust, this book would not have been possible.

I am appreciative of the assistance provided to me in the filming of the video clips by my fellows Deirdre S. Leake, MD; Jeffrey S. Moyer, MD; and Wael K. Abdel-Hamid, MD.

I would like to thank all of the authors of this textbook for devoting hundreds of hours toward the preparation of their chapters. The quality of this textbook is directly related to your contributions.

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SECTION I

FUNDAMENTALS

CHAPTER 1

ANATOMY OF THE SKIN

Marcus L. Frohm • Alison B. Durham • Christopher K. Bichakjian • Timothy M. Johnson

INTRODUCTION

The skin is a complex organ system that is essential for all forms of mammalian life. It may be viewed as a double-layered sheath, cushioned by the underlying subcutaneous adipose tissue, that covers the entire surface of the body. The outer layer of skin, known as the epidermis, is separated from the inner layer, or dermis, by the basement membrane zone. The dermis is attached to the subcutaneous adipose tissue and underlying musculature by fibrous insertions. Important structures, such as epidermal appendages (hair follicles, sebaceous glands, and sweat glands), nerves, blood vessels, and immunologic cells, are present in the skin (Fig. 1-1). As an organ system, the skin has many important physiologic and immunologic properties: it provides a barrier to the environment, regulates body temperature, and serves as an important component of the immune system.[1-3]

A complete understanding of anatomy is the cornerstone of surgery. Moreover, an awareness of cutaneous anatomy is essential for a full appreciation of the human body's functional, social, and aesthetic relationship with its environment. The purpose of this chapter is to provide a basic knowledge of the normal anatomy of the skin. Possession of such knowledge will rebut the allegations of those who purport that most surgeons cannot tell the difference between the epidermis and the dermis yet cut through these layers on a daily basis.

GENERAL CHARACTERISTICS

Skin is highly variable from one person to another and, within the same individual, from one anatomic region to another, with differences to be observed in color, texture, thickness, and content of hair follicles and sebaceous glands. Skin may be divided into smooth, non–hair-bearing (glabrous) and hair-bearing (nonglabrous) areas, although it is virtually always hair-bearing. Skin is the heaviest human organ, weighing approximately 3.8 kg. The largest organ in surface area, the lung, measures about 4.2 m^2 on expiration; in comparison, the skin measures approximately 1.7 m^2 in surface area. As a tissue, skin ranks fourth in weight behind muscle, adipose tissue, and bone.[4]

Considerable variation in skin thickness and content of appendages and elastic fibers exists with respect to anatomic region, age, and sex. An appreciation of these variations is clinically important for understanding wound healing and aesthetics. These variations play an integral role in the definition of facial aesthetic regions, boundaries, and junctions. The surgeon must apply knowledge of these factors to the task of determining the best reconstructive option during flap or graft surgery. Careful examination of the skin is essential for making the best tissue match for aesthetic reconstruction. Discrepancies in the thickness of skin edges should be observed before wound closure for exact reapproximation of the edges. The best donor site for a full-thickness skin graft is determined by an examination of all potential donor sites with respect to skin thickness, color, texture, and content of hair follicles and sebaceous glands. Careful examination of the skin before surgery may uncover several clues that could influence the outcome. Individuals with fair skin, light hair, and blue eyes may develop postoperative scars that remain pink for an extended period. Persons with dark skin, hair, and eyes may develop scars that remain pigmented for a prolonged period after surgery. An assessment of previous scars and keloids should be made. Individuals with hyperelastic skin features are characterized by hyperextensibility of the joints (elbows, wrists, and knees), anterior hooding of the navel, and lax skin (Figs. 1-2 to 1-4). These individuals are at higher risk for development of wide scars, permanent railroad tracking suture marks, hypertrophic scars, and prolonged erythema of the scars lasting up to 1 year, eventually resulting in a porcelain-colored white scar. Whereas it is also present in Ehlers-Danlos syndrome, hyperelastic skin is most often simply a relatively common normal variant within the population. Patients with common skin conditions, such as atopic dermatitis, psoriasis, and unusually dry skin, may have high counts of staphylococcal organisms on their skin and thereby increased risk of wound infections. In essence, basic knowledge of skin anatomy is something that is applied daily in reconstructive surgery.

