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PRINCIPLES OF DERMATOLOGY

FIFTH EDITION

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Introduction 1

Key Points

1. Many outpatient visits are for dermatologic complaints
2. The patient's chief complaint can be divided into two diagnostic skin diseases: growths and rashes

Skin diseases are common and a significant number of outpatient visits are for dermatologic complaints. A minority of these patients are seen by dermatologists; most of the remainder are seen by primary care physicians and physician extenders. In a survey of the family practice clinic at the Pennsylvania State University College of Medicine, we found that dermatologic disorders constituted 8.5% of diagnoses. The incidence is higher in a pediatric practice, in which as many as 30% of children are seen for skin-related conditions.

Although thousands of skin disorders have been described, only a small number account for most patient visits. The primary goal of this text is to familiarize the reader with these common diseases. Some uncommon and rare skin disorders are covered briefly in this book to expand the readers' differential diagnosis.

Our diagnostic approach divides skin diseases into two large groups: growths and rashes. This grouping is based on both the patient's presenting complaint (often a concern about either a skin growth or a symptom from a rash) and the pathophysiologic process (a growth represents a neoplastic change and a rash is an inflammatory reaction in the skin).

Growths and rashes are then subdivided according to the component of skin that is affected. Growths are divided into: epidermal, pigmented, and dermal proliferative processes. Rashes are divided into those with and those without an epidermal component. Furthermore, the correlation between the clinical appearance of the disorder and the pathophysiologic processes responsible for the disease facilitates making the diagnosis and selecting the proper treatment.

2 Structure and Function of the Skin

Chapter Contents

Key Points

1. The major function of the skin is as a barrier to maintain internal homeostasis
2. The epidermis is the major barrier of the skin

ABSTRACT

The skin is a large organ, weighing an average of 4 kg and covering an area of 2 m^2. Its major function is to act as a barrier against an inhospitable environment – to protect the body from the influences of the outside world. The importance of the skin is well illustrated by the high mortality rate associated with extensive loss of skin from burns.

The major barrier is provided by the epidermis. Underlying the epidermis is a vascularized dermis that provides support and nutrition for the dividing cells in the epidermis. The dermis also contains nerves and appendages: sweat glands, hair follicles, and sebaceous glands. Nails are also considered skin appendages. The third and deepest layer of the skin is the subcutaneous fat. The functions of all these components are listed in **Table 2.1**.

Components of skin:

1. Epidermis
2. Dermis
3. Skin appendages
4. Subcutaneous fat

Skin disease illustrates structure and function. Loss of or defects in skin structure impair skin function. Skin disease is discussed in more detail in the other chapters.

EPIDERMIS

Key Points

1. Keratinocytes are the principal cell of the epidermis
2. Layers in ascending order: basal cell, stratum spinosum, stratum granulosum, stratum corneum
3. Basal cells are undifferentiated, proliferating cells
4. Stratum spinosum contains keratinocytes connected by desmosomes
5. Keratohyalin granules are seen in the stratum granulosum
6. Stratum corneum is the major physical barrier
7. The number and size of melanosomes, not melanocytes, determine skin color
8. Langerhans cells are derived from bone marrow and are the skin's first line of immunologic defense
9. The basement membrane zone is the substrate for attachment of the epidermis to the dermis
10. The four major ultrastructural regions include: the hemidesmosomal plaque of the basal keratinocyte, lamina lucida, lamina densa, and anchoring fibrils located in the sublamina densa region of the papillary dermis

The epidermis is divided into four layers, starting at the dermal junction with the basal cell layer and eventuating at the outer surface in the stratum corneum. The dermal side of the epidermis has an irregular contour. The downward projections are called *rete ridges*, which appear 3-dimensionally as a Swiss cheese-like matrix with the holes filled by dome-shaped dermal papillae. This configuration helps to anchor the epidermis physically to the dermis. The pattern is most pronounced in areas subject to maximum friction, such as the palms and soles.

The cells in the epidermis undergo division and differentiation. Cell division occurs in the basal cell layer, and differentiation in the layers above it.

Cell division occurs in the basal cell layer.

TABLE 2.1 Skin functions

Function	Responsible Structure
Barrier	Epidermis
Physical	Stratum corneum
Light	Melanocytes
Immunologic	Langerhans cells
Tough flexible foundation	Dermis
Temperature regulation	Blood vessels Eccrine sweat glands
Sensation	Nerves
Grasp	Nails
Decorative	Hair
Unknown	Sebaceous glands
Insulation from cold and trauma	Subcutaneous fat
Calorie reservoir	Subcutaneous fat

STRUCTURE

Basal Cell Layer

The basal cells can be considered the 'stem cells' of the epidermis. They are the undifferentiated, proliferating cells. Daughter cells from the basal cell layer migrate upward and begin the process of differentiation. In normal skin, cell division does not take place above the basal cell layer. It takes about 2 weeks for the cells to migrate from the basal cell layer to the top of the granular cell layer, and a further 2 weeks for the cells to cross the stratum corneum to the surface, where they finally are shed. Injury and inflammation increase the rate of proliferation and maturation (Fig. 2.1).

Stratum Spinosum

This layer lies above the basal layer and is composed of *keratinocytes*, which differentiate from the basal cells beneath them. The keratinocytes produce keratin, a fibrous protein that is the major component of the horny stratum corneum. The stratum spinosum derives its name from the 'spines,' or intercellular bridges, that extend between keratinocytes and are visible with light microscopy. Ultrastructurally, these are composed of desmosomes, which are extensions from keratin within the keratinocyte; functionally, they hold the cells together (Fig. 2.2).

Keratinization begins in the stratum spinosum.

Stratum Granulosum

The process of differentiation continues in the stratum granulosum, or granular cell layer, in which the cells acquire additional keratin and become more flattened. In addition, they contain distinctive dark granules, seen easily on light microscopy, that are composed of keratohyalin. Keratohyalin contains two proteins, one of which is called profilaggrin, the precursor to filaggrin. As its name suggests, filaggrin plays an important role in the aggregation of keratin filaments in the stratum corneum. The other protein is called *involucrin* (from the Latin for 'envelope'), and plays a role in the formation of the cell envelope of cells in the stratum corneum. Ichthyosis vulgaris (*ichthys*, Greek for 'fish') is an inherited dry skin condition secondary to deficient filaggrin production, as noted on light microscopy of a skin biopsy by a reduced or absent granular layer (Fig. 2.3).

Granular cells also contain lamellar granules, which are visualized with electron microscopy. Lamellar granules contain polysaccharides, glycoproteins, and lipids that extrude into the intercellular space and ultimately are thought to help form the 'cement' that holds together the stratum corneum cells. Degradative enzymes also are found within the granular cells; these are responsible for the eventual destruction of cell nuclei and intracytoplasmic organelles.

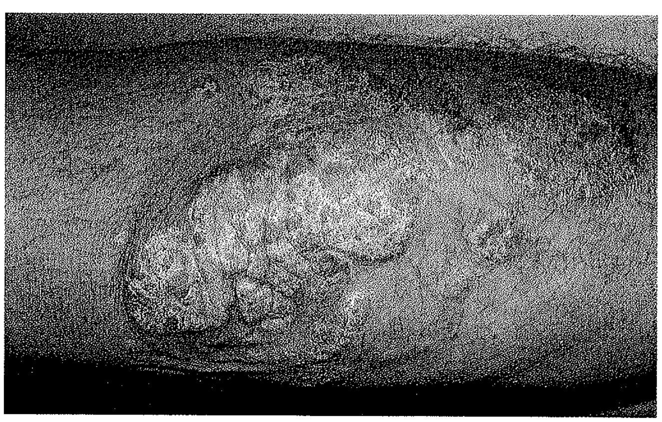


FIGURE 2.1 Psoriasis – an autoimmune disorder characterized by thickened epidermis and increased scale.

FIGURE 2.2 Pemphigus vulgaris – an autoimmune blistering disease wherein antibodies directed against desmosomes result in keratinocyte separation in stratum spinosum.

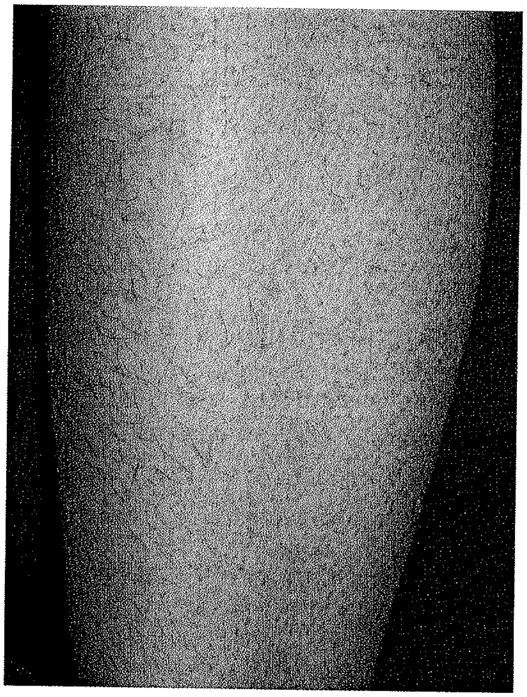


FIGURE 2.3 **Ichthyosis vulgaris** – a common autoimmune inherited dry skin condition secondary to deficient filaggrin production. Note 'fish-like' scale on the anterior shin.

Granular cells contain keratohyalin and lamellar granules.

Stratum Corneum

A remarkably abrupt transition occurs between the viable, nucleated cells at the top of the granular cell layer and the dead cells of the stratum corneum (Fig. 2.4). The cells in the stratum corneum are large, flat, polyhedral, plate-like envelopes filled with keratin. They are stacked in vertical layers that range in thickness from 15 to 25 layers on most body surfaces to as many as 100 layers on the palms and soles. The cells are held together by a lipid-rich cement in a fashion similar to 'bricks and mortar.' The tightly packed, keratinized envelopes in the stratum corneum provide a semi-impenetrable layer that constitutes the major physical barrier of the skin.

The stratum corneum is the major physical barrier.

The epidermis, then, is composed of cells that divide in the basal cell layer (basal cells), keratinize in the succeeding layers (keratinocytes), and eventuate into the devitalized, keratin-filled cells in the stratum corneum.

OTHER CELLULAR COMPONENTS

In addition to basal cells and keratinocytes, two other cells are located in the epidermis: melanocytes and Langerhans cells.

Melanocytes

Melanocytes are dendritic, pigment-producing cells located in the basal cell layer (**Figs 2.4, 2.5**). They protect the skin from ultraviolet radiation. Individuals with little or no pigment develop marked sun damage and numerous skin cancers. The dendrites extend into the stratum spinosum and serve as conduits, through which pigment granules are transferred to their neighboring keratinocytes. The granules are termed *melanosomes*, and the pigment within is melanin, which is synthesized from tyrosine. Melanosomes are preferentially situated above the nucleus to protect the DNA.

People of all races have a similar number of melanocytes. The difference in skin pigmentation depends on (1) the number and size of the melanosomes and (2) their dispersion in the skin. In darkly pigmented skin, melanosomes are larger in size and more numerous compared with melanosomes in lightly pigmented skin. Sunlight stimulates melanocytes to increase pigment production and disperse their melanosomes more widely.

Langerhans Cells

Langerhans cells are dendritic cells in the epidermis that have an immunologic function (**Fig. 2.4**). They are derived from the bone marrow and constitute about

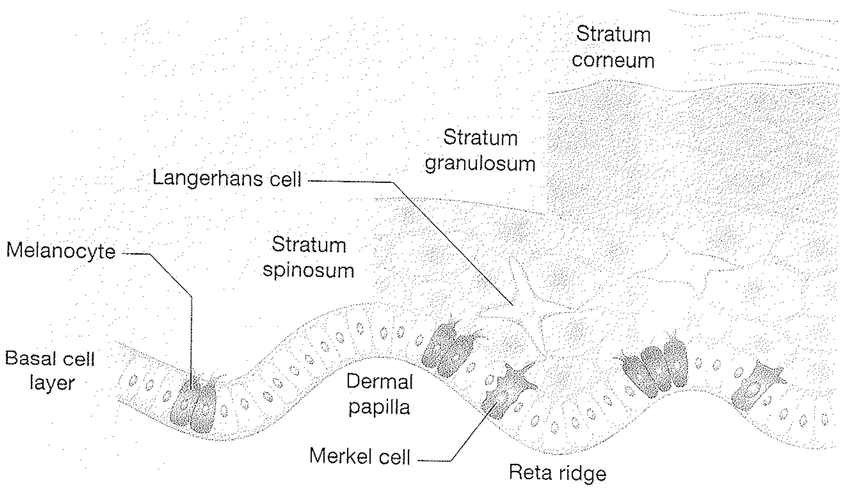


FIGURE 2.4 **Epidermis.**

FIGURE 2.5 **Vitiligo** – an autoimmune disease that results in loss of melanocytes.

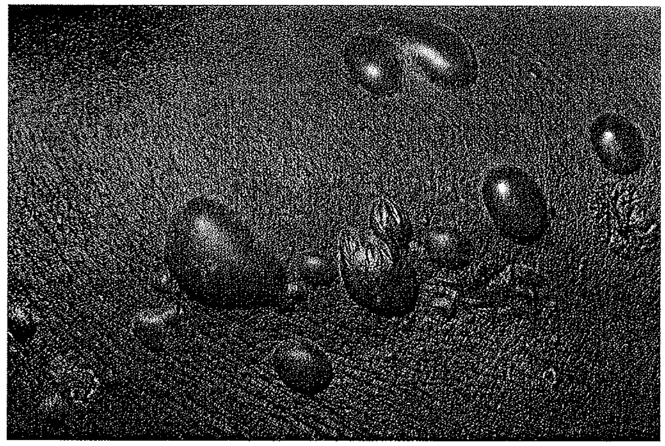


FIGURE 2.6 **Bullous pemphigoid** – the most common autoimmune blistering disease in the elderly secondary to immune disruption of the hemidesmosome. Note bullae on inner thigh, a characteristic location.

5% of the cells within the epidermis. On electron microscopic examination, characteristic 'tennis racket'-shaped granules are seen. Langerhans cells are identical to tissue macrophages and present antigens to lymphocytes, with which they interact through specific surface receptors. As such, Langerhans cells are important components of the immunologic barrier of the skin.

Langerhans cells are the first line of immunologic defense in the skin.

Merkel Cells

Merkel cells are located in the basal cell layer. They are more numerous on the palms and soles and are connected to keratinocytes by desmosomes. Merkel cells function as mechanoreceptors. Merkel cell carcinoma is a rare skin cancer with a high mortality rate, as discussed in Chapter 5.

DERMAL–EPIDERMAL JUNCTION – THE BASEMENT MEMBRANE ZONE

The interface between the epidermis and dermis is called the *basement membrane zone*. With light microscopy, it is visualized only as a fine line. However, electron microscopic examination reveals four regions: (1) keratin filaments in the basal keratinocytes attach to hemidesmosomes (electron-dense units), which in turn attach to anchoring filaments in (2) the *lamina lucida*. The lamina lucida is a relatively clear (lucid) zone traversed by delicate anchoring filaments that connect hemidesmosome of basal cells to (3) the *lamina densa*; the lamina densa is an electron-dense zone composed primarily of type IV collagen derived from epidermal cells and (4) *anchoring fibrils*, which are thick fibrous strands, composed of type VII collagen, and located in the sublamina densa region of the papillary dermis. The basement membrane zone serves as the 'glue' between the epidermis and dermis, and is the site of blister formation in numerous diseases (Fig. 2.6). Hence, its structure, composition, and immunologic make-up continue to be investigated intensely.

DERMIS

Key Points

1. Provides structural integrity and is biologically active
2. The primary components of the dermal matrix are collagen, elastin, and extrafibrillar matrix
3. Collagen is the principal component of the dermis and represents 70% of skin's dry weight

The dermis is a tough, but elastic, support structure that contains blood vessels, nerves, and cutaneous appendages. It provides structural integrity and is biologically active by interacting and regulating the functions of cells (i.e., tissue regeneration). The dermis ranges in thickness from 1 to 4 mm, making it much thicker than the epidermis, which in most areas is only about as thick as this piece of paper (Fig. 2.7). The dermal matrix is composed primarily of collagen fibers (principal component), elastic fibers, and ground substance (now called extrafibrillar matrix), which are synthesized by dermal fibroblasts. Collagen accounts for 70% of the dry weight of skin. Collagen and elastic fibers are fibrous proteins that form the strong, yet compliant skeletal matrix. In the uppermost part of the dermis (papillary dermis), collagen fibers are fine and loosely arranged. In the remainder of the dermis (reticular dermis), the fibers are thick and densely packed (Fig. 2.8). Elastic fibers are located primarily in the reticular dermis, where they are thinner and more loosely arranged than collagen fibers. The extrafibrillar matrix fills the space between fibers. It is a non-fibrous material made up of several different mucopolysaccharide molecules, collectively called proteoglycans or glycosaminoglycans. The extrafibrillar matrix imparts to the dermis a more liquid quality, which facilitates movement of fluids, molecules, and inflammatory cells.

Structural components of the dermis:
1. Collagen
2. Elastic fibers
3. Extrafibrillar matrix

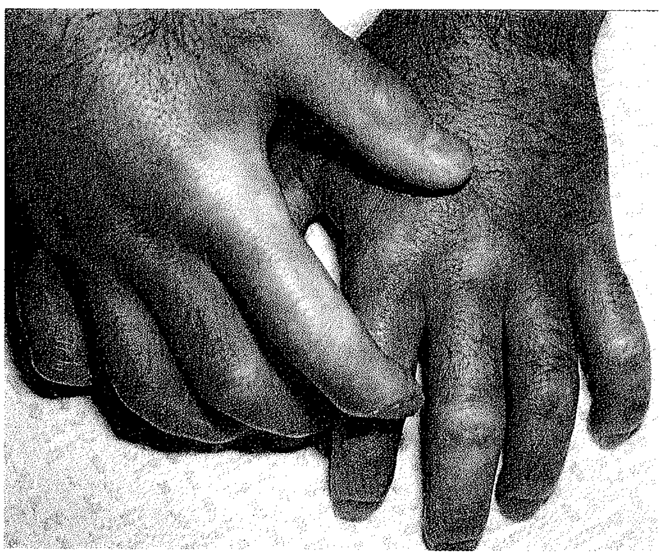


FIGURE 2.7 Systemic scleroderma – an increase in the number and activity of fibroblasts produces excessive collagen and results in dermal thickening.

Nerves and blood vessels course through the dermis, and a layer of subcutaneous fat lies below it (Fig. 2.9).

Free nerve endings are the most important sensory receptors.

