

SECTION 1

Basic Considerations

Structure and Functions of Skin

STRUCTURE OF SKIN

Epidermis is the keratinising stratified squamous epithelium that covers the body. Under it lies the dermis and the subcutaneous fat (hypodermis). Within the dermis are present epidermal appendages viz. hair follicles, eccrine and apocrine sweat units and nail units. Structure of skin is shown in Fig. 1.1.

Epidermis

Epidermis provides a tough, dry and semipermeable covering for the body (Fig. 1.2). It does this by producing a protein called keratin. Hence, epidermal cells are known as keratinocytes. The epidermal basal layer is the germinative layer of the epidermis and is thus continuously multiplying. Ordinarily, epidermal layer is 10–15 cells thick.

As the basal columnar epidermal cells multiply, mature and produce more and more keratin, they move up towards the surface and assume polygonal shapes. These polygonal cells are connected to each other by desmosomal bridges that are seen as spines under the ordinary microscope. Hence,

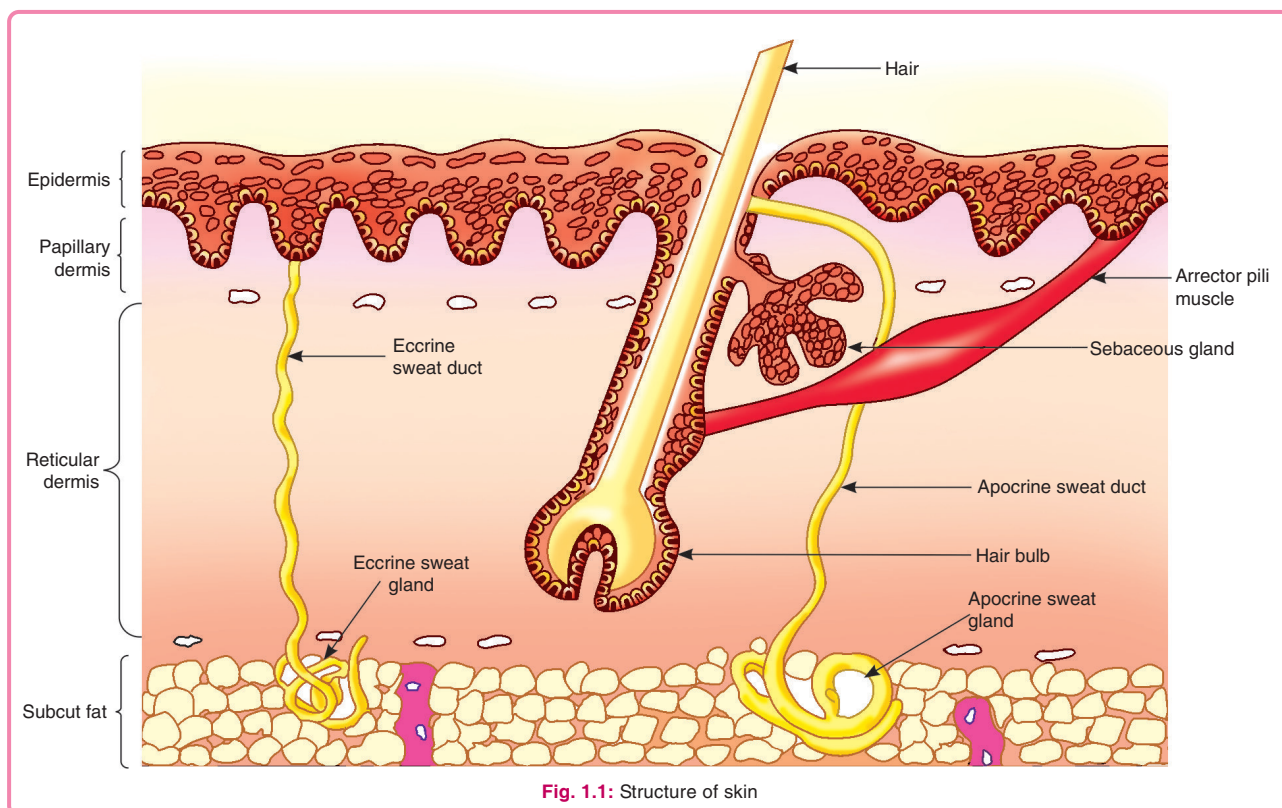
this layer, which forms the substance of the epidermis, is known as the spinous layer (stratum spinosum).

Further maturation and upward movement of keratinocytes is accompanied by appearance of keratohyaline granules within the cells, which now become flattened (elongated on cross section). This layer is called granular layer (stratum granulosum). Keratohyaline granules provide the matrix for the fibrous protein, keratin.

Stratum corneum or the cornified layer is the topmost layer of epidermis. Its fully matured red cells contain keratin in its final form. As keratinocytes mature they lose their nuclei and cellular organelles and hence the stratum corneum cells are dead cells without nuclei. After some days, these cornified cells are gradually shed as individual squames and their place is taken by newly formed cells.