EPIDERMIS

The epidermis, the outermost layer of the skin, is a continually renewing, keratinizing, stratified, squamous epithelium. All epidermal appendages, including hair follicles, sebaceous glands, and eccrine and apocrine sweat glands, derive from this layer. The epidermis consists of four distinct cell types: keratinocytes, melanocytes, Langerhans cells, and Merkel cells. The predominant cell type is the keratinocyte, which constitutes at least 80% of epidermal cells. Four clearly defined layers are identified

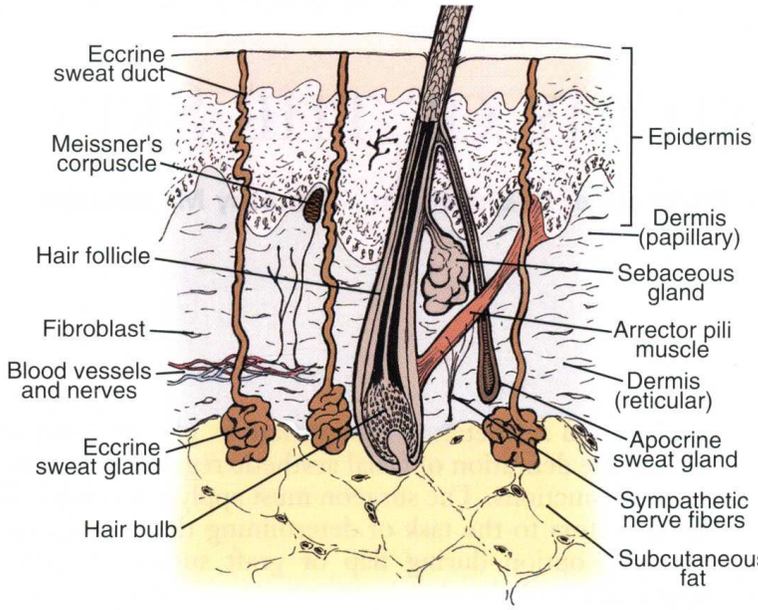

FIGURE 1-1 ■ Schematic vertical cross section of skin.

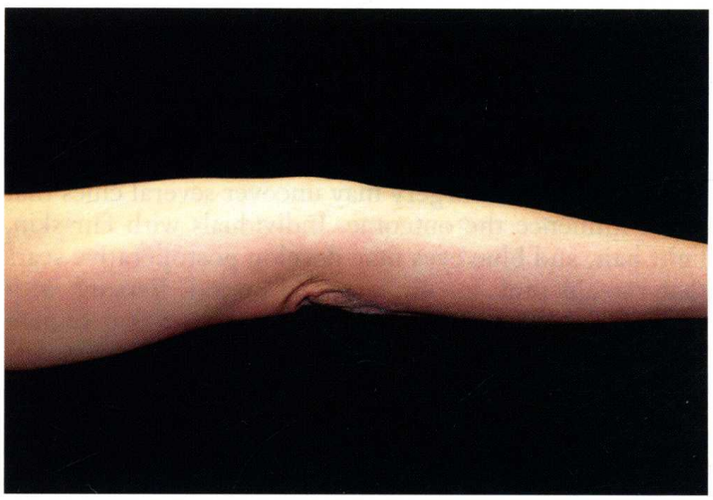

FIGURE 1-2 ■ Hyperextensibility of elbow in a healthy 28-year-old woman with hyperelastic skin features.