Nerves

The skin is a major sensory receptor. Without the sensations of touch, temperature, and pain, life would be less interesting and more hazardous. Sensations are detected in the skin by both free nerve endings and more complicated receptors that are corpuscular in structure. The free nerve endings are the more widespread and appear to be more important. The nerve supply of the skin is

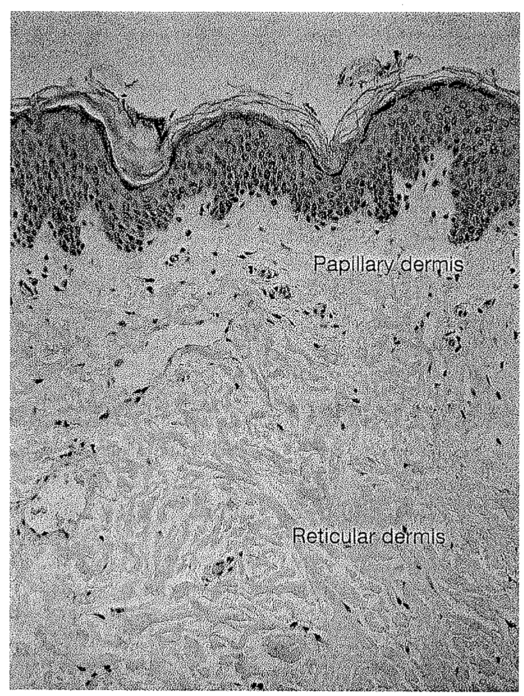


FIGURE 2.8 Papillary dermis – fine and loose collagen strands. Reticular dermis – thick and dense collagen strands.

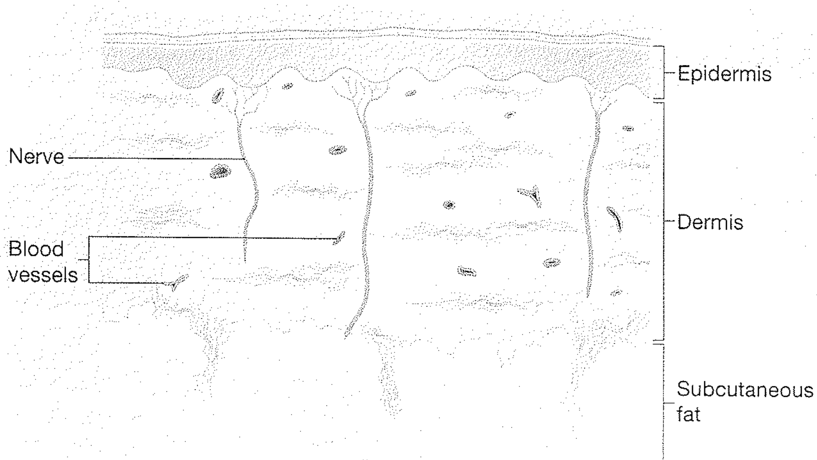


FIGURE 2.9 Dermis and subcutaneous fat.

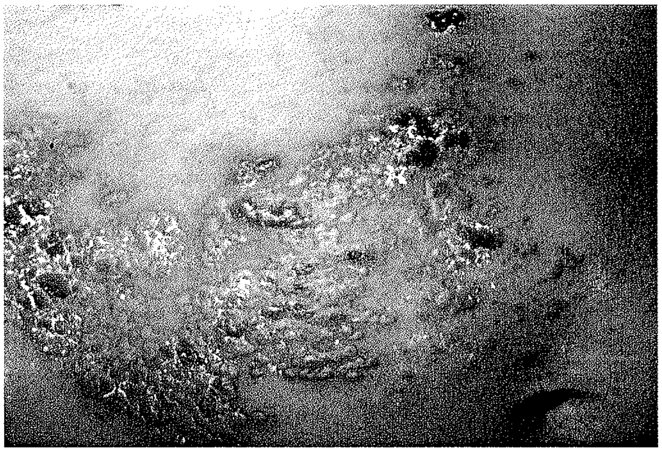


FIGURE 2.10 Herpes zoster – reactivation of varicella-zoster virus in sensory nerve ganglia results in a painful, vesicular, dermatomal eruption.

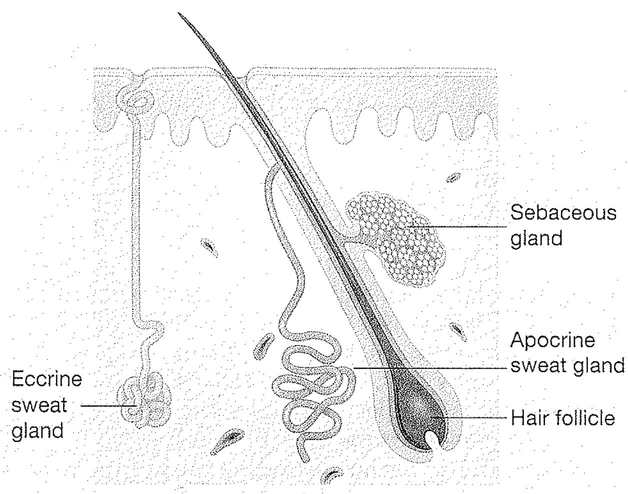


FIGURE 2.11 Sweat gland, apocrine gland, and hair follicle with sebaceous gland.

segmental (dermatomal), with considerable overlap between segments (**Fig. 2.10**).

Blood Vessels

The blood vessels in the skin serve two functions: nutrition and temperature regulation. The epidermis has no intrinsic blood supply and therefore depends on the diffusion of nutrients and oxygen from vessels in the papillary dermis. Blood vessels in the dermis also supply the connective tissue and appendageal structures located therein.

Functions of blood vessels:
1. To supply nutrition
2. To regulate temperature

The vasculature of the skin is arranged into two horizontal plexuses that are interconnected. The superficial plexus is located at the lower border of the papillary dermis, and the deep plexus is located in the reticular dermis. Temperature regulation is achieved through shunts between the plexuses. Increased blood flow in the superficial plexus permits heat loss, whereas shunting of blood to the deep plexus conserves heat.

SKIN APPENDAGES

Key Points

1. Eccrine glands help to regulate body temperature
2. Apocrine sweat glands depend on androgens for their development
3. The stem cells of the hair follicle reconstitute the non-permanent portion of the cycling hair follicle
4. Sebaceous glands are under androgen control
5. Nails, like hair, are made of keratin

The skin appendages are the eccrine and apocrine sweat glands, hair follicles, sebaceous glands, and nails. They are epidermally derived but, except for nails, are located in the dermis.

Eccrine Sweat Glands

For physically active individuals and for people living in hot climates, the eccrine sweat glands are physiologically the most important skin appendage. They are activated by emotional and thermal stimuli. Cholinergic innervation is responsible for physiologic eccrine secretion. Botulinum toxin type A (Botox) injected intradermally can treat axillary hyperhidrosis by blocking acetylcholine action. Eccrine sweat glands help to regulate body temperature by excreting sweat onto the surface of the skin, from which the cooling process of evaporation takes place. Two to three million eccrine sweat glands are distributed over the entire body surface, with a total secretory capacity of 10 L of sweat per day. The secretory portion of the sweat apparatus is a coiled tubule located deep in the dermis. The sweat is transported through the dermis by a sweat duct, which ultimately twists a path through the epidermis (**Fig. 2.11**). Sweat secreted in the glandular portion is isotonic to plasma but becomes hypotonic by the time it exits the skin as a result of ductal reabsorption of electrolytes. Hence, the sweat apparatus is similar to the mechanism in the kidney, that is, glandular (glomerular) excretion is followed by ductal reabsorption.

Eccrine sweat glands help to regulate temperature and are under cholinergic innervation.

Apocrine Sweat Glands

In humans, apocrine sweat glands are androgen dependent for their development and serve no known useful function, although they are responsible for body odor. The odor actually results from the action of surface skin bacteria on excreted apocrine sweat, which itself is odorless. Apocrine sweat glands are located mainly in the axillary and anogenital areas. The secretory segment of an apocrine gland is also a coiled tubule located deep in the dermis. However, unlike in eccrine glands, in which the secretory cells remain intact, in apocrine glands the secretory cells 'decapitate' their luminal (apical) portions as part of the secretory product (Fig. 2.11). The apocrine duct then drains the secreted sweat into the midportion of a hair follicle, from which it ultimately reaches the skin surface.

Bacterial action on apocrine sweat causes body odor.

Hair Follicle

In most mammals, hair serves a protective function, but in humans it is mainly decorative.

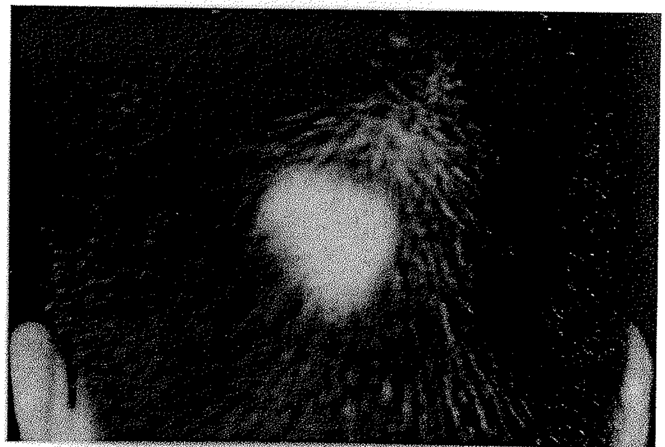
Hair follicles are distributed over the entire body surface, except the palms and soles. Hair comes in two sizes: (1) vellus hairs, which are short, fine, light colored, and barely noticed; and (2) terminal hairs, which are thicker, longer, and darker than the vellus type. Terminal hairs in some locations are hormonally influenced and do not appear until puberty, e.g., beard hair in males, and pubic and axillary hair in both sexes.

Types of hair:
1. Vellus (light and fine)
2. Terminal (dark and thick)

A hair follicle can be viewed as a specialized invagination of the epidermis (Fig. 2.11), with a population of cells at the bottom (hair bulb) that are replicating even more actively than normal epidermal basal cells. These cells constitute the hair matrix. As with basal cells in the epidermis, the matrix cells first divide and then differentiate, ultimately forming a keratinous hair shaft. Melanocytes in the matrix contribute pigment, the amount of which determines the color of the hair. As the matrix cells continue to divide, hair is pushed outward and exits through the epidermis at a rate of about 1 cm per month. Hair growth in an individual follicle is cyclical, with a growth (anagen) phase, a transitional (catagen) phase, and a resting (telogen) phase. The lengths of the phases vary from one area of the body to another. On the scalp, e.g., the anagen phase lasts for about 3 years, the catagen phase for about 3 weeks, and the telogen phase for about 3 months. The length of anagen phase varies from individual to individual, explaining why some persons can grow hair longer than others.

Hair growth cycles through growth (anagen), transitional (catagen), and resting (telogen) phases.

At the end of the anagen phase, growth stops and the hair follicle enters the catagen and telogen phase, during which the matrix portion and lower two-thirds of the hair follicle shrivels and the hair within the follicle is shed. Subsequently, through mesenchymal interaction



[illegible] condition resulting in [illegible]

[illegible] hair matrix is [illegible] and the cycle is [illegible] of scalp hair [illegible] in the telogen [illegible] shedding rate of 25 [illegible]

[illegible] each day.

[illegible] is situated in [illegible] attached arrector [illegible] the hair is [illegible] a 'goose flesh' [illegible] of the hair follicle [illegible] follicle, where the [illegible] follicle. The stem [illegible] the non-permanent [illegible]

[illegible]

[illegible] substance termed [illegible] In fact, the skin [illegible] skin of adults [illegible]

[illegible] *unit* and so [illegible] located. In addition, [illegible] found on mucous [illegible] yellow papules [illegible] glands are [illegible] and are moderately [illegible] The size and secretion [illegible] androgen control. [illegible] enlarged owing [illegible] months, the glands [illegible] in preadolescence [illegible] androgens and reach [illegible] androgens are [illegible]

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FIGURE 2.13 Infantile acne – a common disorder affecting the pilosebaceous unit. Maternal androgens are influential.

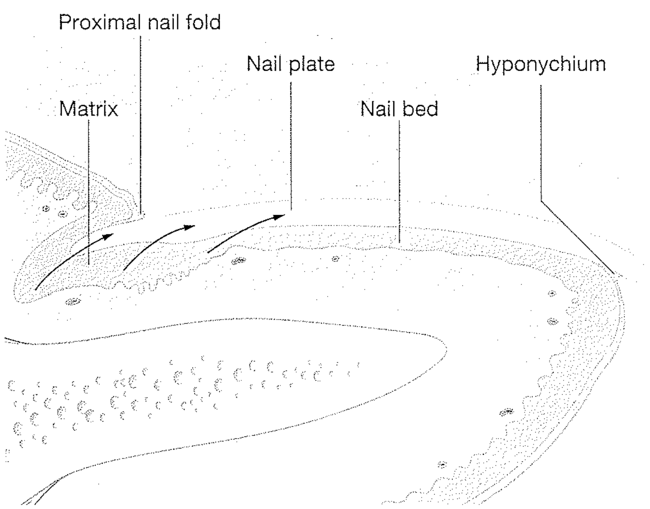

FIGURE 2.14 Normal nail.

FIGURE 2.15 Lichen planus – an inflammatory condition that normally affects the skin and mucous membranes, but can affect the nail matrix and cause dystrophic nails.

FIGURE 2.16 Erythema nodosum. Subcutaneous nodules most commonly seen on shins of women after starting birth control pills which results from inflammation concentrated in the fibrous septa that separate the aggregated fat cells or lobules.

The lipid-laden cells in the sebaceous glands are wholly secreted (holocrine secretion) to form sebum. Triglycerides compose the majority of the lipid found in sebaceous gland cells. From the sebaceous glands, sebum drains into the hair follicle (Fig. 2.11), from which it exits onto the surface of the skin.

Nails

Nails, like hair, are made of keratin, which is formed from a matrix of dividing epidermal cells (Fig. 2.14). Nails, however, are hard and flat, and lie parallel to the skin surface. Located at the ends of fingers and toes, they facilitate fine grasping and pinching maneuvers.

Nail is made of keratin produced in the matrix.

The *nail plate* is a hard, translucent structure composed of keratin. It ranges in thickness from 0.3 to 0.65 mm. Fingernails grow at a continuous rate of about 0.1 mm/day, and toenails at a slightly slower rate.

Four epithelial zones are associated with the nail:

1. The *proximal nail fold* helps to protect the matrix. The stratum corneum produced there forms the cuticle.
2. The *matrix* produces the nail plate from its rapidly dividing, keratinizing cells. Most of the matrix underlies the proximal nail fold, but on some digits (especially the thumb) it extends under the nail plate, where it is grossly visible as the white lunula. The most proximal portion of the matrix forms the top of the nail plate; the most distal portion forms the bottom of the nail plate (Fig. 2.15).

3. The epithelium of the *nail bed* produces a minimal amount of keratin, which becomes tightly adherent to the bottom of the nail plate. The pink color of a nail is due to the vascularity in the dermis of the nail bed.
4. The epidermis of the *hyponychium* underlies the free distal edge of the nail plate. Stratum corneum produced there forms a cuticle to seal the junction of the distal nail bed and nail plate.

SUBCUTANEOUS FAT

A layer of subcutaneous fat lies between the dermis and the underlying fascia. It helps to insulate the body from cold, cushions deep tissues from blunt trauma, and serves as a reserve source of energy for the body. Biologically active fat cells play a role in hormone messaging, as evidenced by metabolic disturbances in obese children and adolescents with peripheral insulin resistance. Within the subcutaneous fat layer, aggregates of fat cells (lipocytes) are separated by fibrous septa that are traversed by blood vessels and nerves (Fig. 2.16).

Subcutaneous fat:
1. Insulates
2. Absorbs trauma
3. Is a reserve energy source
4. Is biologically active

Principles of Diagnosis 3

Chapter Contents

Key Points

1. Morphologic appearance is critical in making the diagnosis
2. Skin diseases can be divided into growths and rashes

ABSTRACT

The approach to a patient with skin disease does not differ markedly from the approach to any other patient. Data are collected from a history and physical examination (and sometimes from the laboratory), a differential diagnosis is generated, and the best diagnosis is selected.

Steps in dermatologic diagnosis:
1. History
2. Physical – identify the morphology of basic lesion
3. Consider clinicopathologic correlations
4. Configuration or distribution of lesions (when applicable)
5. Laboratory tests

In history taking, a modified format is suggested. Instead of beginning with an exhaustive interrogation, it is more efficient to divide the history into a preliminary and a follow-up format. You should sit, face the patient, let the patient talk, listen, show empathy, and then clarify with questions.

The most important part of the physical examination is inspection. Dermatology is a visual specialty, and diagnosis rests heavily on skin inspection. Unfortunately, although the skin is the most visible organ of the body, in a routine physical examination it often is the one most overlooked. Skin lesions need to be looked *for*, not *at*. Just as the examiner hears only the subtle heart sounds for which he or she listens, so will a clinician see on the skin only the lesions for which he or she searches. We need to train our eyes to see the skin lesions before us and ultimately be able to recognize them.

Dermatologic diagnosis depends on the examiner's skill in skin inspection.

We have divided skin disorders into two broad categories: growths and rashes. A *growth* is a discrete lesion resulting from proliferation of one or more of the skin's components. A *rash* is an inflammatory process that usually is more widespread than a growth. For both skin growths and rashes, the most important task is to characterize the clinical appearance of the basic lesion, that is, to identify its morphology. The pathophysiologic processes responsible for the clinical lesion must then be considered. These clinicopathologic correlations are emphasized in the diagnostic approach presented in this book. For skin rashes, important diagnostic information can sometimes also be obtained by noting the manner in which the lesions are arranged or distributed.

After the history and physical examination have been completed, laboratory tests may be indicated. In dermatology, these are usually simple office procedures that can provide valuable information needed either to confirm or to establish a diagnosis in selected disorders.

HISTORY

Key Points

1. Let the patient talk uninterruptedly in the beginning
2. Clarify duration, symptoms, distribution, and prior treatment
3. Expand the history based on the differential diagnosis

In medicine, the traditional approach is to take the history before doing the physical examination. Some dermatologists prefer to reverse this order. We find it most useful to ask questions both before and after the examination. With this approach, a preliminary history is taken, in which several general questions are asked of all patients. Depending on the physical findings, more selective questions may be asked subsequently. For example, a history of sexual contacts would be inappropriate for an 82-year-old invalid complaining of an itching scalp, but would be indicated for a patient with an indurated ulcer on the penis.

PRELIMINARY HISTORY

In addition to its diagnostic value, a preliminary history also helps to establish rapport with the patient. The short-cut of examining the skin without expressing an interest in the person will often be found wanting, especially by the patient. This initial history is composed of two parts that correlate with the chief complaint and the history of the present illness in the standard history format.

The initial history can be abbreviated by asking four general questions:
1. How long?
2. Where affected?
2. Does it itch or other symptoms?
3. How have you treated it?

Chief Complaint

In eliciting the chief complaint, one can often learn much by asking an open-ended question, such as, 'What is your skin problem?' This is followed by four general questions regarding the history of the present illness.

History of the Present Illness

The general questions concern onset and evolution of the condition, distribution, symptoms, and treatment to date.

Onset and Evolution. 'When did it start? Has it gotten better or worse?' Answers to these questions determine the duration of the disorder and how the condition has evolved over time. For most skin conditions, this is important information.

Symptoms. 'Does it bother you?' is an open-ended way of asking about symptoms. For skin disorders, the most common symptom is itching. If the patient does not respond to the general symptom question, you may want to ask specifically, '*Does it itch?*' Questions concerning systemic symptoms (e.g., 'How do you feel otherwise?') are not applicable for most skin diseases and are more appropriately reserved until after the physical examination.