Epidermis is thus in a state of dynamic balance between multiplication of basal cells and shedding of cornified cells.

Melanin, the pigment responsible for skin colour, is made by melanocytes. Melanocytes are situated in the basal layer of the skin and distribute



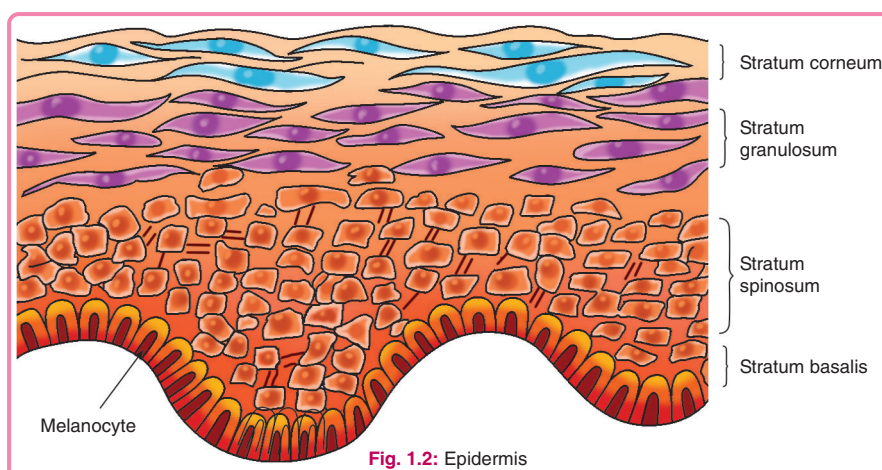


Fig. 1.2: Epidermis

their pigments by means of dendrites to the surrounding keratinocytes.

Dermoepidermal junction : The epidermal-dermal interface is not a straight line but an undulating one. The alternating thicker parts of the epidermis are known as the rete pegs as they fit like pegs into complementary valleys in the papillary dermis. The corresponding alternating projecting parts of the papillary dermis are called dermal papillae. The dermoepidermal junction is also known as the basement membrane zone (BMZ). It consists of a lamina lucida, lamina densa and anchoring filaments.

Dermis

The dermis is made up of reticular dermis, which forms the substance of the skin, and the adventitial dermis. Reticular dermis provides strength and resilience to the skin through the collagen and elastic fibres that constitute it. These fibres are situated in a 'watery' matrix of mucopolysaccharides, called the ground substance. Adventitial dermis houses vascular and neural plexuses. It comprises papillary dermis that nourishes and innervates the epidermis and the periappendageal dermis that does the same functions for the epidermal appendages.

CUTANEOUS APPENDAGES

Folliculosebaceous Units

The hair follicle is a cup-like invagination of the epidermis that has its root in the deep dermis or sometimes (e.g. on scalp) in the subcutis. The germinative and matrical cells in its root produce a different keratin product that emerges on the surface as hair shaft. The hair follicle is continuously passing through the growth phase (anagen), degeneration phase (catagen) and resting

phase (telogen). (Please see chapter on alopecia for details). Hair follicles are present all over the body, except the palms/soles and mucocutaneous junctions. However, in some regions, e.g. over face, hair shafts are very thin and short (vellus hair), so that the hair are hardly visible.

The sebaceous glands are lobulated structures that produce sebum. Sebum is produced as a holocrine secretion by discharging the whole of the mature fat laden sebocytes into sebaceous

ducts that open into the follicular canal. Arrector pili muscles attach to the deeper portion of follicles and straighten them under the influence of the autonomic nerves (resulting in goose pimples). The point of attachment of arrector pili muscle is thicker than the rest of the follicle and is called the 'bulge' of the follicle. The follicular stem cells reside in the bulge area of the follicle. During early anagen, a new follicle develops from these cells.

Apocrine Sweat Units

These are present only in the axillae, groins, areola, perianal and perigenital regions. They may open into follicles or on the surface of skin through apocrine ducts. The apocrine gland is a coiled structure that lies at the junction of the dermis and subcutis, and is lined by secretory cells that make the apocrine sweat by discharging their terminal portions into the lumen by a process of 'pinching off'.

Eccrine Sweat Units

These are present over most parts of the body and are concentrated over palms/soles, face and scalp. They open on the surface of skin through eccrine ducts. The deeper part of the duct, situated in deep reticular dermis, is coiled, just like the secretory glandular part of the units. The glandular part is lined with cells that discharge sweat into the lumen by merocrine (discharging granules) method.