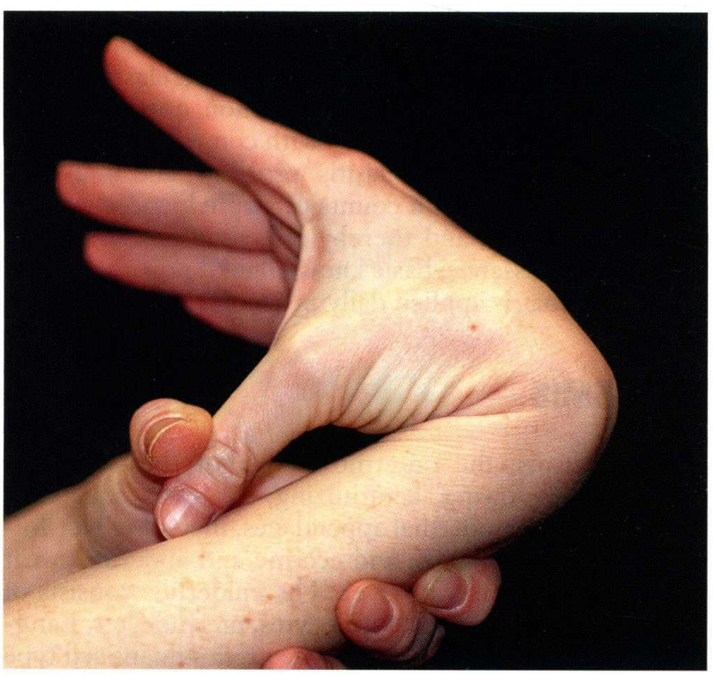

FIGURE 1-3 ■ Hyperextensibility of wrist in a healthy 36-year-old woman with hyperelastic skin features.

in the epidermis (Fig. 1-5): basal layer (stratum germinativum), spinous layer (stratum spinosum), granular layer (stratum granulosum), and cornified layer (stratum corneum). The basal layer is the deepest layer in the epidermis. It is composed of a single germinative layer of columnar-shaped keratinocytes that attach to the basement membrane zone and give rise to the more superficial epidermal layers. The next layer, the spinous layer, is several cells thick and composed of polygonal cells with abundant eosinophilic cytoplasm. Small spiny desmosomal attachments between the spinous cells are evident under light microscopy. As the spinous cells migrate superficially and differentiate into granular cells, they become larger and flatter. The granular layer, usually one to four cells thick, is composed of cells with deeply basophilic keratohyalin granules. Further maturation occurs in the outermost stratum corneum, which is highly variable in thickness. In this layer, keratinocytes lose their nuclei and flatten to form plates of keratin, which are shed as "dead skin." The stratum corneum is thickest on the palms and soles and thinnest on the eyelids and genitalia.

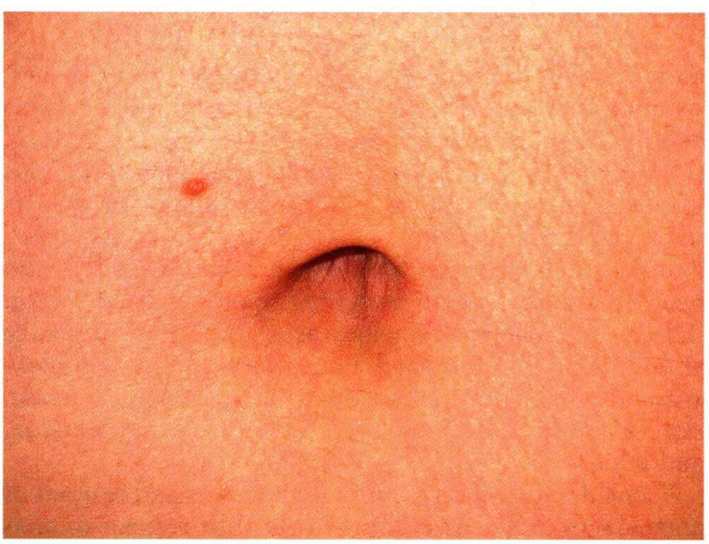

FIGURE 1-4 ■ Anterior hooding of navel in a healthy 30-year-old woman with hyperelastic skin features.