Treatment to Date. The question, 'How have you treated it?' results in an incomplete response from almost all patients. For skin disease, one is particularly interested in learning what topical medications have been applied. Many patients do not consider over-the-counter preparations important enough to mention. The same applies for some systemic medications. Providing the patient with specific examples of commonly used topical and systemic medications, such as calamine lotion and aspirin, may jog a patient's memory enough to recall similar products that they may have used. It is important to inquire about medications, not only because they cause some conditions, but also because they may aggravate many others. For example, contact dermatitis initially induced by poison ivy may be perpetuated by contact allergy to an ingredient in one of the preparations used in treatment.

After the skin examination, one may need to return to the treatment question if any suspicion exists that a medication is causing or contributing to the disorder. Interestingly, a patient often recalls using pertinent medication only when he or she is asked the question again.

Persistence is often required in eliciting a complete medication history.

Finally, at the end of the visit, when one is ready to prescribe medications for the patient, it is helpful to know what medications have already been used. This approach avoids the potentially awkward situation in which a patient replies to your enthusiastic recommendation of your favorite therapy with, 'I've already tried that and it didn't work!'

FOLLOW-UP HISTORY

After the initial history and physical examination, it is hoped that a diagnosis, or at least a differential diagnosis, has been formulated. With a diagnosis in mind, more focused questions may be necessary. This questioning may include obtaining more details about the history of the present illness or may be directed toward eliciting specific information from other categories of the traditional medical history, including past medical history, review of systems, family history, and social history. The following serve only as examples for the use of focused questions.

Past Medical History

After the physical examination, one may want to learn more about the patient's general health. For example, in a patient with suspected herpes zoster, a past history of chickenpox would be of interest. We have discussed how topically applied and systemically administered medications often contribute to skin conditions. Skin findings may encourage further pursuit of these possibilities. For example, in a patient with a generalized erythematous rash or hives, systemic drugs should be high on the list of possible causes. Because drugs can cause virtually any type of skin lesion, it is useful to consider drug eruptions in the differential diagnosis of almost any skin disease. It may also be helpful to ascertain whether the patient has any known allergies, in order to determine whether any medications are currently being used that could produce a cross-reaction.

Drugs can cause all types of skin rash.

Review of Systems

In a patient with a malar rash, a diagnosis of systemic lupus erythematosus should be considered, and the examiner will want to question the patient further for symptoms of additional skin or other organ involvement, including Raynaud's phenomenon, photosensitivity, hair loss, mouth ulcers, and arthritis. In a patient with a generalized maculopapular eruption, the two most common causes are drugs and viruses, so the physician will want to inquire about both medication use and viral symptoms such as fever, malaise, and upper respiratory or gastrointestinal symptoms.

Family History

In certain cutaneous conditions, some knowledge of the family history may help in diagnosis. Innumerable inherited disorders have dermatologic expression. The following serve only as examples:

- In a child with a chronic itching eruption in the antecubital and popliteal fossae, atopic dermatitis is suspected. A positive family history for atopic diseases (atopic dermatitis, asthma, hay fever) supports the diagnosis.
- In a youngster with multiple café-au-lait spots, a diagnosis of neurofibromatosis is considered. A positive family history for this disorder, substantiated by examination of family members, helps to support the diagnosis of this dominantly inherited disease.

Knowledge of the family's present health is also important when considering infectious diseases. For example, impetigo can occur in several family members, and this knowledge may help in considering the diagnosis; it would certainly be important for treatment. Likewise, in a patient with suspected scabies, it is important to know, for both diagnostic and therapeutic purposes, whether other family members are itching.

Social History

In some disorders, knowledge of the patient's social history may be important. For example, a chronic skin ulcer from persistent herpes simplex infection is a sign of immunosuppression, particularly acquired immune deficiency syndrome (AIDS). Therefore, a patient with such an ulceration should be asked about high-risk factors for acquiring AIDS, including sexual behavior, intravenous drug abuse, and exposure to blood products.

For persistent skin infections, consider the possibility of AIDS.

Another common occasion for probing into a patient's social history is when the patient is suspected of having contact dermatitis; this aspect of the social history could be subtitled the *skin exposure history*. Patients encounter potentially sensitizing materials both at work and at play. Industrial dermatitis is a leading cause of workers' disability. For chronic hand dermatitis, questions about occupational exposure are important and should be directed particularly to materials and substances the patient contacts either by handling or by immersion. Similarly, a patient presenting with an acute eruption characterized by streaks of vesicles should be queried regarding recent outdoor activities resulting in exposure to poison ivy or poison oak. Contact dermatitis is a common and challenging problem. On the part of the physician, it often requires painstaking efforts in a detective-type search to elicit from the patient an exposure history that fits the dermatitis.

A complete 'skin exposure history' is required whenever contact dermatitis is suspected.

Some harbor the misconception that in dermatology, one needs only to glance at the skin to arrive at a diagnosis and that talking with the patient is superfluous. Although this is occasionally true, we hope that the previous examples serve to illustrate that this frequently is not the case. In fact, in some instances (and contact dermatitis is a good example), detailed historical information is essential to establish a diagnosis.

PHYSICAL EXAMINATION

Key Points

1. Complete skin examination is recommended at the first visit
2. Good lighting is critical
3. Describe the morphology of the eruption

The physical examination follows the preliminary history. For the skin to be inspected adequately, three essential requirements must be met: (1) an undressed patient, clothed in an examining gown; (2) adequate illumination, preferably bright overhead fluorescent lighting; and (3) an examining physician prepared to see what is there.

You should examine the entire mucocutaneous surface, but patients will be more firmly convinced of your sincere interest in their particular problems if you start by examining the affected areas before proceeding with the more complete examination.

At least for the initial examination, the patient needs to be disrobed so that the entire skin surface can be examined. Busy physicians who tend to overlook this rule will miss much. An occasional patient may be reluctant to comply, saying, 'My skin problem is only on my hands; why do you need to look at the rest of my skin?' We tell such patients that we have at least two reasons:

1. Other lesions may be found that 'go along with' the lesions on the hands, and help to confirm the diagnosis. For example, in a patient with sharply demarcated plaques on the palms, the finding of a few scaling plaques on the knees or a sharply marginated intergluteal plaque will help to substantiate a suspicion of psoriasis.
2. An important incidental skin lesion may be found. The finding of a previously undetected malignant melanoma on a patient's back is an example. We studied the yield from a complete skin examination in 1157 consecutive new dermatology patients and found an incidental skin malignancy in 22. Some 20 of these patients had basal cell carcinoma, one had melanoma, and one had Kaposi's sarcoma that served as the presenting manifestation of AIDS. A subsequent study of 874 patients reported an incidental skin cancer detection rate of 3.4%.

The entire skin surface is examined for:
1. Lesions that may accompany the presenting complaint
2. Unrelated but important incidental findings

For the skin to be examined adequately, it must be properly illuminated. Natural lighting is excellent for this purpose but is difficult to achieve in most offices and hospital rooms. The alternative is bright overhead fluorescent lighting, supplemented with a movable incandescent lamp that is usually wall mounted. One additional illuminator that is often useful is a simple penlight. Either this or the movable incandescent lamp can be used as side-lighting to detect whether a lesion is subtly elevated. For this technique, the light is directed onto the lesion from an angle that is roughly parallel to the skin. If the lesion is elevated, a small shadow will be thrown, and the relief of the skin will be appreciated. The penlight also is useful for examining the mouth, an area that is sometimes overlooked but in which one may detect lesions that are helpful in diagnosing a cutaneous disorder.

'Side-lighting' helps to detect subtle elevations.

Another piece of examination equipment that is occasionally useful is the Wood's light, a long-wavelength ultraviolet 'black' light. Contrary to some popular misconceptions, this light does not enable one to diagnose most skin fungal infections; it detects fluorescence of affected hairs only in some, now uncommon, types of tinea capitis. The Wood's light is, however, still used to accentuate pigmentary alterations in the skin, such as vitiligo.

Except for provision of adequate illumination, minimal equipment is needed for examining the skin. A simple hand-held lens can be helpful. Enlarging the image may improve diagnostic accuracy. However, on some occasions, such as clarifying a burrow in scabies or detecting Wickham's striae in a lesion of lichen planus, a hand-held lens can be useful. For diagnosing pigmented growths, some dermatologists employ a dermatoscope. This is an illuminated hand-held magnifying device intended to help the clinician to diagnose melanoma clinically.

An adequate examination of the skin should actually be called a mucocutaneous examination so that one is reminded to include an examination of the mouth. Similarly, the scalp and nails should not be overlooked. Because both cutaneous and systemic diseases may be expressed in the nails and nail beds as well as in the mouth, inspection of these areas should be included in every cutaneous examination.

The scalp, mouth, and nails should not be overlooked.

Physical examination depends largely on inspection, but one should not neglect the opportunity to palpate the skin as well. One should do hand hygiene prior to and after touching the patient. The two major purposes for this are: (1) to assess the texture consistency and tenderness of the skin lesions; and (2) to reassure patients that we are not afraid to touch their skin lesions – that they do not have some dreadful contagious disease. Nothing is more disquieting to a patient than to be cautiously approached with a gloved hand. For anogenital, mucosal, and all weeping lesions, gloving is necessary and expected, but for most other lesions, the physician learns more and the patient is less frightened if the touching is done without gloves. Palpation is the major method by which we evaluate not only the consistency (e.g., softness, firmness, fluctuance) but also the depth of a lesion.

Palpation helps to:
1. Assess texture and consistency
2. Evaluate tenderness
3. Reassure patients that they are not contagious

After the patient is properly gowned and perfectly illuminated, for what do we inspect and palpate? The first and most important step is to characterize the appearance (i.e., identify the morphology) of each skin lesion. After the morphology of a lesion is identified, its clinicopathologic correlation can be considered.

The most important task in the physical examination is to characterize the morphology of the basic lesion.

TERMINOLOGY OF SKIN LESIONS

Key Points

1. Primary lesions include macule, patch, papule, plaque, nodule, cyst, vesicle, pustule, ulcer, wheal, telangiectasia, burrow, and comedo
2. Secondary lesions include scale, crust, oozing, lichenification, induration, fissure, and atrophy

A special vocabulary is used in describing the morphologic appearances of skin lesions. These terms are illustrated and defined in **Figure 3.1**.

CLINICOPATHOLOGIC CORRELATIONS

Key Points

1. Envisioning the gross and microscopic morphology together helps to make the diagnosis
2. Rash or growth?
3. Epidermal, dermal, or subcutaneous?

The lesions defined in **Figure 3.1** result from alterations in one or more of the skin's structural components. For clinical diagnostic purposes, we try to envision what pathologic changes are associated with each clinical lesion (**Table 3.1**). Scale, lichenification, vesicles, bullae, pustules, and crusts represent epidermal alterations, whereas erythema, purpura, and induration reflect changes in the dermis. Such clinicopathologic correlations form the basis of the diagnostic approach. For example, scaling of a nodule suggests hyperkeratosis of the stratum corneum and, thus, an epidermal growth.

Determine which of the skin components are involved in the clinical lesion.

TABLE 3.1 Clinicopathologic correlations

Skin Component	Pathologic Alteration	Clinical Manifestation
Epidermis		
Stratum corneum	Hyperkeratosis	Scale
Subcorneal epidermis	Hyperplasia	Lichenification
	Hyperplasia	Papules, plaques, and nodules
	Disruptive inflammatory changes	Vesicles, bullae, and pustules
	Dried serum	Crusts
Melanocytes	Increased number or function	Pigmented macules, papules, and nodules
	Decreased number or function	White spots
Dermis		
Blood vessels	Hyperplasia or inflammation	Macules, papules, and nodules
	Vasodilatation	Erythema
	Hemorrhage	Purpura
	Vasodilatation with edema	Wheals
Nerves	Hyperplasia	Papules, nodules
Connective tissue	Hyperplasia	Induration, papules, nodules, and plaques
	Loss of epidermis and dermis	Ulceration
Dermal appendages		
Pilosebaceous units	Hyperplasia	Hirsutism
	Atrophy	Alopecia
	Hyperplasia or inflammation	Comedones, papules, nodules, and cysts
Sweat glands	Hypersecretion	Hyperhidrosis
	Hyperplasia or inflammation	Vesicles, papules, pustules, and cysts
Subcutaneous fat	Hyperplasia or inflammation	Induration and nodules

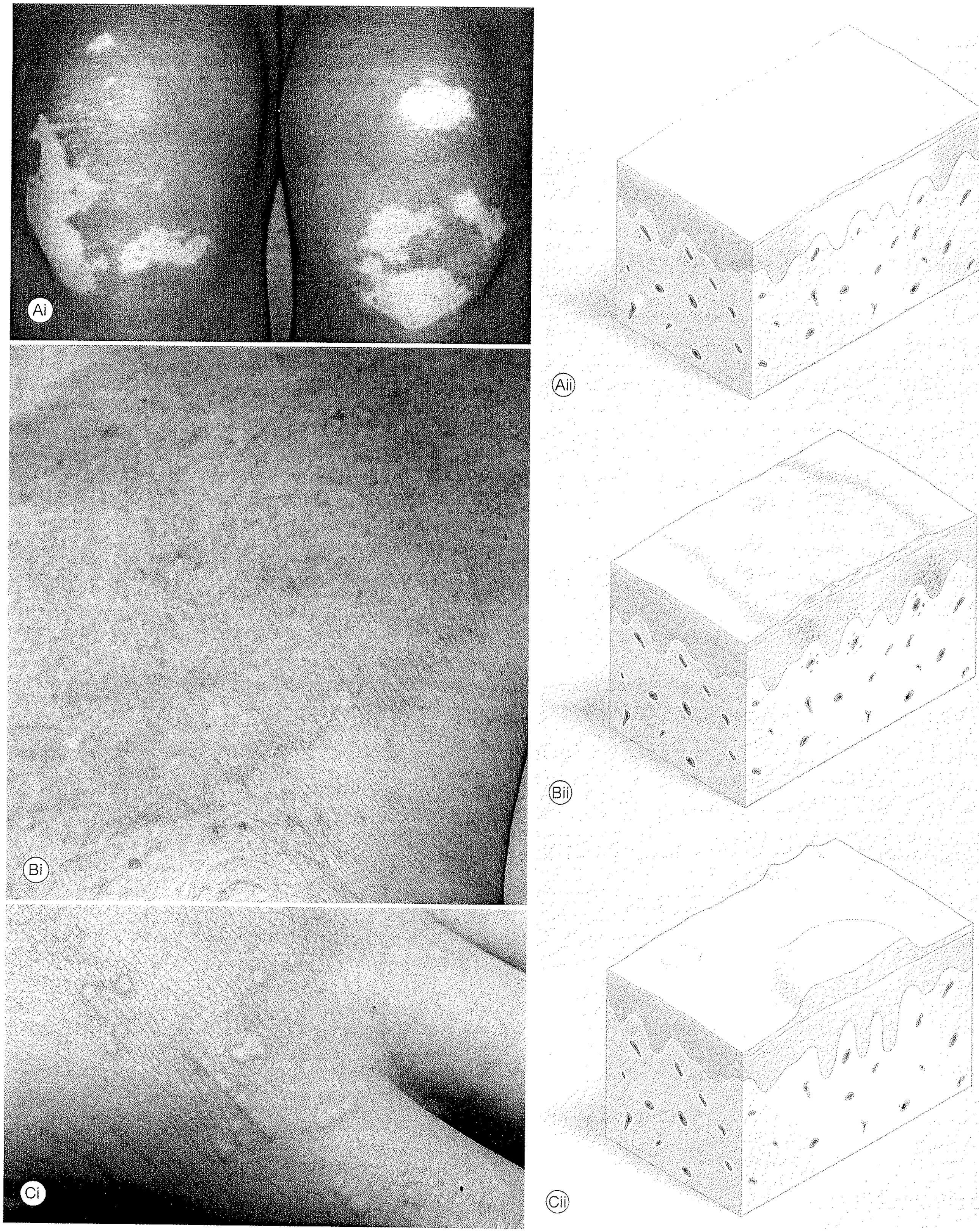

FIGURE 3.1 Skin lesions. A. Vitiligo – **macule**. A flat skin lesion recognizable because its color is different from that of the surrounding normal skin. The most common color changes are white (hypopigmented), brown (hyperpigmented), and red (erythematous and purpuric). **B.** Tinea corporis – **patch**. A macule with some surface change, either slight scale or fine wrinkling. **C.** Flat warts – **papules**. Small elevated skin lesions <0.5 cm in diameter.

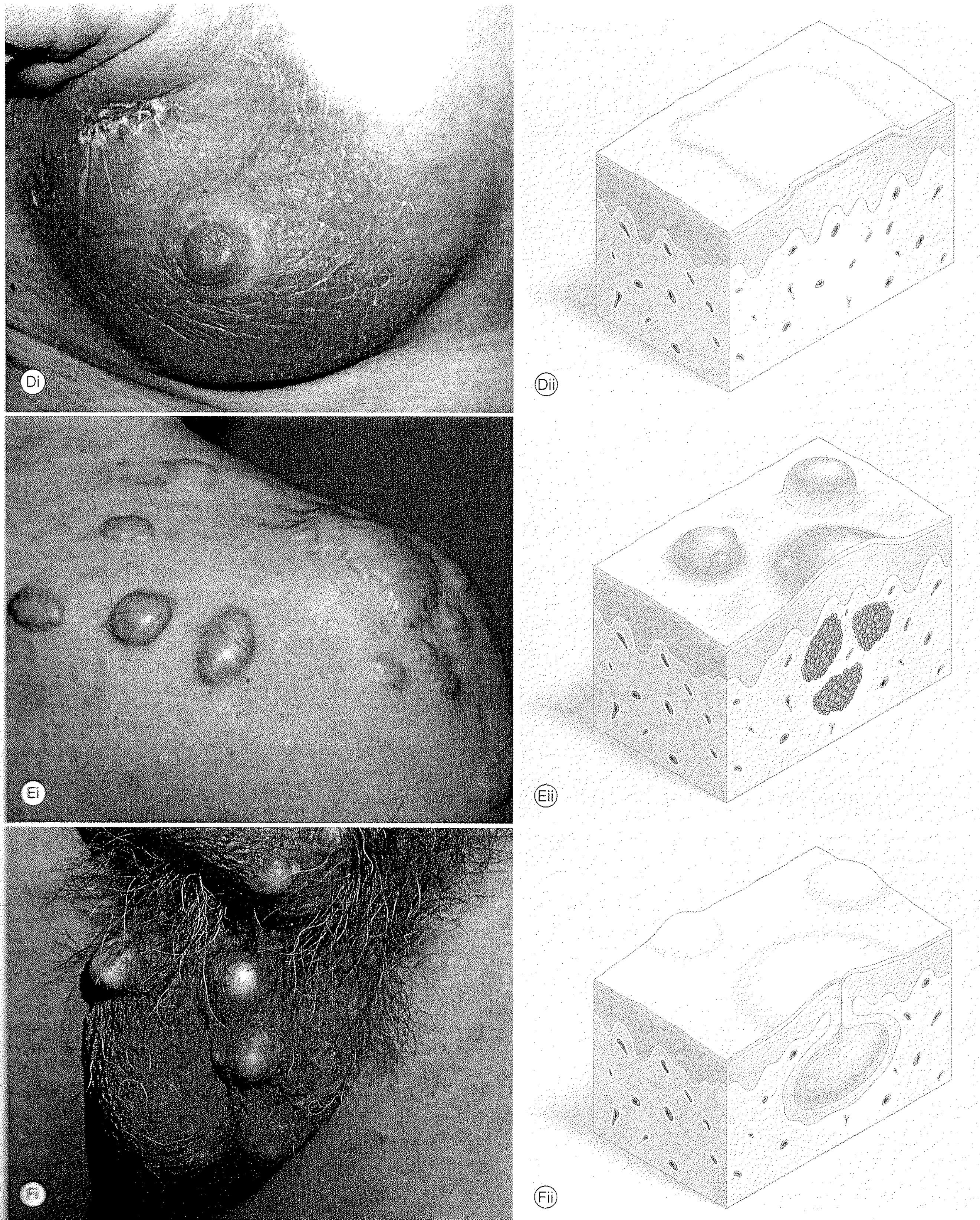

FIGURE 3.1 *Continued* **D.** Breast carcinoma – **plaque**. An elevated, 'plateau-like' lesion >0.5 cm in diameter but without substantial depth. **E.** Scars – **nodules**. Elevated, 'marble-like' lesions >0.5 cm in both diameter and depth. **F.** Epidermal inclusion **cysts**. Nodules filled with expressible material that is either liquid or semi-solid.