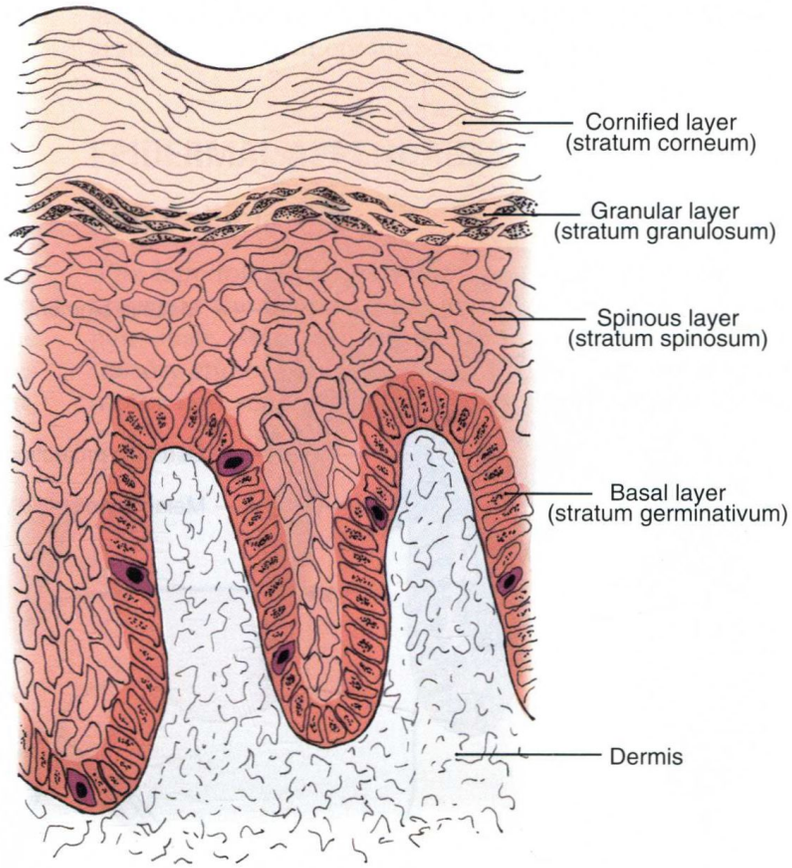

FIGURE 1-5 ■ Layers of epidermis.

Total epidermal turnover time from the basal layer to the stratum corneum is approximately 30 days. The thickness of the epidermis is generally about 0.075 to 0.15 mm. The epidermis is thin at birth, becomes thicker during puberty and early adulthood, and thins in the fifth and sixth decades of life.[1,3]

Melanocytes

Melanocytes are dendritic, pigment-synthesizing cells of neural crest origin with clear cytoplasm confined to the basal layer. The ratio of melanocytes to basal cells ranges from 1 : 4 on the cheek to 1 : 10 on the limbs. The function of melanocytes is to produce protective melanin pigment. Melanin is packaged in the form of melanosomes, which are transported through stellate dendritic projections to a group of adjacent keratinocytes in the basal and spinous layers (epidermal melanin unit). The keratinocytes engulf the melanosomes and arrange the pigment in an umbrella-like distribution over the nuclei, protecting them from potentially harmful ultraviolet irradiation (Fig. 1-6). This partly explains why people with less pigmentation are at greater risk for development of cutaneous malignant neoplasms, such as basal cell carcinoma, squamous cell carcinoma, and melanoma.[5,6] The number of melanocytes does not differ between races. The number and size of melanosomes is greater in pigmented skin and accounts for the darker skin color seen in pigmented persons. In vitiligo, melanocytes are completely absent. In albinism, melanocytes are present but lack the enzyme tyrosinase. Without tyrosinase, tyrosine cannot be transformed into melanin. Tyrosinase activity and melanocyte density decrease with age.[7]

Langerhans Cells

Langerhans cells are bone marrow–derived, antigen-processing, and antigen-presenting cells found mainly in the suprabasal epidermal layers. They are, however, not unique to the epidermis and are found in other squamous epithelia and in the normal dermis. In routine histologic preparations, Langerhans cells are pale-staining cells that are difficult to identify and more readily demonstrated with special stains or immunohistochemistry. Like melanocytes, Langerhans cells are characterized by dendritic processes. The cytoplasm, as seen by electron microscopy, contains small racket-shaped structures known as Birbeck or Langerhans cell granules. Langerhans cells are responsible for recognizing and presenting antigens to lymphocytes in the skin and are implicated in the pathologic mechanism underlying allergic contact dermatitis and skin allograft reactions. The number of Langerhans cells decreases after ultraviolet irradiation. This results in a diminished capacity for immune surveillance, which may play a role in cutaneous carcinogenesis. The number of Langerhans cells also decreases with age.[8]

Merkel Cells

Merkel cells are neuroendocrine cells of epidermal origin that function as slow-adapting mechanoreceptors primarily concerned with touch sensation.[9,10] They are

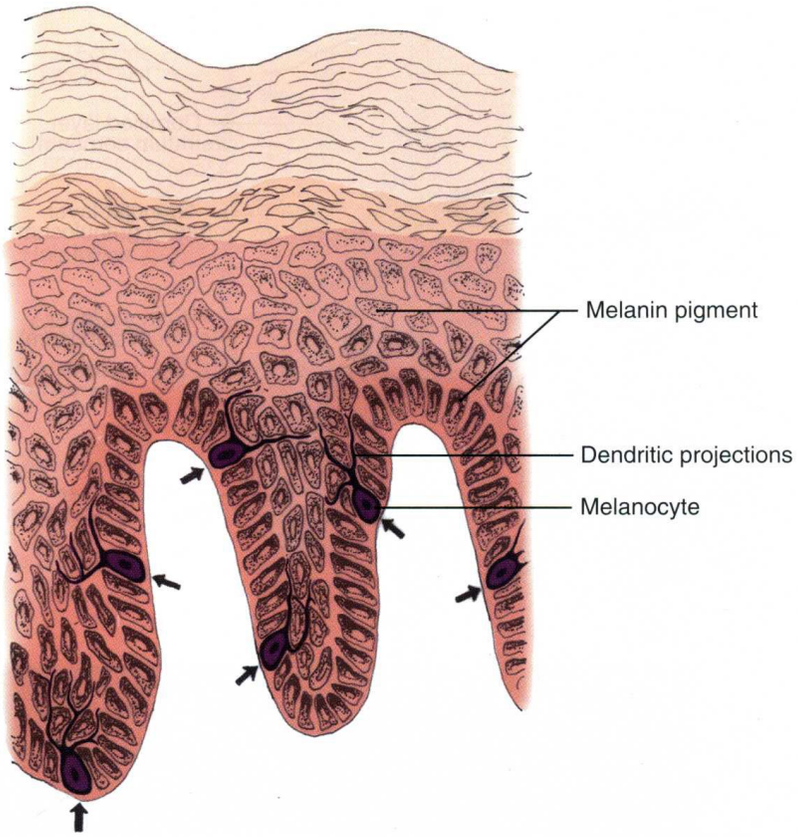

FIGURE 1-6 ■ Melanocytes in basal layer *(arrows)* project stellate, dendritic processes to surrounding keratinocytes in basal and spinous layers (epidermal melanin unit). Note umbrella-like distribution of melanin pigment over keratinocyte nuclei.