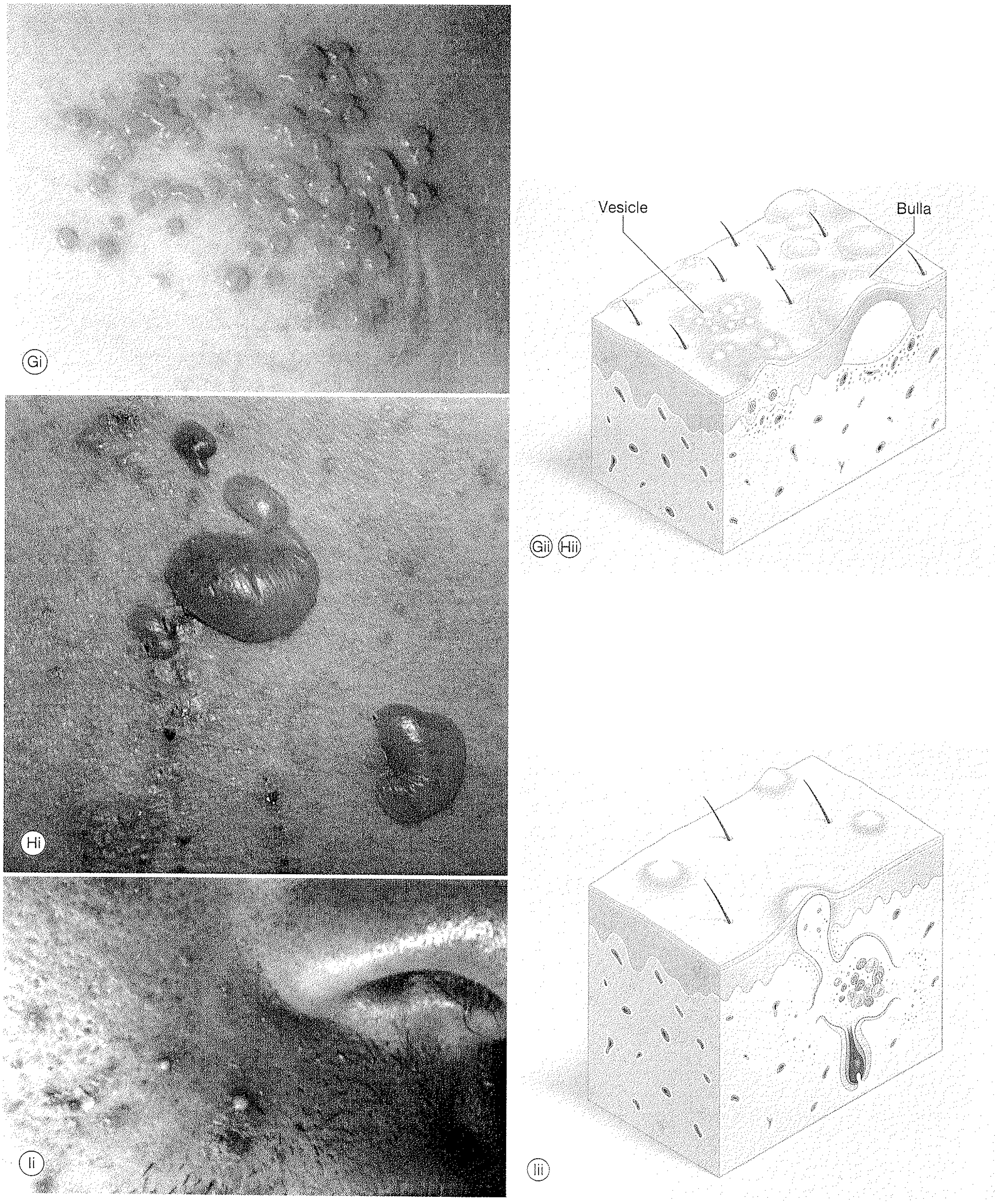

FIGURE 3.1 ***Continued*** **G.** Herpes simplex – **vesicles**. **H.** Bullous pemphigoid – **bullae**. Blisters are filled with clear fluid. Vesicles are <0.5 cm and bullae are >0.5 cm in diameter. **I.** Acne – **pustules**. Vesicles filled with cloudy or purulent fluid.

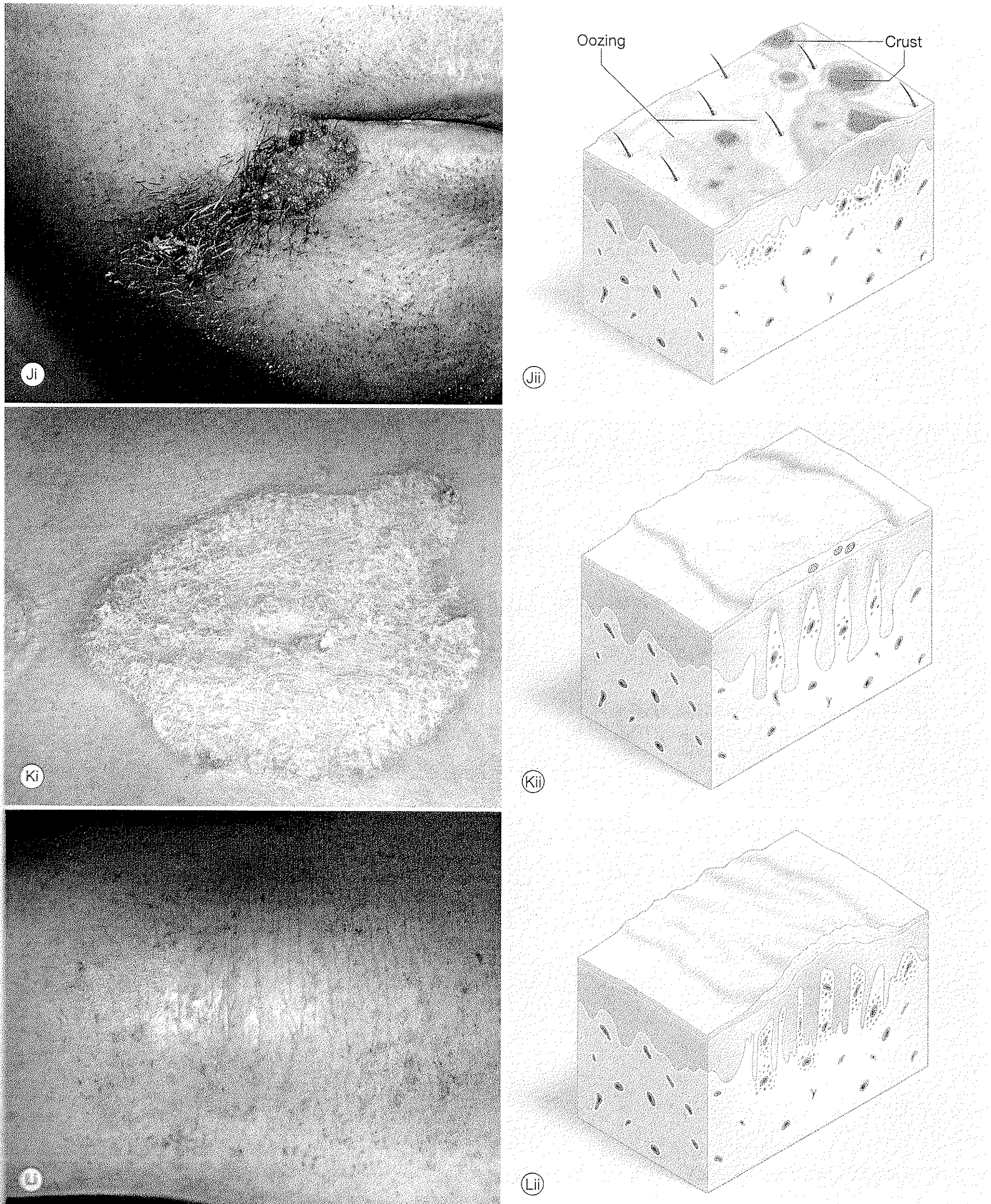

FIGURE 3.1 *Continued* **J.** Chronic herpes simplex – **crust**. Liquid debris (e.g., serum or pus) that has dried on the surface of the skin. Crust most often results from breakage of vesicles, pustules, or bullae. **K.** Psoriasis – **scale**. Visibly thickened stratum corneum. Scales are dry and usually whitish. These features help to distinguish scales from crusts, which are often moist and usually yellowish or brown. **L.** Atopic dermatitis – **lichenification**. *Epidermal thickening* characterized by (i) visible and palpable thickening of the skin with (ii) accentuated skin markings.

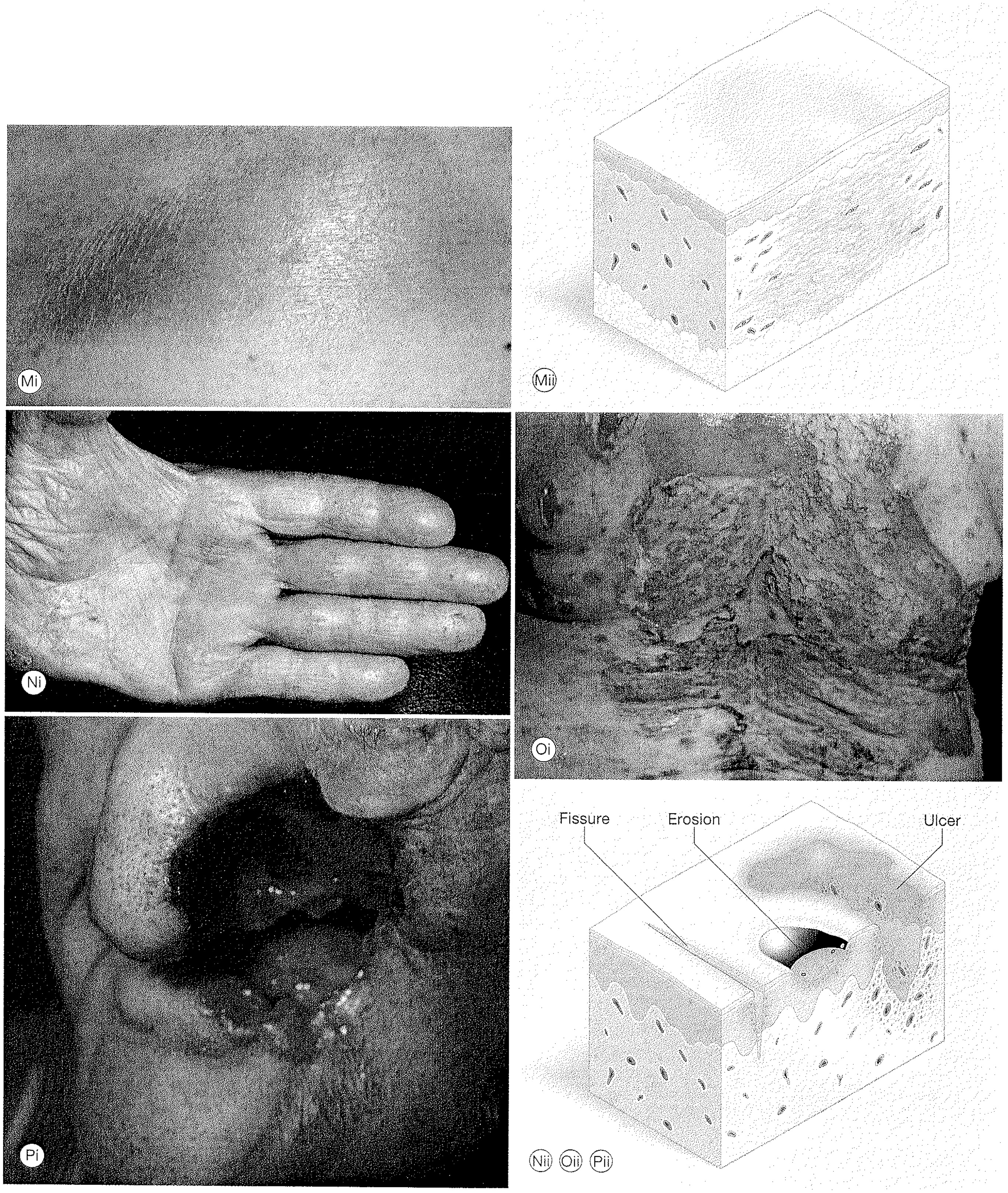

FIGURE 3.1 ***Continued*** **M.** Localized scleroderma (morphea) – **induration**. *Dermal thickening* resulting in the skin that *feels* thicker and firmer than normal. **N.** Hand dermatitis – **fissure**. **O.** Pemphigus vulgaris – **erosion**. **P.** Basal cell carcinoma – **ulcer**. A fissure is a thin, linear tear in the epidermis. An erosion is wider but is limited in depth, confined to the epidermis. An ulcer is a defect devoid of epidermis, as well as part or all of the dermis.

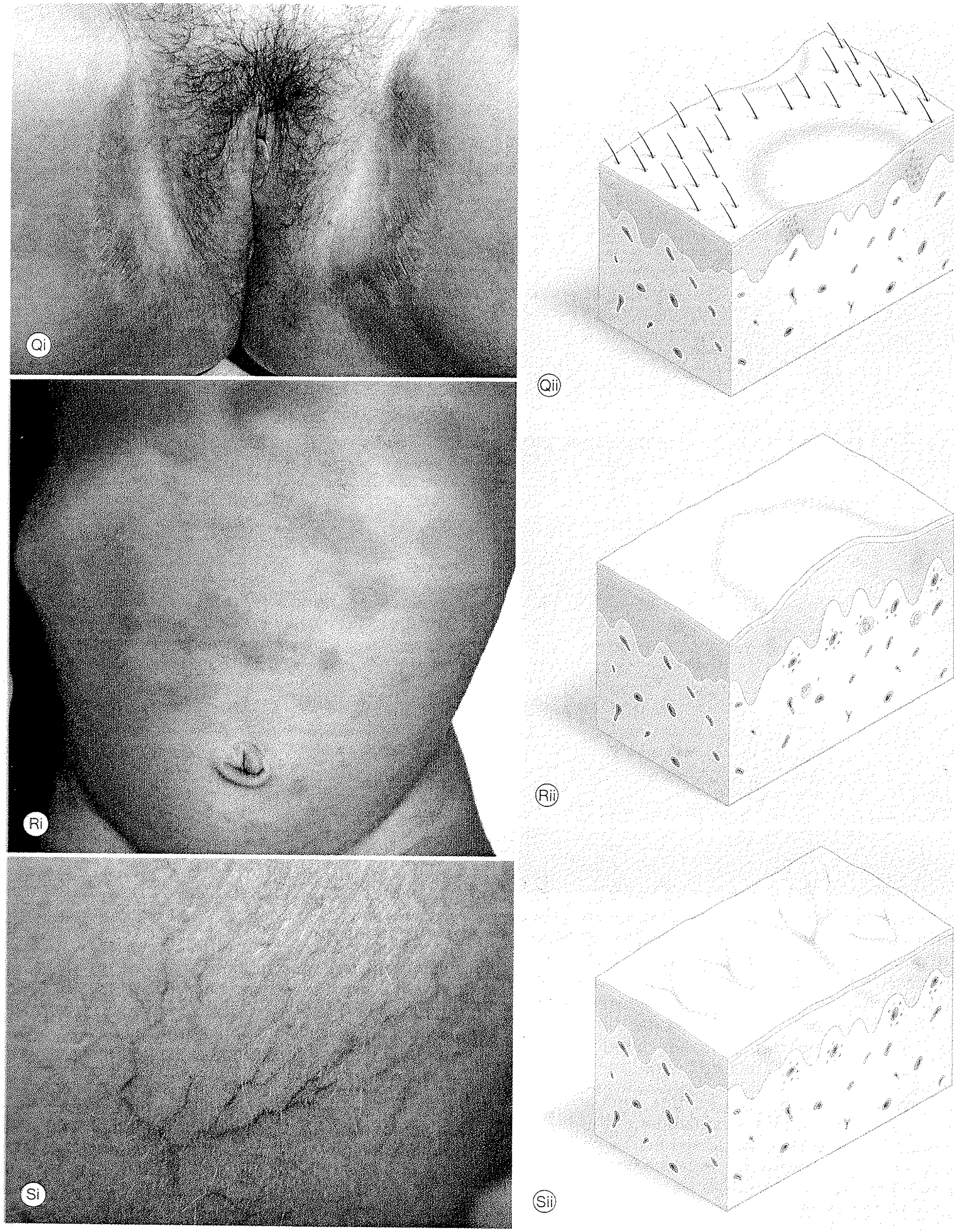

FIGURE 3.1 *Continued* **Q.** Lichen sclerosus et atrophicus – **atrophy**. Loss of skin tissue. With epidermal atrophy, the surface appears thin and wrinkled. Atrophy of the much thicker dermal layer results in a clinically detectable depression in the skin. **R.** Urticaria – **wheal**. A papule or plaque of dermal edema. Wheals (or *hives*) often have central pallor and irregular borders. **S.** Sun damage/aging – **telangiectasia**. Superficial blood vessels enlarged sufficiently to be clinically visible.