predominantly found among basal keratinocytes in areas of high tactile sensitivity, such as the lips, digits, oral cavity, and hair follicles. At these sites, Merkel cells often aggregate in specialized structures, called tactile disks or touch domes, in close association with peripheral nerve endings to form the Merkel cell–neurite complex. Merkel cells, like Langerhans cells, are difficult to identify in light microscopy without the use of immunohistochemical markers. Ultrastructurally, Merkel cells are characterized by membrane-bound, dense-core granules. These granules are similar to the neurosecretory granules found in neurons and contain neurotransmitter-like substances and markers of neuroendocrine cells. Merkel cell carcinoma, or cutaneous neuroendocrine carcinoma, most likely arises from epidermal Merkel cells.[11]

DERMAL-EPIDERMAL JUNCTION

The epidermis is attached to the dermis by a basement membrane zone known as the dermal-epidermal junction (Fig. 1-7).[12] By light microscopy, the dermal-epidermal junction is identified as a thin pink band that stains positive with periodic acid–Schiff stain. This complex zone provides mechanical support to the epidermis and acts as a semipenetrable barrier to chemicals and other

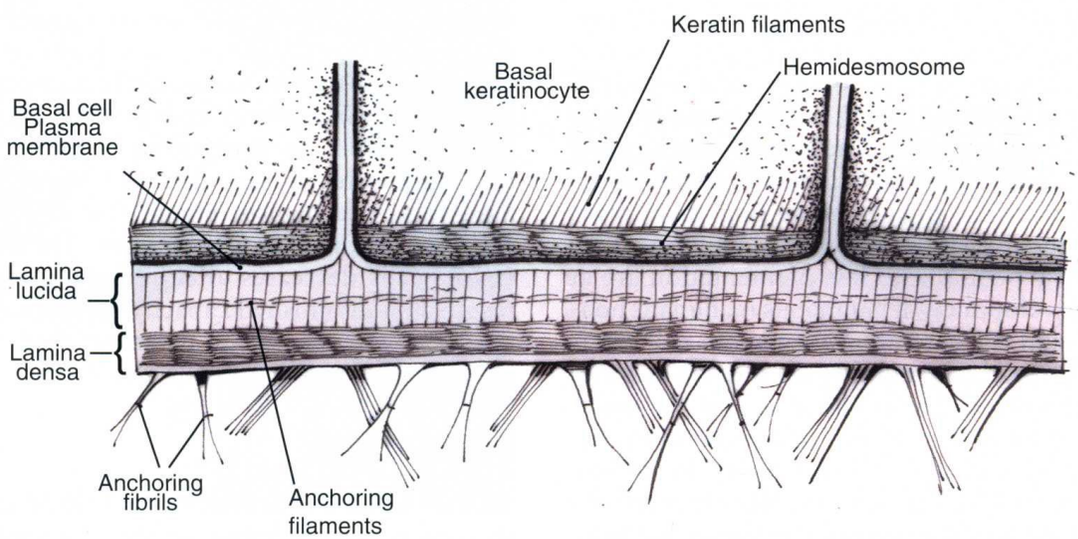

FIGURE 1-7 ■ Dermal-epidermal junction.

substances. Keratin filaments within the basal keratinocyte condense and attach to an electron-dense plaque at the inferior aspect of the cell membrane, known as the hemidesmosome. The hemidesmosomes are firmly anchored to the underlying lamina densa through connecting anchoring filaments in the lamina lucida. The lamina densa is attached to anchoring plaques in the underlying dermis by anchoring fibrils and elastic fibers. Anchoring fibrils, mainly composed of type VII collagen, are degraded by collagenases and are absent in new scars. The importance of the dermal-epidermal junction can be surmised from a variety of inherited and acquired diseases of the skin in which different components are absent, altered, or destroyed, resulting in dermal-epidermal separation, such as in epidermolysis bullosa.[13]

EPIDERMAL APPENDAGES

Hair Follicle

The hair follicle is the main component of a structure known as the pilosebaceous unit, which also includes the hair shaft, sebaceous gland, arrector pili muscle, and sensory end organ (Fig. 1-8). The pilosebaceous unit has motor and sensory functions and is responsible for the

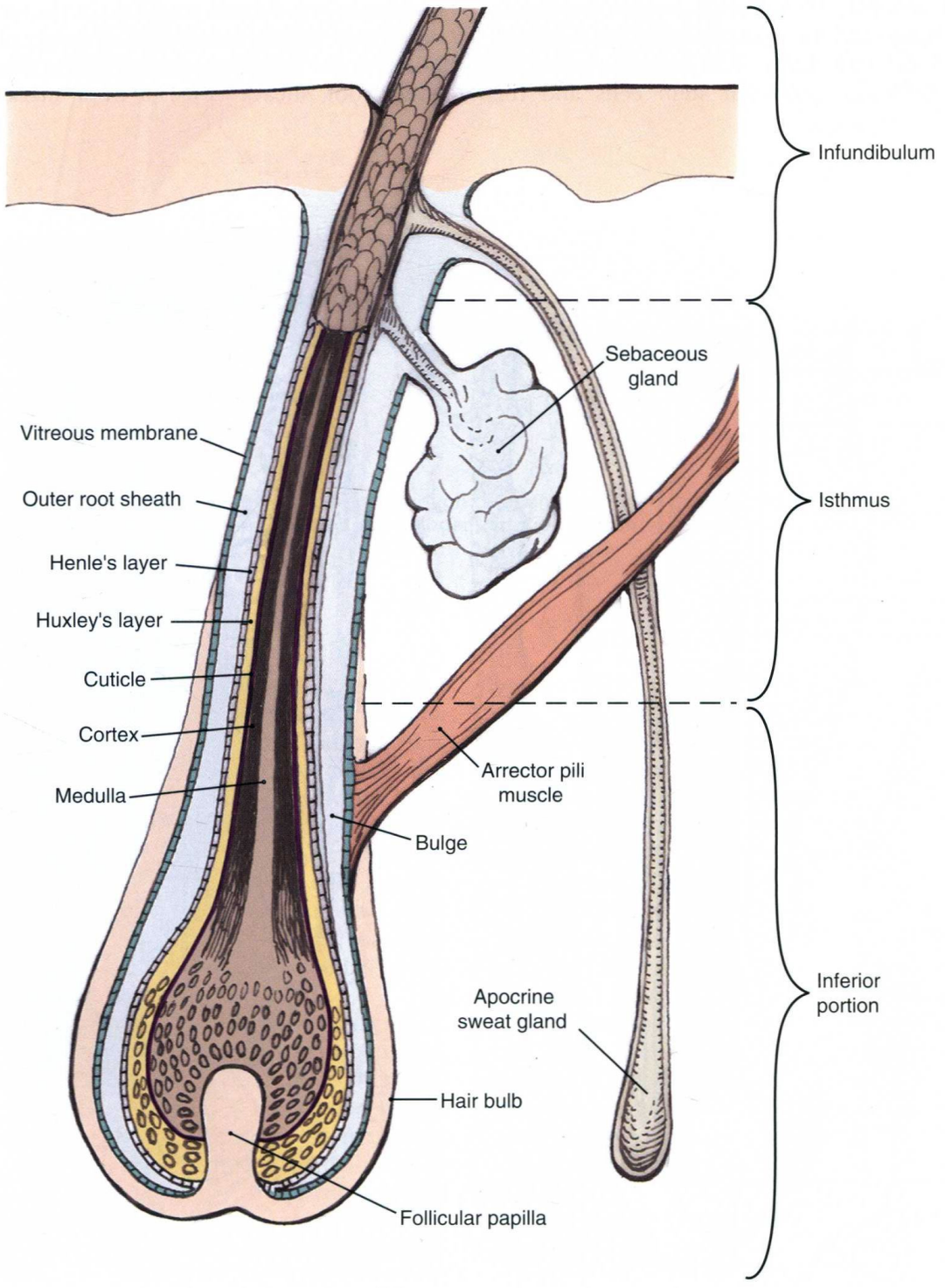

FIGURE 1-8 ■ Pilosebaceous unit.