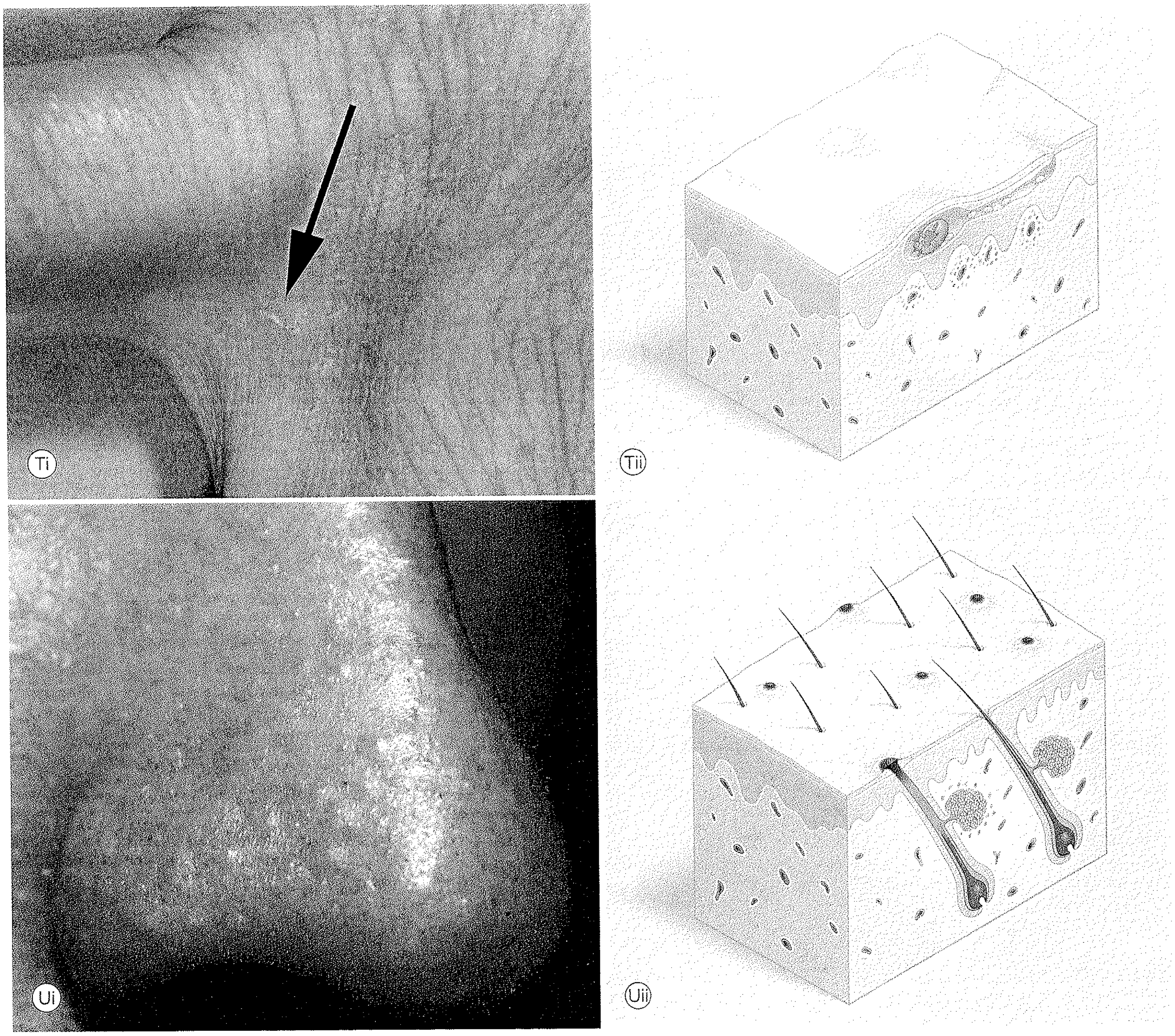

FIGURE 3.1 ***Continued*** **T.** Scabies – **burrow**. Serpiginous tunnel or streak (arrow) caused by a burrowing organism. **U.** Acne – **comedo** (plural, *comedones*). The non-inflammatory lesions of acne that result from keratin impaction in the outlet of the pilosebaceous canal.

Table 3.2 presents an algorithm for this approach and outlines the organization of the remainder of this book. Most skin disorders can be categorized first as proliferative 'growths' (neoplasms) or inflammatory 'rashes' (eruptions). The growths and rashes are then subdivided, depending on how they appear clinically and which structural component is involved pathologically.

Growths are hyperplastic lesions; rashes are inflammatory.

GROWTHS

Growths are subdivided into epidermal, pigmented, and dermal or subcutaneous proliferative processes.

Growths are subdivided into one of three categories:

1. Epidermal
2. Pigmented
3. Dermal or subcutaneous

TABLE 3.2 Schematic for diagnosis of skin diseases

						Discussed in Chapter:
Growths					Epidermal	5
					Pigmented	6
					Dermal and subcutaneous	7
Rashes	With epidermal involvement				Eczematous	8
					Scaling	9
					Vesicular	10
					Papular	11
					Pustular	12
					Hypopigmented	13
	Without epidermal involvement	Red	Blanchable	Erythema	Generalized	14
					Localized	15
					Specialized	16
			Non-blanchable	Purpura	Macular	17
					Papular	17
					Indurated	18
Miscellaneous					Ulcers	19
					Hair disorders	20
					Nail disorders	21
					Mucous membrane disorders	22
Symptom						23

Epidermal growths result from hyperplasia of keratinocytes; many of these neoplasms have scaling surfaces. *Scale* accumulates when the rate of stratum corneum production exceeds the rate of shedding. *Hyperkeratosis* is another term used to describe excessive accumulation of keratin, the fibrous protein that makes up the stratum corneum. The term 'hyperkeratosis' is most often used with skin growths (e.g., seborrheic keratoses); 'scaling' is used to describe both growths and rashes.

Scale and hyperkeratosis are both terms for excess stratum corneum.

Because the normal function of the epidermis is to produce the keratotic stratum corneum, hyperkeratosis may be expected in epidermal neoplasms. These proliferative processes may be benign (e.g., seborrheic keratoses), premalignant (e.g., actinic keratoses), or malignant (e.g., squamous cell carcinoma).

Hyperplasia of the subcorneal epidermis results in elevated lesions of the skin papules, plaques, and nodules. Benign growths originating in the epidermis often appear superficial. Malignant epidermal growths, by definition, have invaded the dermis, and they therefore feel *indurated*, a term used to designate thickening of the dermis.

Malignant epidermal growths usually feel indurated, except for superficial basal and squamous cell carcinomas, which are patches.

Pigmented lesions result from increased melanin production or increased numbers of melanin-producing cells, and so may be either macular or papular. Freckles are common examples of hyperpigmented macules that result from increased melanin production. Nevi and melanomas are examples of growths characterized by increased numbers of melanin-producing cells. Nevi that are sufficiently cellular to impart a mass effect are elevated, and so appear clinically as hyperpigmented papules, plaques, or even nodules.

Dermal and subcutaneous growths result from *focal* proliferative processes in the dermis or subcutaneous fat. They appear most often as nodules, which are most fully appreciated by palpation. The proliferative elements that form nodules may be either endogenous (e.g., a dermatofibroma that results from the proliferation of dermal fibroblasts) or exogenous (e.g., a metastasis from an internal malignant disease) to the skin. Because often no surface markers exist to differentiate one dermal nodule from another, the definitive diagnostic test frequently must be a biopsy. This clinical point deserves emphasis: for undiagnosed skin nodules, particularly firm lesions, malignancy must be suspected, and a biopsy must be performed.

A skin biopsy is often required for the diagnosis of a dermal nodule.

RASHES

For rashes, the first diagnostic step is to determine whether the epidermis is involved. Types of epidermal involvement are listed in **Table 3.2**. Although some rashes produce several epidermal changes, usually one change is distinctive or predominant.

Eczematous dermatitis is histologically characterized by epidermal intercellular edema (spongiosis), which is manifested clinically by vesicles, 'juicy' papules, or lichenification. *Lichenification* represents epidermal hyperplasia clinically expressed as thickened skin with accentuated skin markings. Lichenification is the hallmark of chronic dermatitis.

Lichenification is the hallmark of chronic eczematous dermatitis.

Epidermal rashes:
1. Eczematous
2. Scaling
3. Vesicular
4. Papular
5. Pustular
6. Hypopigmented

Scale must be distinguished from crust

Scaling eruptions are the result of thickened stratum corneum. Scaling rashes can involve either focal areas or the entire cutaneous surface. Examples of the former are more common and are represented by the so-called papulosquamous diseases. These disorders are characterized by scaling (squamous) papules and plaques and patches. Psoriasis and fungal infections serve as examples. Ichthyosis ('fish skin') is an example of generalized scaling.

Scale is usually white or light tan and flakes off rather easily. These features help to distinguish scale from crust. *Crust* is dried serum and debris on the skin surface and is usually darker, most often yellow or brown; it is adherent and, when removed, a weeping base is revealed. The distinction between scale and crust is important because the differential diagnoses are entirely different. Crusts are associated with vesicles, bullae, pustules, and malignant growths.

Vesicles and bullae occur when fluid accumulates within or beneath the epidermis. They characterize a relatively small number of important dermatologic disorders, so are extremely helpful diagnostic findings. Vesicles and bullae occur either intraepidermally or subepidermally. The differential diagnoses are different for intraepidermal and subepidermal blisters, so it is important to try to distinguish them. Clinically, one clue is the fragility of the blister. Because of their more substantial roof, fresh subepidermal blisters are tense and less easily broken, whereas intraepidermal bullae are flaccid and easily ruptured. A biopsy of the *edge* of an early lesion confirms the clinical impression.

Vesicles and bullae are important diagnostic findings.

Pruritic papules are produced by inflammation, predominantly in the dermis. Pustules occur when inflammatory cells aggregate within the epidermis. Pustules may be located superficially in the epidermis, or they may arise from superficial locations in appendageal structures. With purulence, one usually thinks of bacterial infection. This is an appropriate reflex, and Gram-staining or culture of the contents of a pustule is indicated if a bacterial infection is suspected. However, not all pustular processes are bacterial in origin; viral and fungal infections can also result in pustules, and acne is a common example of a non-infectious cause.

Pustules often (but not always) indicate infection.

When melanin pigment is lost from the epidermis, white spots result. Because no associated increase in cellular mass occurs, hypopigmented lesions can be expected to be macular (not papular) white spots. Hypopigmentary changes are accentuated under Wood's light examination, whereby previously unnoticed lesions may become apparent and the degree of pigment loss can be roughly assessed. The more pronounced the pigment loss, the whiter the lesion appears under the scrutiny of the Wood's light.

Hypopigmentary changes are accentuated with Wood's light examination.

Dermal rashes without epidermal involvement are either inflammatory or infiltrative; most are inflammatory. Inflammatory eruptions appear red because of vasodilatation of *dermal* blood vessels (the epidermis is devoid of vasculature). Redness in skin lesions can be due to either *erythema* or *purpura*. It is extremely important to differentiate between the two. With erythema, the increased blood in the skin is contained within dilated blood vessels. Therefore, erythema is *blanchable* (**Fig. 3.2**). With purpura, blood has extravasated from disrupted blood vessels into the dermis, and the lesion is non-blanchable

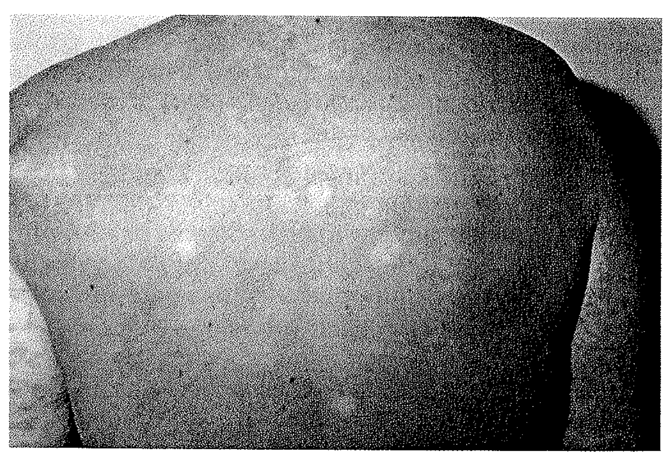

FIGURE 3.2 **Erythema is blanchable,** as demonstrated with fingertip pressure on the midback in this patient with a drug eruption.

FIGURE 3.3 Purpura is purple and was not blanchable in this patient with fragile skin that had been injured.

(Fig. 3.3). The test for blanchability is called *diascopy*. It is performed by simply applying pressure with a finger or glass slide and observing color changes.

Erythematous rashes are subdivided into generalized, localized, and specialized (e.g., hives) types. A *wheal*, or hive, is a special type of blanchable, transient, erythematous lesion of the skin. Blood vessels in a wheal are dilated, and fluid leaks from them, causing edema in the surrounding dermis. This fluid is not compartmentalized as in vesicles or bullae, but rather is dispersed evenly throughout the dermal tissue. The result is an elevated erythematous lesion, often with central pallor that is due to the intense edema.

Purpuric rashes are subdivided into macular and papular categories. *Macular purpura* is flat and non-palpable, whereas *papular purpura* is elevated (sometimes subtly) and palpable. This clinical distinction is important because the differential diagnoses and clinical implications are different for the two types. Macular purpura occurs in two settings: (1) conditions associated with increased capillary fragility and (2) bleeding disorders. Macular hemorrhage is not accompanied by inflammation. In papular or palpable purpura, inflammatory changes are present in the vessel walls and are responsible for the elevation of the lesions. Disruption and necrosis of the blood vessels caused by an inflammatory reaction are called *necrotizing vasculitis*. This condition is usually immunologically mediated and can occur in numerous settings, such as sepsis, collagen vascular diseases, and, occasionally, drug reactions. In diagnosis of a patient with palpable purpura, such systemic processes must be excluded.

Macular purpura is usually a sign of a bleeding disorder or vascular fragility; papular purpura indicates a necrotizing vasculitis, often systemic.

Rashes resulting from *infiltrative processes* in the dermis are much less common than inflammatory disorders. Clinically, they feel indurated. Induration, resulting from increased amounts of collagen, is also called *sclerosis*. Scleroderma, an idiopathic disorder of increased collagen deposition, is an example.

MISCELLANEOUS CONDITIONS

Skin ulcers and disorders of hair, nails, and mucous membranes are easily recognizable and grouped as miscellaneous.

An *ulcer* is totally devoid of epidermis, and some or all of the dermal tissue is missing. Ulcers may extend down to underlying bone, as, e.g., in advanced decubitus ulcers. Malignant processes can result in ulcerations that do not heal. For this reason, all chronic ulcers should be biopsied.

Chronic skin ulcers should undergo biopsy to rule out malignancy.

Too little hair is a much more common dermatologic complaint than too much hair. *Alopecia* means hair loss. For diagnostic purposes, it is helpful to classify alopecia as either *non-scarring* or *scarring*. Clinically, the distinction depends on whether follicular openings are visible. The differential diagnoses are different for each of these two categories.

For alopecia, first determine whether it is scarring or non-scarring.

Most nail disorders are inflammatory and can affect the nail matrix, nail bed, or periungual skin (paronychia). Inflammation and scaling in the nail bed result in separation of the nail plate from the bed (onycholysis). Fungal infection and psoriasis are the most common causes.

The two most common manifestations of mucous membrane disorders are: (1) erosions and ulcerations; and (2) white lesions. On mucous membranes, whiteness represents hyperkeratosis, which is white because of maceration from continuous wetness.

CONFIGURATION OF SKIN LESIONS

Key Points

1. Configuration can help make the diagnosis
2. Morphology is more important than configuration

The diagnosis of rash is often aided by considering the configuration of the lesions or their distribution on the body surface. *Configuration* refers to the pattern in which skin lesions are arranged. The four most common patterns are listed in **Table 3.3**, along with examples of

TABLE 3.3 Some examples of configuration

Configuration	Morphology	Disease	Illustration
Linear	Vesicles Papules	Contact dermatitis[a] Psoriasis[b] Lichen planus[b] Flat warts	See **Fig. 3.4**
Grouped	Vesicles Papules	Herpes (simplex and zoster) Insect bites	See **Fig. 3.5**
Annular	Scaling	Tinea corporis	See **Fig. 3.6**
		Secondary syphilis	
		Subacute cutaneous lupus erythematosus	
	Dermal plaque	Granuloma annulare	
Geographic	Wheals Plaques	Urticaria Mycosis fungoides	See **Fig. 3.7**

[a]Typical for contact dermatitis from a plant resin (e.g., poison ivy).
[b]The Koebner reaction.

FIGURE 3.4 Contact dermatitis from poison ivy, demonstrating linear streaks of vesicles.

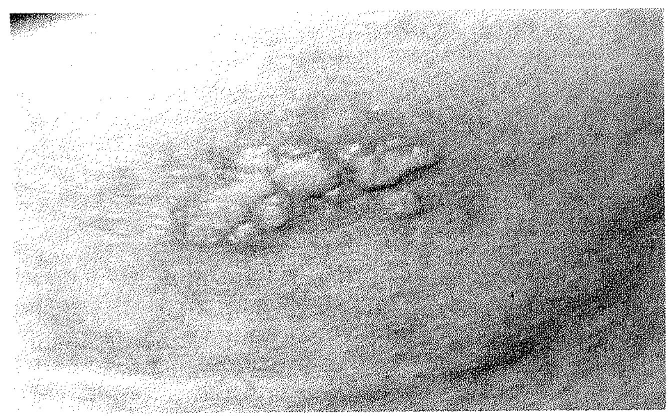

FIGURE 3.5 Herpes simplex – grouped vesiculopustules.

diseases that most often present in these configurations. Occasionally, a configuration is specific for a disease. For example, streaks of vesicles are characteristic of contact dermatitis from poison ivy or poison oak. More often, a configuration is not completely specific for a given disease, but may still be helpful in the diagnosis. For example, in psoriasis, scaling papules sometimes develop in streaks as a result of the Koebner reaction, in which lesions of a disorder develop after trauma, such as scratching.

As can be seen from Table 3.3 (Figs 3.4–3.7), configuration considerations are sometimes diagnostically helpful, but morphology takes precedence. The annular impetigo shown in Figure 3.8 illustrates this point. If the crust had been interpreted as scale, the annular lesions would almost certainly have been misdiagnosed as tinea corporis (ringworm). The honey-colored crust, however, should focus attention on the pustular nature of the primary process and raise the question of bacterial infection. So, for dermatologic diagnosis, the morphology of the primary lesion must be identified correctly before consideration is given to a specific configuration, if one is present. If a conflict appears to exist between the morphology and the configuration, more diagnostic weight should be given to the morphology.

Mucous membrane disorders:
1. Erosions and ulcerations
2. White lesions

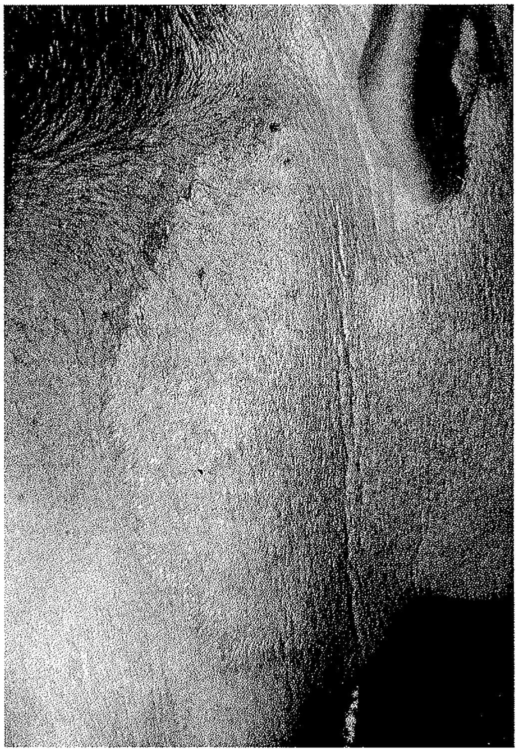

FIGURE 3.6 **Tinea corporis** – annular scaling patch.

FIGURE 3.7 **Urticaria** – typical wheals.

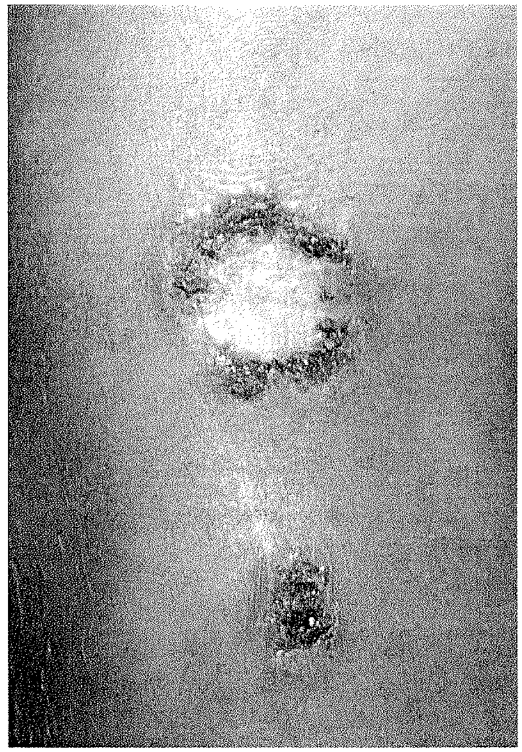

FIGURE 3.8 **Annular impetigo** – when morphology and configuration (or distribution) appear to conflict, the morphology takes precedence.

DISTRIBUTION OF SKIN LESIONS

Key Points

1. The distribution of skin lesions and the region affected can help to suggest or confirm a diagnosis

Many skin diseases have preferential areas of involvement, so the location of the eruption may help in diagnosis. A good example of this is herpes zoster, in which consideration of all three diagnostic criteria (morphology, configuration, and distribution) secures the diagnosis: vesicles in grouped configuration and dermatomal distribution are diagnostic for herpes zoster.

Many skin disorders have favored regional distributions (i.e., a propensity for a particular area of the body), such as the scalp, face, hands, groin, or feet. Sometimes, this propensity can be used as a starting point for developing a differential diagnosis. These 'regional' diagnoses are outlined in Table 3.4. For rashes that affect widespread areas, the distribution *pattern* may also aid in the diagnosis. This is particularly true for contact dermatitis, in which the location of the rash on the skin may be helpful, not only in leading one to suspect a contact origin but also in providing a clue about the nature of the contactant. For example, a rash on the earlobes and around the neck should lead one to suspect allergic contact dermatitis caused by the nickel present in jewelry.

TABLE 3.4 Regional diagnoses

Growths	Rashes
Scalp	
Nevus	Seborrheic dermatitis (dandruff)
Seborrheic keratosis	Psoriasis
Pilar cyst	Tinea capitis Folliculitis
Face	
Nevus	Acne
Lentigo	Acne rosacea
Actinic keratosis	Seborrheic dermatitis
Seborrheic keratosis	Contact dermatitis (cosmetics)
Sebaceous hyperplasia	Herpes simplex
Basal cell carcinoma	Impetigo
Squamous cell carcinoma	Pityriasis alba
Flat wart	Atopic dermatitis
Nevus flammeus	Lupus erythematosus
Trunk	
Nevus	Acne
Skin tag	Tinea versicolor
Cherry angioma	Psoriasis
Seborrheic keratosis	Pityriasis rosea
Epidermal inclusion cyst	Scabies
Lipoma	Drug eruption
Basal cell carcinoma	Varicella
Keloid	Mycosis fungoides
Neurofibroma	Secondary syphilis
Genitalia	
Wart (condyloma acuminatum)	Herpes simplex Scabies
Molluscum contagiosum	Psoriasis
Seborrheic keratosis	Lichen planus Syphilis (chancre)
Groin (inguinal)	
Skin tag	Intertrigo
Wart	Tinea cruris
Molluscum contagiosum	Candidiasis Pediculosis pubis Hidradenitis suppurativa Psoriasis Seborrheic dermatitis
Extremities	
Nevus	Atopic dermatitis
Dermatofibroma	Contact dermatitis
Wart	Psoriasis
Seborrheic keratosis	Insect bites
Actinic keratosis	Erythema multiforme
Xanthoma	Lichen planus (wrists and ankles) Actinic purpura (arms) Stasis dermatitis (legs) Vasculitis (legs) Erythema nodosum (legs)
Hands (palmar)	
Wart	Nonspecific dermatitis Atopic dermatitis Psoriasis Tinea manuum Erythema multiforme Secondary syphilis
Feet (dorsal)	
Wart	Contact dermatitis (shoe)
Feet (plantar)	
Wart (plantar)	Contact dermatitis (shoe)
Corn	Tinea pedis
Nevus	Nonspecific dermatitis Psoriasis Atopic dermatitis

Dermatologic Therapy and Procedures 4

Chapter Contents

ABSTRACT

Because the skin is so accessible, it can be treated with a variety of therapeutic options not available for use in diseases of internal organs. Drugs for dermatologic therapy can be administered topically, intralesionally, and systemically. In addition, physical modalities such as ultraviolet (UV) and ionizing radiation, surgery, laser, and cryotherapy can be easily administered.

At one time, dermatologic therapy was based largely on empiric approaches. However, much progress has been made in defining the scientific bases for numerous dermatologic treatments, resulting in a well-rounded rationale for choosing specific modalities.

The discussions in this chapter are limited to principles of external therapies unique to the skin. Other, more specific, topical therapies, such as those used for acne and for fungal diseases, as well as all systemic therapies, are discussed in chapters concerning the diseases in which they are used.

PRINCIPLES OF TOPICAL THERAPY

Key Points

1. Many types of drug are available in topical preparation
2. The vehicle is almost as important as the active ingredient
3. Give enough volume to treat the area of disease involvement adequately

A diverse group of medications is available in topical preparations, including antibiotics, antifungals, corticosteroids, acne preparations, sunscreens, cytotoxic agents, antipruritics, antiseptics, and pesticides. Topical therapy has the distinct advantage of delivering medications directly to the target organ. This route reduces the potential of systemic side-effects and toxicity seen with systemic therapy. The disadvantages of topical therapy are that it is time consuming, it can require large volumes of medication, it requires patient education in the technique of using topicals, and, at times, it is not esthetically pleasing because of staining or greasy preparations.

Advantages of topical medication:

1. Direct delivery to target tissue
2. Reduced systemic side-effects

For a medication to be effective topically, it must be absorbed into the skin. The main diffusion barrier of the skin is the stratum corneum, which is responsible for most of the protection offered by the skin against toxic agents, microorganisms, physical forces, and loss of body fluids.

Percutaneous absorption is influenced by: (1) physical and chemical properties of the active ingredient; (2) concentration; (3) vehicle; and (4) variations in type of skin. Cutaneous penetration of an active ingredient is enhanced when it has a low molecular weight, is lipid soluble, and is non-polar.

Percutaneous absorption depends on:
1. Active ingredient
2. Concentration
3. Vehicle
4. Skin type

Substances move across the stratum corneum by passive diffusion and follow a dose–response curve. The higher the *concentration* applied, the greater is the quantity of medication absorbed.

The *vehicle* is nearly as important as the active agent in the formulation of topical medications. This was realized when investigators found that the release of drugs varied greatly with different vehicles. The more occlusive the vehicle, the greater is the hydration of the stratum corneum and penetration of the medication. In addition, occlusive vehicles increase local skin temperature and prevent mechanical removal and evaporation of the active agent. An ointment is the most occlusive vehicle.

Percutaneous absorption is also influenced by the *location of the skin* to which it is applied. Passive diffusion is slow through the stratum corneum but rapid through the viable epidermis and papillary dermis. Therefore, absorption is generally low on the palm and sole, in which the stratum corneum is thick, and high on the scrotum, face, and ear, in which the stratum corneum is thin. Breakdown of the barrier function of the stratum corneum by disease, chemicals (soaps or detergents), and physical injury results in increased permeability.

The *selection of a topical preparation* must involve not only the active agent but also its other ingredients. The formulation of many topical medications is complex. A water-based preparation (cream), e.g., is composed of numerous ingredients, including the active agent, vehicle, and preservative, as well as an emulsifier to bring together the oil and water components of the preparation. As a general rule, it is better to select a commercially formulated preparation that is scientifically compounded than an extemporaneous preparation. The most frequently used vehicles are creams, ointments, lotions, foams, and gels.

Creams are semi-solid emulsions of oil in water that vanish when rubbed into the skin. They are white and non-greasy, and contain multiple ingredients. Preservatives are added to prevent the growth of bacteria and fungi. *Ointments* (oil-based) are emulsions of water droplets suspended in oil that do not rub in when applied to the skin. They are greasy and clear, and do not require preservatives. Ointments are selected when increased hydration, occlusion, and maximal penetration of the active ingredient are desired. *Lotions* are suspensions of powder in water that may require shaking before application. Calamine lotion is the classic example. Itching is relieved by the cooling effect of water evaporation, and a protective layer of powder is left on the skin. Other liquids such as solutions, sprays, aerosols, and tinctures are characterized by ingredients dissolved in alcoholic vehicles that evaporate to leave the active agent on the skin. These agents are particularly useful for hairy areas. *Gels* are transparent and colorless semi-solid emulsions that liquefy when applied to the skin.

WRITING A DERMATOLOGIC PRESCRIPTION

Writing a prescription for a topical medication involves more than simply requesting the active ingredient. In addition to the medication, the vehicle, concentration, and amount must be indicated, as well as the instructions for use. Several concentrations and vehicles may be available for a given topical drug. The physician should indicate which vehicle the pharmacist is to dispense. Patient compliance is often directly related to their preference of vehicle. Greasy ointments on the face and hands can be unacceptable to the patient, and on the trunk or extremities may soak through clothing.

Elements of a topical prescription:
1. Medication
2. Vehicle
3. Concentration
4. Amount
5. How to apply

The type of error most frequently made in prescribing a topical drug probably involves the volume of medication to be dispensed. The size of the area being treated, the frequency of application, and the time between appointments or before predicted clearing of the eruption must all be taken into consideration when writing the prescription. An adequate quantity of medication is necessary to ensure the patient's compliance, successful therapy, and cost savings. Smaller volumes of medication are comparatively more expensive than larger volumes. One gram covers an area approximately 10 × 10 cm. A single application of a cream or ointment to the face or hands requires 2 g; for one arm or the anterior or posterior trunk, 3 g; for one leg, 4 g; and for the entire body, 30 g. Prescribing 15 g to be applied twice a day to an eruption that involves large portions of the trunk and extremities would be unreasonable; the patient would be required to return for refills twice daily.

Amount needed for one application:
- Face or hands: 2 g
- Arm: 3 g
- Leg: 4 g
- Whole body: 30 g

The physician needs to know the principles involved in writing a dermatologic prescription. For example, the patient's eruption is moderately severe and requires an intermediate-strength topical steroid such as triamcinolone acetonide. Triamcinolone acetonide is available in three concentrations: 0.025%, 0.1%, and 0.5%. A 0.1% concentration is effective for moderately severe eruptions and can generally be used without concern for local or systemic side-effects. In this example, it is dispensed in a cream vehicle because the patient prefers a non-greasy preparation that rubs into the skin. The patient is going to use the medication on extensive areas of skin, requiring approximately 10 g per application twice a day. A prescription for 454 g (1 lb) of cream will last almost 2 weeks, and two refills will allow more than enough medication until the next appointment in 4 weeks.

DRESSINGS AND BATHS

Key Points

1. Dressing may be dry, wet, or occlusive
2. Baths can be considered a form of wet dressing

Dressings are useful as protective coverings over wounds. They prevent contamination from the environment, and many absorb serum and blood.

Dry dressings are used to protect wounds and to absorb drainage. They usually consist of absorbent gauze secured with adhesive tape. Adhesive tape can cause allergic contact dermatitis, in which case hypoallergenic tapes may be used. These are made of an acrylic plastic adhesive mass with a plastic or cloth backing. After surgery, the skin is often painted with an adhesive that contains benzoin, which may also be responsible for allergic contact dermatitis. Dry dressings may be non-adherent or adherent. *Non-adherent dressings* are used for clean wounds. When changed, they should not pull off newly formed epithelium. An example of a non-adherent dressing is petrolatum-impregnated gauze. *Adherent dressings* are used for debridement of moist wounds. The dressings may be dry or wet at first. For dry dressings, gauze is applied and changed regularly. For wet-to-dry dressings, water, saline, or an antiseptic solution is added to the dressing and allowed to dry. Accumulated debris is removed, although removal may be painful. Discomfort can be reduced if adherent dressings are first moistened (i.e., remoistened) before removal.

Wet dressings are used to treat acute inflammation. They consist of gauze, pads, or towels soaked continuously with water, an *astringent* (drying agent), or an antimicrobial solution. They soothe, cool, and dry through evaporation. In addition, when changed, they remove crusts and exudate. Water is the most important ingredient of wet dressings, but astringents such as aluminum acetate (Domeboro) and antiseptics such as povidone-iodine (Betadine) are frequently added. Impermeable covers such as plastic should *not* be placed over wet dressings because of the maceration that would ensue.

Occlusive dressings made of semipermeable plastic membranes (e.g., Duoderm) promote wound healing by maintaining a moist environment. They are frequently used on chronic ulcers, e.g., stasis ulcers. The moist environment allows migration of keratinocytes over the ulcer base to proceed more rapidly. In addition, occlusive dressings allow autodigestion of necrotic tissue by accumulation of inflammatory cells. For some wounds, e.g., donor graft sites, these dressings also significantly reduce pain.

Baths may be thought of as a form of wet dressing. They are effective in soothing, in decreasing itching, and in cleansing, and they are relaxing. They are used for acute eruptions that are crusting and weeping. They hydrate dry skin, but only if a moisturizer is applied immediately after the bath. Routinely used baths include tar emulsions (Cutar), colloidal oatmeal (Aveeno), and bath oils. Baths are limited to 30 min to prevent maceration, and are performed once or twice daily.

TOPICAL STEROIDS (GLUCOCORTICOSTEROIDS)

Key Points

1. Potency depends on steroid structure, concentration, and vehicle
2. Learn to use a low (hydrocortisone 1%), moderate (triamcinolone 0.1%), and high potency steroid (clobetasol 0.05%)

Perhaps no topical therapeutic modality is used more frequently than steroids because of their anti-inflammatory effects. The use of glucocorticosteroids applied directly to diseased skin has resulted in a high therapeutic benefit with relatively little local and systemic toxicity. The mechanism of action of topical glucocorticosteroids is complex and is not thoroughly understood.

POTENCY

The potency of a topical glucocorticosteroid depends on its molecular structure. For example, triamcinolone acetonide is 100 times more potent than hydrocortisone. In addition, the vehicle carrying the steroid is important. For a steroid to be effective, it must be absorbed. Penetration of glucocorticosteroids through the stratum corneum (and, hence, increased activity) is optimized by using non-polar, lipophilic glucocorticosteroid molecules compounded in vehicles that readily release the steroid.

Dozens of different topical glucocorticosteroids (**Fig. 4.1**) have been formulated for use in skin disease, with many of these developed on the basis of potency assays. Measurement of the ability of glucocorticosteroids to induce vasoconstriction or blanching of the skin, *vasoconstrictive assay*, is the most frequently used method of estimating relative potency. The results of the vasoconstrictive assay parallel those found in clinical studies. Because this assay is much simpler to perform than

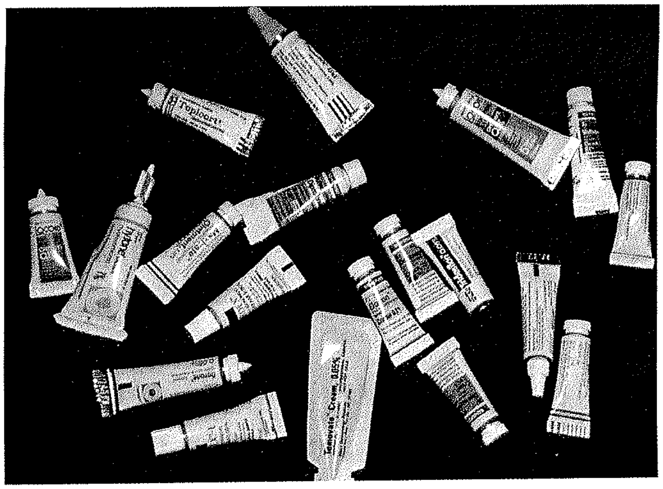

FIGURE 4.1 Multiple steroids – choose and become familiar with a low, medium, and high potency steroid.

TABLE 4.1 Topical steroids

Potency	Generic Name	(%)
Low	Hydrocortisone	1.0
Medium	Triamcinolone acetonide	0.1
High	Fluocinonide	0.05
Super-high	Clobetasol propionate	0.05

complicated clinical studies, it is widely used to screen specific formulations before they are used in clinical trials.

Vasoconstrictive assay is the most common method for measuring potency.

Table 4.1 lists some topical glucocorticosteroids with different potencies. The percentage of the steroid present is relevant only when comparing percentages of the same compound. Thus, triamcinolone acetonide 0.5% is stronger than its 0.1% formulation, but hydrocortisone 1% is much weaker than triamcinolone acetonide 0.1%. In addition, potency depends on the vehicle. The same preparation tends to be more potent in an ointment base than in a cream base because of enhanced percutaneous penetration.

SIDE-EFFECTS

Numerous hazards are involved with the use of topical glucocorticosteroids. In general, the more potent the glucocorticosteroid, the greater the likelihood of an adverse reaction. However, when patients are educated on proper use, side-effects are uncommon.

Topical side-effects:
1. Atrophy
2. Acne
3. Enhanced fungal infection
4. Retarded wound healing
5. Contact dermatitis
6. Glaucoma, cataracts

Systemic side-effects are worrisome but rarely occur. They include adrenal suppression, iatrogenic Cushing syndrome, and growth retardation in children. These complications have been reported with long-term, extensive use of potent topical steroids, particularly when these agents are used under occlusion. The recent introduction of super-high-potency topical steroids has increased the possibility of hypothalamopituitary axis suppression. These steroids should not be used for longer than two consecutive weeks, and the total dosage should not exceed 50 g/week.

Systemic side-effects:
1. Adrenal suppression
2. Cushing syndrome
3. Growth retardation

GUIDELINES FOR TOPICAL STEROID USAGE

A bewildering array of topical steroids is available in different vehicles. When prescribing a steroid preparation, one should consider several factors before making the selection of potency: vehicle, amount to be dispensed, and frequency of use. It is best to become familiar with one steroid in each class: lowest, medium, and high potency. By using only a few preparations, you will gain an enhanced appreciation of clinical efficacy, frequency of side-effects, available vehicles and volumes, and costs. Lowest-potency topical steroids are recommended for dermatoses that are mild and chronic, and involve the face and intertriginous regions. More potent steroids (medium and high) are used for dermatoses that are more severe and recalcitrant to treatment.

Once the appropriate potency has been selected, the vehicle (Fig. 4.2) should be chosen. Acute and subacute inflammations characterized by vesiculation and oozing are best treated with non-occlusive vehicles in a gel, lotion, or cream. Ointments, because of their occlusive properties, are better for treating chronic inflammation characterized by dryness, scaling, and lichenification. Because of their greasy nature, ointments are less acceptable esthetically. However, they have less potential for irritation and allergic reaction. Lotions and gels are best used on hairy areas such as the scalp.

Use creams on weeping eruptions, ointments on dry lichenified skin, and gels, foams, or solutions on hairy areas.

FIGURE 4.2 **Steroid cream, ointment, and gel** – vehicles are important.

Another consideration in topical steroid therapy is the frequency of application. The stratum corneum acts as a reservoir and continues to release topical steroid into the skin after the initial application. Applications once or twice a day are usually sufficient. Investigators have observed that chronic dermatoses, especially psoriasis, may become less responsive after prolonged use of topical steroids. This phenomenon is called *tachyphylaxis*. This diminished responsiveness after repeated applications has also been observed in vasoconstrictive assays.

Finally, the physician should instruct the patient in proper application and dispense sufficient medication to ensure adequate treatment. A good rule is to use the smallest quantity and the weakest preparation that are effective for a particular eruption. The need for continued treatment should be reviewed periodically.

PHOTOTHERAPY

Key Points

1. Positive effects are therapeutic
2. Negative effects are sunburn, photo-aging, and skin cancer

PHOTOBIOLOGY AND THERAPY

The sun emits a broad spectrum of electromagnetic radiation that is both ionizing (cosmic, gamma, and X-rays) and non-ionizing (UV, visible, infrared, and radio) (**Fig. 4.3**). The Earth's atmosphere absorbs one-third of the solar radiation. Of the radiation that reaches the Earth's surface, 60% is infrared, 37% is visible, and 3% is in the UV range. The UV spectrum is between X-ray and visible light, and composes the 200–400 nm wavelength band. It is subdivided into three groups based on physical and biologic properties: UVC (200–290 nm, germicidal spectrum); UVB (290–320 nm, sunburn spectrum); and UVA (320–400 nm). All the UVC radiation is filtered by the ozone layer, so only UVB and UVA rays reach the Earth's surface.

Because light has properties of waves and particles, two theories are used to describe its physics. The wave theory relates the speed of light to its wavelength and frequency; the light spectrum is divided according to its wavelength (nanometers, nm). The quantum theory is based on the existence of a particle of energy (photon) and relates light energy (joules, J) directly to frequency and inversely to wavelength.

The positive effects of UV radiation include vitamin D metabolism and phototherapy of cutaneous diseases. Numerous diseases are responsive to UV radiation alone or in combination with a photosensitizing drug (photochemotherapy). These diseases include psoriasis, dermatitis, pityriasis rosea, pruritus, vitiligo, and mycosis fungoides. However, these beneficial effects must be weighed against the potential adverse effects, which include sunburn, aging, and skin cancer.

For therapeutic purposes, sunlight is the least expensive source of UV radiation. However, because of its varying intensity and availability, it is often not the optimal source. To overcome these disadvantages, artificial light sources were developed. Fluorescent bulbs are placed in a light box for office use or are combined in groups of two or four for self-treatment at home. The enhancement of phototherapy using tar is sometimes used to treat psoriasis. High-intensity UVA fluorescent bulbs were developed and combined with psoralens in the photochemotherapy of psoriasis (*PUVA*, or *psoralens* plus *UVA*). PUVA is also used for selected patients with vitiligo, mycosis fungoides, and atopic dermatitis. However, close supervision, experience in use, and awareness of adverse effects are necessary for proper administration of UV radiation.

SUN PROTECTION

Excessive exposure to solar irradiation results acutely in sunburn and chronically in premature aging (**Fig. 4.4**) and carcinogenesis. These adverse effects may be prevented with the use of topical sunscreens and protective clothing, and by avoiding midday exposure when sunlight is most intense.

Sun protection includes: sunscreen with at least SPF30, protective clothing, and avoiding midday sun.

Cosmic	Gamma	X-ray	Ultraviolet			Visible	Infrared	Radio
			UVC	UVB	UVA			

200 290 320 400 nm

FIGURE 4.3 **Electromagnetic spectrum.**

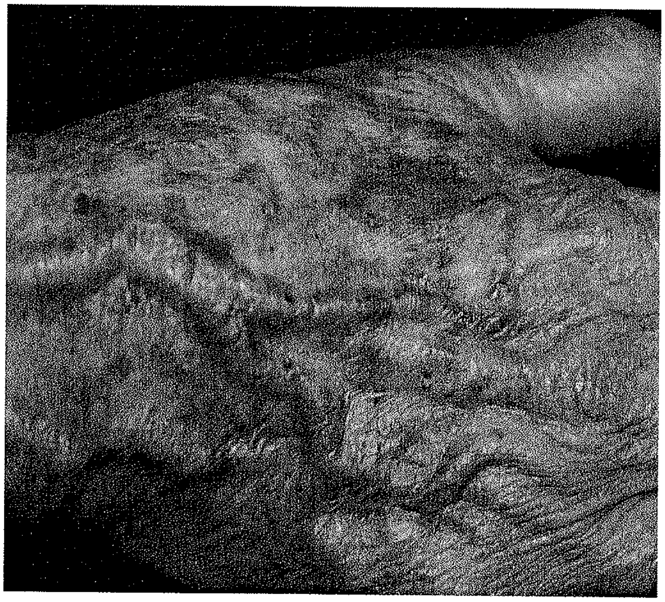

FIGURE 4.4 Photo-aged skin – note the actinic damage – brown macules, fragility, and purpura.

The amount of protection afforded by a sunscreen is measured by its sun protective factor (SPF). In general, to provide adequate protection, a sunscreen should have an SPF of 30. The SPF is calculated by comparing the amount of time required to produce erythema (minimal erythema dose, MED) in skin covered with a sunscreen divided by the time required to produce erythema in an unscreened control site. Thus, a sunscreen with a SPF of 10 would allow a person who normally burns in 20 min to be exposed for as long as 200 min before burning occurs.

The two broad categories of sunscreens are chemical and physical. The most widely used chemical sunscreens contain para-aminobenzoic acid (PABA) esters, benzophenones, salicylates, anthranilates, and cinnamates, and are available in cream, lotion, spray, or gel vehicles. Physical sunscreens contain titanium dioxide, zinc oxide, or talc in creams or pastes. Sunscreens with benzophenone combined with PABA esters are those most often used to protect against sunburn, which is primarily due to UVB radiation, and, to a lesser degree, to protect against UVA. Many moisturizers that are advertised as having 'anti-aging' properties contain sunscreens. Newer sunscreens containing avobenzone (Parsol) or ecamsule (Mexoryl) are particularly helpful for patients who have photosensitivities provoked by UVA and for those who are receiving PUVA therapy.

An additional measure of a sunscreen is its ability to remain effective when the person using it is sweating or swimming. This property is called *substantivity* and has been found to be a function of both the active sunscreen and its vehicle. At present, no universally accepted means of expressing substantivity exists, as there is with SPF. In choosing a sunscreen, phrases such as *water resistant* or *waterproof* indicate a preparation's substantivity.

Topical sunscreens are not without mild irritant cutaneous and ocular adverse reactions. However, allergic contact dermatitis or allergic photocontact dermatitis rarely occurs from sunscreen ingredients.

DIAGNOSTIC TESTS

Key Points

1. Microscopic examination is frequently diagnostic
2. Sample selection is critical in obtaining the proper diagnostic specimen

In general, laboratory tests serve as important tools that are relied on, sometimes too heavily, as diagnostic aids. Imaging studies and blood and urine tests are occasionally helpful for patients suspected of having a systemic disease. For example, an antinuclear antibody test should be ordered in a patient with skin lesions of lupus erythematosus. A serologic test for syphilis is appropriate in a patient with a skin rash in which syphilis is considered to be a possible cause. However, because most dermatologic diseases are limited to the skin, tests for systemic disease are less frequently indicated than are microscopic examinations, cultures, biopsies, and patch tests, which more specifically involve the skin.

As a highly accessible organ, the skin lends itself to direct laboratory examination. Specimen gathering is easy, minimally traumatic, and often highly rewarding diagnostically. Numerous tests can be performed in the office, with results immediately available. For other tests, specimens must be sent to the microbiology or pathology laboratory for further evaluation.

Diagnostic tests include:
- Microscopic examination
- Cultures
- Biopsy
- Patch testing

POTASSIUM HYDROXIDE MOUNT FOR DERMATOPHYTIC INFECTIONS

For undiagnosed scaling lesions of the skin, a fungal origin must be excluded. The best way to do this is with a potassium hydroxide (KOH) preparation of the scale scraping. In experienced hands, this simple test is more sensitive than fungal culture. For those just learning to perform KOH examinations, hyphae are more easily said than seen. The following steps should be followed in performing this examination:

If it scales, scrape it!

1. *Vigorously* scrape the scale from the edge of the scaling lesion onto a microscopic slide (Fig. 4.5). Use a no. 15 scalpel blade for scraping. Avoid

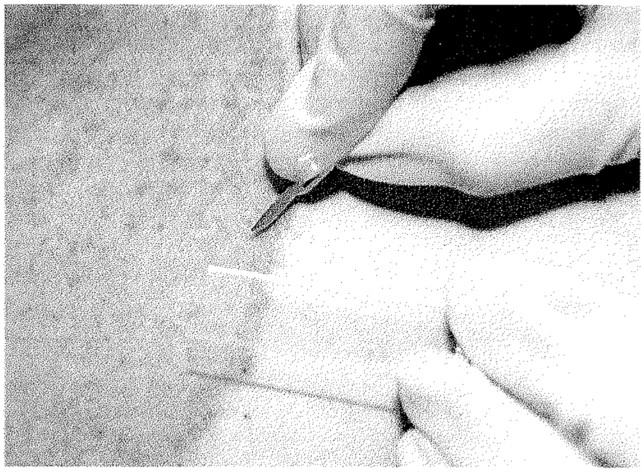

FIGURE 4.5 Obtain scales for fungal KOH preparation at the inflammatory margin of the patch.

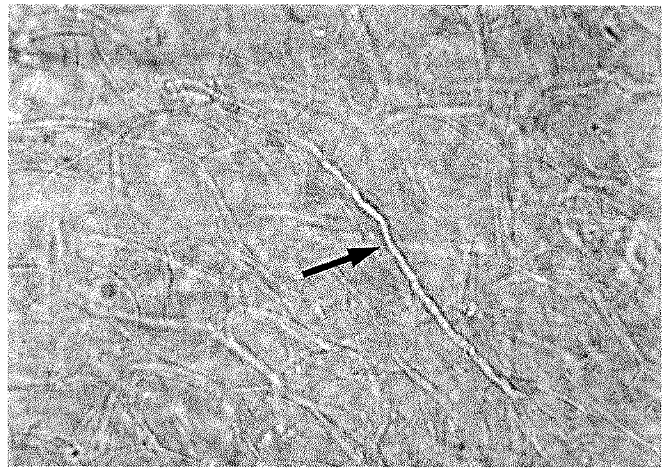

FIGURE 4.6 Positive KOH showing fungal hyphae (arrow).

extremely thick pieces of scale, because they are difficult to examine.

2. Place no more than 1 or 2 drops of 20% KOH with dimethylsulfoxide (DMSO) on the scale before covering with the coverslip.
3. *Blot* out the excess KOH by firmly pressing a paper towel on top of the coverslip and slide. This important step achieves two purposes. First, it spreads the cells into a thin layer on the slide. A monolayer of cells is desired for the microscopic examination; grossly, this looks like a cloudy film under the coverslip. Second, the blotting removes excess KOH on and around the coverslip; the microscope objective can be permanently etched by contact with KOH.
4. When examining the preparation under the microscope, use *low illumination*. This is most easily achieved by racking the light condenser down all the way. Bright illumination 'washes out' the preparation so that hyphae 'disappear.'
5. Scan the *entire* coverslip under low power (×10). In the cellular areas, look for the hyphae, which often appear as slightly refractile branching tubes (**Fig. 4.6**). When suspicious elements are seen, use the high dry objective (×45) for confirmation.
6. Unlike mucous membrane preparations for candidiasis, in skin scrapings, hyphae are often sparse. *Careful search*, sometimes with multiple preparations, is indicated when there is a high index of suspicion that a lesion may be fungal.

POTASSIUM HYDROXIDE PREPARATION FOR CANDIDAL INFECTION

In addition to causing scale, candidal infections may cause pustules. Sometimes, the pustules predominate and are a good source of material for KOH examination. The specimen is prepared and examined exactly as outlined above. KOH preparations are particularly useful for diagnosing candidal infections because the finding of hyphae or pseudohyphae is diagnostic of *infection* with this organism. Spores are inadequate for diagnosis of infection; yeast organisms, including *Candida albicans*, can colonize skin without infecting it. For this reason, a culture growing *C. albicans* does not necessarily implicate infection, whereas finding hyphal forms on KOH examination does.

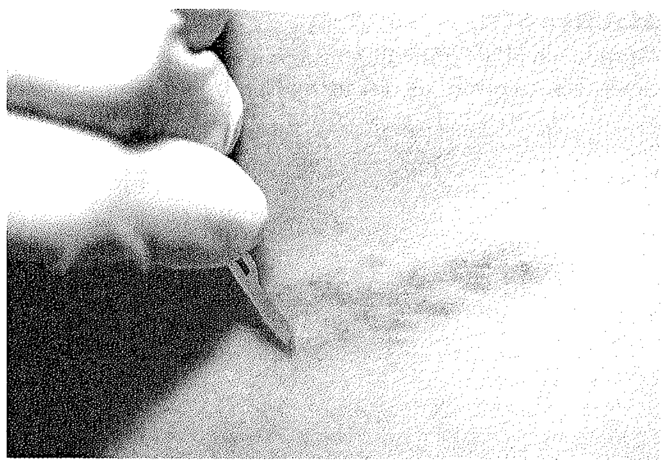

FIGURE 4.7 Scrape the base of the blisters for a Tzanck preparation.

Hyphae, not spores, are the diagnostic findings in candidal infections.

TZANCK PREPARATION

The Tzanck preparation provides an opportunity to make an immediate diagnosis of a herpes simplex or varicella-zoster infection. The preferred specimen is the scraping of the contents and base of a freshly opened vesicle (**Fig. 4.7**). This material is placed on a glass slide, air-dried, methanol fixed, and then stained for 10 s with toluidine blue. Inclusion bodies are not well seen, but the finding of multinucleate giant cells is diagnostic for infection with either herpes simplex or varicella-zoster virus (Fig. 4.8).

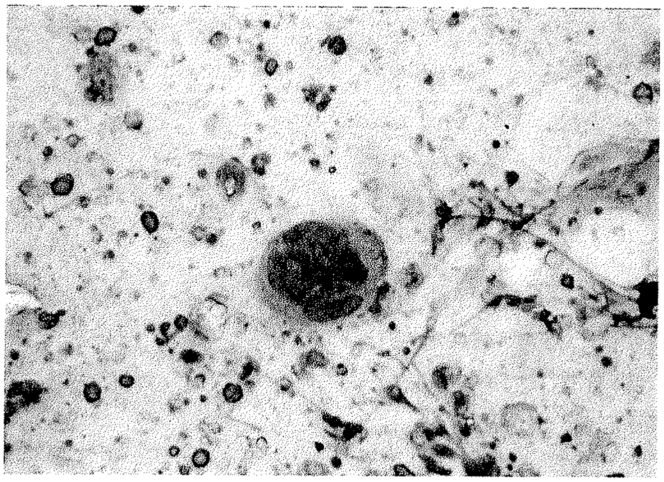

FIGURE 4.8 Positive Tzanck preparation showing multinucleated giant cell typical of a herpesvirus infection.

SCABIES SCRAPING

Finding a scabies mite under the microscope confirms the diagnosis as well as ensuring treatment compliance, should the patient be skeptical. Burrows produce the highest yield, but, because their presence alone is diagnostic, scraping a burrow serves only to dramatize the diagnosis. On close inspection of the burrow, the adult scabies mite is sometimes barely visible as a tiny black speck. Under the microscope, it appears more impressive. A scraping may be more helpful when definite burrows are not found, in which case small papules or questionable burrows are scraped. The scraping is done with a no. 15 scalpel blade moistened with oil (any oil) so that the scraped skin adheres to the blade, from which it can be easily transferred to a drop of oil on a glass slide, covered with a coverslip, and examined microscopically. In scraping, the scalpel blade is held perpendicular to the skin surface. The key to a successful test is to scrape *vigorously*. Alternatively, *KOH* can be used in place of oil on the slide.

CULTURE

The microbiology laboratory can confirm and further characterize bacterial, viral, and fungal pathogens, some of which may initially be identified in an office microscopic examination.

Organisms for both superficial and deep fungal infections can be isolated from an appropriate skin specimen. For a superficial fungal (dermatophyte) infection, this specimen is simply a collection of scales scraped or vigorously swabbed from the surface of the lesion. For deep fungal infections, skin tissue is needed and is obtained most easily with a punch biopsy from the active border of the lesion. Tissue should simultaneously be sent to the pathology laboratory for histologic examination to include special fungal stains. If the specimen is sufficiently large, it may be bisected; otherwise, two biopsy specimens should be collected.

Material for bacterial culture should be obtained from intact pustules, bullae, or abscesses. If only crusts are present, they should first be removed so that the underlying exudate can be swabbed and cultured. More invasive procedures are required for deeper bacterial infections. For bacterial cellulitis, the responsible organisms can sometimes be retrieved from the involved site by injecting and aspirating 0.5–1 mL of non-bacteriostatic saline. Cultures of skin biopsies may also be rewarding, especially for mycobacterial infections of the skin. Some atypical mycobacteria grow only at room temperature, so to handle the skin tissue properly, the laboratory needs not only the specimen but also the clinician's diagnostic considerations.

Intact pustules, bullae, or abscesses are the source of specimen for bacterial cultures.

Viral cultures must be transported in a viral transport medium, which can be obtained from the viral laboratory. For herpes cultures, a vesicle is opened or a crust is unroofed, and the underlying serum is swabbed. The swab is placed in the transport medium, and the container is returned to the laboratory for processing. Herpes simplex cultures have a high yield, but herpes varicella-zoster grows either slowly (7–10 days) or not at all. An immunofluorescent staining technique for herpes varicella-zoster produces a much higher yield in a much faster time (same day). The test is performed on a vesicle fluid smeared on a special slide, which is returned to the virology laboratory for testing.

SKIN BIOPSY

In no other organ-based specialty is tissue so easily available for histologic examination as in dermatology. Although a biopsy is not necessary to diagnose the majority of skin disorders, in certain circumstances its value cannot be overemphasized. The following serve only as examples. Already mentioned is the mandate that skin nodules of uncertain origin must undergo biopsy to rule out malignancy. For plaques with unusual shapes and colors, a diagnosis of mycosis fungoides, a cutaneous T-cell lymphoma, may be confirmed with a skin biopsy, but sometimes only after multiple biopsies have been taken serially over time. A skin biopsy is usually necessary to secure the exact diagnosis of a primary blistering disorder. In lupus erythematosus, the information obtained from a skin specimen may help to establish the diagnosis.

Occasionally, excisional biopsies are preferred (e.g., for melanoma), but for most skin lesions a punch or shave biopsy is more convenient to perform. For a punch biopsy, a 3 mm instrument is standard, but punches are available in sizes ranging from 2 to 8 mm. The procedure is simple. After the skin is infiltrated with a local anesthetic (Fig. 4.9), the punch is drilled into, and preferably through, the skin (**Fig. 4.10**). The specimen then is *gently* lifted and snipped off at the subcutaneous fat level. Hemostasis can be achieved simply with pressure or absorbable gelatin (Gelfoam) packing. Occasionally, the skin defect is closed with a suture to stop bleeding.

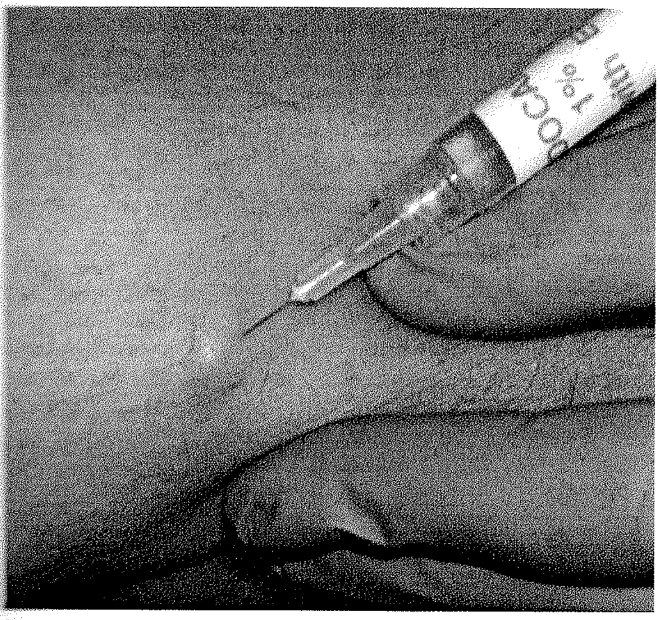

FIGURE 4.9 Use 1% lidocaine, usually with epinephrine (less bleeding) and a 30-gauge needle (less pain), to raise a wheal for local anesthesia.

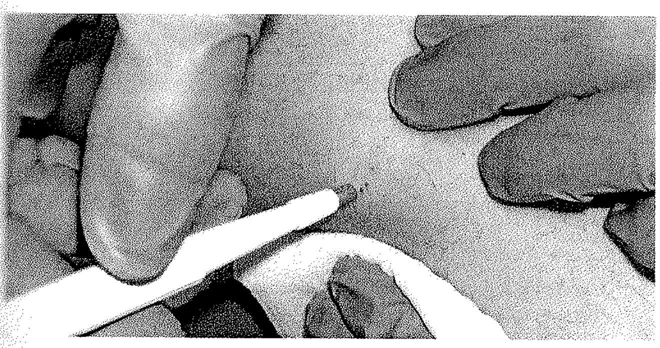

FIGURE 4.10 Use a twisting action when doing a punch biopsy to sample epidermal and deeper dermal tissue.

Note that, in the foregoing procedure, gentleness is emphasized. A biopsy specimen will be artifactually damaged, sometimes to the point of being histologically uninterpretable, if it is squeezed too firmly with the tissue forceps. To avoid this problem, one should either lift the specimen gently from below or grasp it by the very edge. With nodules and other dermal processes, it is particularly important that the specimen be of full thickness. For processes involving the subcutaneous fat, even deeper and larger specimens may need to be obtained.

Extremely superficial lesions can undergo biopsy or be removed with a shave technique. A wheal is raised with the anesthetic injection, after which the area is shaved with a scalpel blade maneuvered either parallel to the surface or in a slight 'scooping' fashion (Fig. 4.11).

For most skin lesions, adjacent normal skin is not needed, so the biopsy should be obtained from the center of the lesion. The exception is with blistering disorders, in which case the biopsy should be taken from the edge of an early lesion to include a portion of the adjacent, non-blistered skin. This is needed to identify the exact histologic origin of the blister.

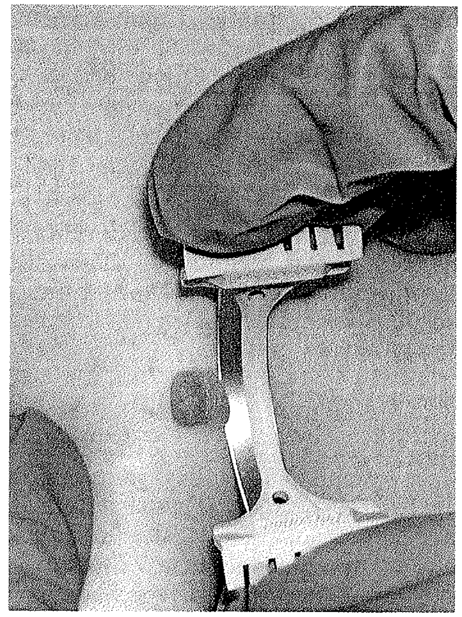

FIGURE 4.11 Shave biopsy is the most common technique for obtaining a superficial biopsy.

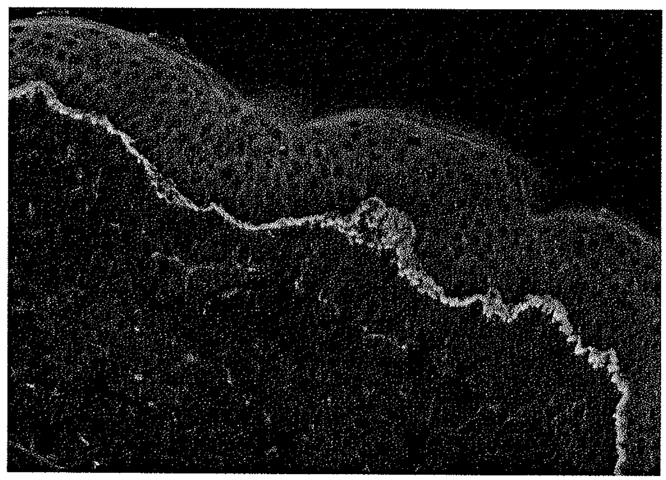

FIGURE 4.12 Positive immunofluorescence showing a linear deposit of immunoglobulin G at the dermal–epidermal junction, characteristic of bullous pemphigoid.

For routine histologic processing and for most special stains, the specimen is placed in formalin. For electron microscopy, buffered glutaraldehyde is used. With immunofluorescence testing, the specimen must be either immediately snap-frozen or placed in a special buffered transport solution.

IMMUNOFLUORESCENCE TEST

For the diagnosis of blistering disorders such as pemphigus, bullous pemphigoid, and dermatitis herpetiformis, immunofluorescence tests on skin (direct) and, sometimes, serum (indirect) are invaluable and widely used (Fig. 4.12). These techniques detect autoantibodies directed against portions of skin. For example, immunoglobulin (Ig) G antibodies deposited at the basement membrane in pemphigoid are detected by direct immunofluorescence testing using the patient's skin and fluorochrome-labeled anti-IgG antibodies. The same test may also be useful in helping to diagnose lupus erythematosus, in which it is called the *lupus band test.* The presence of IgM, IgA, complement, and fibrin can also be detected with appropriate reagents.

ELECTRON MICROSCOPY

An electron microscopic examination of skin tissue is less often indicated but is helpful in diagnosing several uncommon disorders, including Langerhans cell histiocytosis and subtypes of the inherited mechanical bullous disease, epidermolysis bullosa.

PATCH TESTING

Patch testing is a valuable tool for identifying responsible allergens in patients with allergic contact dermatitis. These tests detect delayed (type IV) hypersensitivity responses to contact allergens. Patch test reactions take several days to develop and hence differ from scratch tests, which evoke immediate (type I) hypersensitivity responses (within minutes). Either specifically suspected substances may be tested, or an entire battery of allergens may be screened. For either purpose, standardized trays of common sensitizing chemicals are available, each appropriately diluted in water or petrolatum. These test materials are applied to the skin under occlusive patches that are left in place for 48 h. The patches then are removed, the sites inspected, and positive reactions noted (Fig. 4.13). Because these delayed hypersensitivity responses sometimes take more than 48 h, a final reading at 72–96 h is recommended. If positive tests are found, the last and most important step is to determine their clinical relevance. In itself, a positive patch test does not prove that agent to be the cause of dermatitis. Clinical correlation with an appropriate exposure history is required. Patch testing should not be done with unknown chemicals because severe irritant reactions with residual scars can result. Contact dermatitis and patch testing are discussed further in Chapter 8.

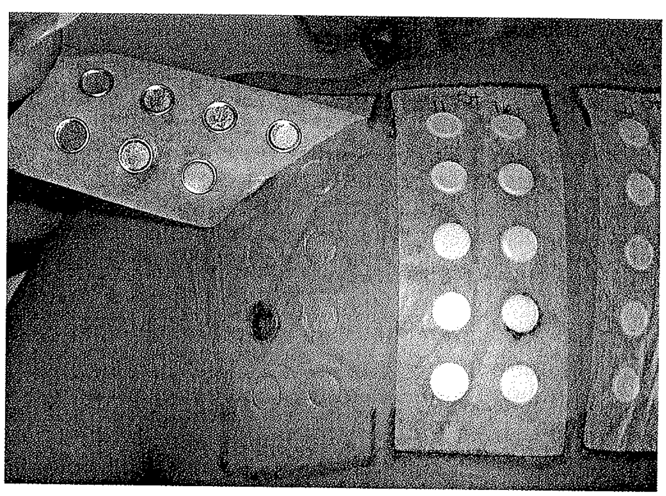

FIGURE 4.13 Removing patch tests on day 2 to detect a delayed-type hypersensitivity reaction.

Patch tests are used to detect contact allergens and confirm allergic contact dermatitis.

DERMATOLOGIC SURGERY

Key Points

1. Know the surgical options
2. Know how to handle complications
3. Obtain informed consent

Numerous techniques are available for surgery of the skin. The three most common and simplest procedures are elliptical excision, curettage and electrodesiccation, and cryosurgery. For defects that cannot be closed primarily, skin flaps or grafts may be used. A specialized form of cancer surgery, *Mohs technique*, involves serial excisions of tissue, which are systematically mapped and microscopically examined to define the extent of cancerous invasion and to ensure that surgical margins are free of tumor. This technique is the most successful means of treating basal cell and squamous cell carcinomas.

Mohs technique is the most effective surgery for basal and squamous cell carcinoma. It is most frequently used for recurrent and facial carcinomas.

Before surgery, the patient should be informed of the procedure chosen, why it is necessary, and what to expect and do after surgery. The potential complications of the procedure, including excessive scar formation, infection, bleeding, and nerve injury, should be explained. When properly selected and technically well performed, simple excision, curettage and electrodesiccation, and cryosurgery usually have no significant complications.

Surgery explanation includes: procedure, potential complications, and what to do after the operation.

EXCISION

The simple elliptical excision is used for obtaining tissue for biopsy and for the removal of benign and cancerous lesions. The axis of the lesion, cosmetic boundaries (e.g., the vermilion border of the lip), and skin lines should be taken into consideration when planning the excision. Most procedures require a minimal number of instruments, including a needle holder, small forceps, skin hook, small clamp, small pointed scissors, syringe, and needle (30 gauge), and a no. 15 scalpel blade plus handle. Disposable sterile gloves, eye sheet, and gauze are also necessary.

Numerous antiseptics are available for preoperative preparation of the skin, including 70% isopropyl alcohol,

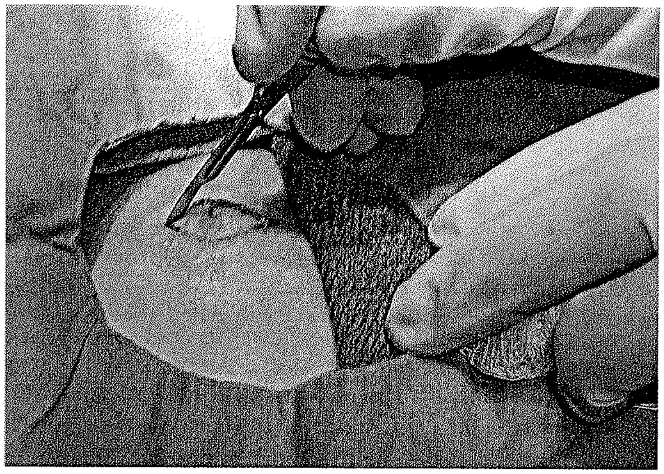

FIGURE 4.14 Excision demonstrating that the length is three times greater than the width, and the cut is perpendicular to the skin surface.

povidone-iodine (Betadine), and chlorhexidine gluconate (Hibiclens). The boundaries of the excision are marked. This is done before injection of local anesthesia because the volume of anesthetic distorts the normal skin contours. The preferred local anesthetic is 1% lidocaine because of the rarity of allergic reactions. In addition, lidocaine, an amide, does not cross-react with procaine hydrochloride (Novocain), an ester. Transdermal anesthesia with a topical anesthetic cream can be applied under an occlusive dressing 1–2 h before the procedure to reduce the pain associated with injection.

Lidocaine (Xylocaine) does not cross-react with procaine hydrochloride (Novocain).

Normal saline or diphenhydramine hydrochloride (Benadryl) may be used for local anesthesia if lidocaine cannot be used. The addition of epinephrine to lidocaine prolongs its anesthetic effect and reduces operative bleeding. Care should be taken when using epinephrine in the earlobe and digits to avoid ischemic changes secondary to vasoconstriction.

The length of the ellipse should be three times the width to ensure easy closure. The cut should be made perpendicular to the surface and through the dermis into the subcutaneous tissue (**Fig. 4.14**). Hemostasis is achieved with pressure, electrodesiccation, or suture ligation. Repair of the wound is easy if an adequate ellipse has been formed, the edges are perpendicular, and skin lines are followed. If the defect is large, the edges may be undermined to reduce closure tension. Buried absorbable suture is used to close deeper layers. Numerous methods are used for skin closure: interrupted sutures with monofilament nylon is the simplest method. In most cases, 5-0 or 4-0 sutures are adequate for both subcuticular and skin closure. The removal of skin sutures depends on the site, wound tension, and whether buried sutures have been used. In general, facial sutures are removed in 5 days, and trunk and extremity sutures are removed in 1–2 weeks. Most wounds are dressed with either sterile adherent bandages or gauze secured with tape. Paper tape with an acrylic adhesive mass should be used in patients with a history of tape sensitivity. Topical antibiotics are not necessary after surgery. The patient is instructed to keep the wound dry for 24 h, to change the dressings daily, and to return to the clinic if bleeding, purulent drainage, or excessive pain or swelling occurs. Postoperative pain is usually negligible, requiring only acetaminophen.

The length of elliptical excision is three times its width.

Suture removal:
- Face: 5 days
- Trunk and extremities: 1–2 weeks

CURETTAGE AND ELECTRODESICCATION

The procedure of curettage and electrodesiccation is used most often for the treatment of selected small basal cell and squamous cell carcinomas. It is a deceptively simple procedure that requires proper selection of tumor and a skilled practitioner. Otherwise, the recurrence rate is unacceptably high. The tumor is prepared and anesthetized with a local anesthetic. The *curette*, an oval instrument with a cutting edge, is used to remove the soft cancerous skin. The tumor margins are determined by 'feel,' with normal skin having a firm and gritty consistency. After curettage, the base and borders of the wound are electrodesiccated to destroy residual tumor and to provide hemostasis. The wound heals by secondary intention in 2–3 weeks.

Curettage and electrodesiccation require experience to avoid a high recurrence rate.

CRYOSURGERY

Keratoses and warts are frequently treated with cryosurgery. Liquid nitrogen (−195.6 °C) is the standard agent because it is inexpensive, rapid, and non-combustible. Tissue destruction is caused by intercellular and extracellular ice formation, by denaturing lipid–protein complexes, and by cell dehydration. This treatment usually requires no skin preparation or anesthesia. Liquid nitrogen application is accomplished with direct spray and usually requires <30 s (**Fig. 4.15**). A repeat freeze–thaw cycle results in more cellular damage than a single cycle.

During the procedure, the patient feels a stinging or burning sensation. Subsequently, burning occurs along with tissue swelling. Within 24 h, a blister often forms in the treated area. If the blister is excessively large or painful, the fluid should be removed in a sterile manner. Otherwise, it is allowed to heal spontaneously.

Treatment of skin cancers with cryotherapy requires an operator experienced with thermocouple devices to ensure adequate freezing for tissue destruction.

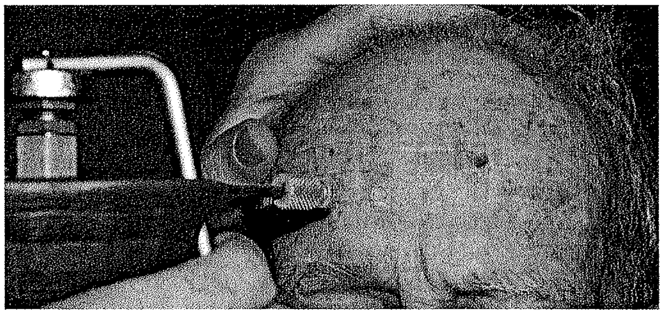

FIGURE 4.15 Cryotherapy of a seborrheic keratosis – using a spray unit, the white freeze cycle should last about 10 s.

Postoperative morbidity includes significant tissue edema and necrosis.

PATIENT EDUCATION

Key Points

1. Verbal and written communication is important
2. Education enhances understanding and compliance

A dialogue must be established between the physician and the patient. This is begun during the history and physical examination. Once a diagnosis is established, the patient should be told what the disease is, what its cause is, and what to expect from treatment. Patients are frequently hesitant to ask certain questions because they are either afraid or embarrassed. It is important that these unasked questions be answered: Is my disease contagious? Is it cancer? Do I have something wrong internally that is causing my skin problems?

Answer the unasked questions:
- Contagious?
- Cancer?
- Internal?

For therapy to be successful, patient cooperation and compliance are necessary. To ensure this goal, therapeutic options, expected outcome, and potential side-effects should be explained. Instructions on how to use topical medications must be demonstrated. All too frequently, too much medication is applied, and it is not rubbed in sufficiently. For example, when applying a white cream, patients should be instructed to apply sparingly and rub it in until it 'disappears.' If white cream remains on the surface, either too much has been applied or it has not been rubbed in sufficiently. Dressings may be either too wet or too dry, or left on too long, resulting in maceration. These pitfalls are avoided when the medication or dressing is applied to the area of dermatitis as a demonstration while the patient is in the office.

Patient instruction sheets augment the spoken word. They inform and instruct patients. Frequently, medical problems and therapies are complex, and the patient fails to understand them. Instruction sheets save time, reinforce what has been told to the patient, answer unasked questions, and provide a reference for the patient to read.

Penn State Hershey's Dermatology website (www.PennStateHershey.org/dermatology) provides a lot of patient education material and links to other trusted websites.