Nail Unit

This consists of the nail plate which sits on the nail bed (Fig. 1.3). Proximal and lateral sides of the nail plate fit into cutaneous invaginations called proximal and lateral nail folds that are continuous with the nail bed. The potential space between the nail plate and the proximal and lateral nail folds is sealed by the cuticle which is an extension of the

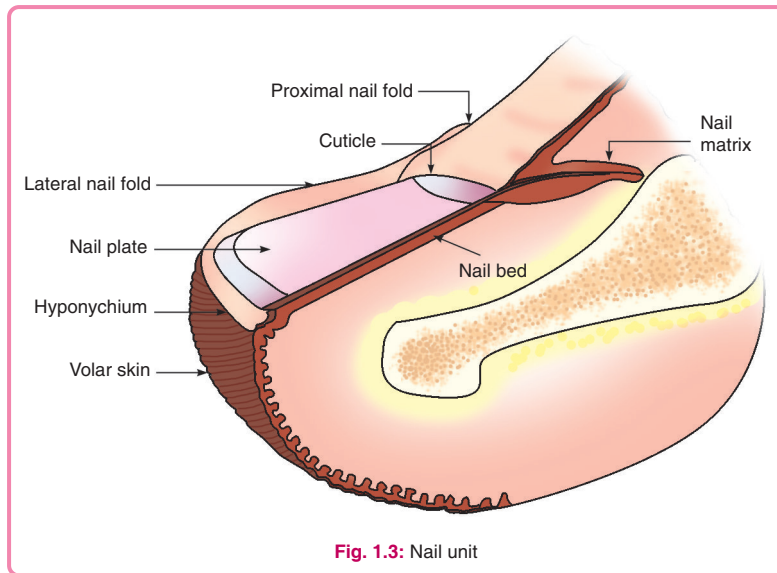


Fig. 1.3: Nail unit

stratum corneum of nail folds onto the nail plate. The proximal nail fold contains the nail matrix, the keratinocytes of which mature (keratinize) and form the nail plate.

Hypodermis (Subcutaneous Fat)

This is arranged as fat lobules that contain individual fat cells (adipocytes) amid a rich vascular plexus. The lobules are separated by fibrous septa that house larger vessels and nerves.

Organelles for Sensations

Special organelles are present in the skin for sensing various physical stimuli. Pain, temperature, crude touch and itch sensations are detected by free nerve endings. Meissner's corpuscles mediate the sensation of fine touch and are present mainly over the palms and soles. Pacinian corpuscles sense pressure and are also found over palms and soles. Sensation of cold is perceived by end bulb of Krause while end organ of Ruffini detects the sensation of heat.

Summary : Skin consists of the epidermis, dermis and hypodermis. Epidermal cells (keratinocytes) are continually multiplying and maturing (keratinising) to provide the protective stratum corneum. The epidermal layers from base to the top are stratum basalis, stratum spinosum, stratum granulosum and stratum corneum. Melanocytes within the epidermis produce melanin. Dermis consists of connective tissue, blood vessels and nerves situated in a matrix of 'ground substance'. Folliculosebaceous units, eccrine and apocrine sweat units and nail units are the cutaneous appendages.

FUNCTIONS OF SKIN

Skin is the largest organ of the body, both in terms of volume and weight. Its functions are as follows.

Protective Interface

The keratinised epidermis acts as an effective barrier against a variety of insults. These may be:

- **Chemical** (because it is impermeable to harmful water soluble substances).
- **Mechanical** (because the skin is tough and the subcutaneous fat provides a cushioning effect against blunt trauma).
- **Biological** (dryness, acidic pH and protective normal flora ward off infections).
- **Radiational** (melanin, the protective skin pigment, absorbs a wide range of harmful rays and hence minimises the risk of skin cancers).

Sensitive Interface

The sensations of touch, pain, temperature, etc., are essential for **protection** against danger. The sensation of touch is also used, between individuals, to express **emotions**. Facial skin reacts to emotions very fast.

Maintaining Balances

Skin maintains **water and electrolyte** balance by avoiding undue evaporation of body water or absorption of it. It has the capacity to concentrate or dilute sodium in sweat.

It maintains **thermal balance** by:

- Increased sweating causes cooling due to evaporation of sweat.
- Subcutaneous fat protects against excessive cold.
- The amount of blood flowing through the skin can be varied by peripheral vasodilation and opening up of arteriovenous shunts. This can suitably adjust the core temperature.

By peripheral vasodilation or constriction skin helps in maintaining normal **blood volume**.

Other Metabolic Functions

In the presence of sunlight, skin **manufactures vitamin D** from cholesterol. Subcutaneous fat acts

as a storehouse of energy in the form of fat. Fat cells actively participate in the dynamic lipid metabolism.

Aesthetic Function

Smooth, soft glowing skin is aesthetically valued. Feminine 'curves' and masculine 'cuts' are largely on account of the difference in the distribution of subcutaneous fat between women and men.

Summary : Skin not only serves the function of a protective and sensitive interface between the internal milieu of the body and the external environment, but also participates in regulating body temperature, water and electrolyte balance.

Pathology of the Skin

A skin biopsy is frequently needed to make or confirm a diagnosis in patients who pose diagnostic difficulty or do not respond adequately to therapy. Compared to biopsies of other organs, it is relatively non-invasive, can be carried out in a dermatologist's office under local anaesthesia and usually causes only an insignificant scar. Various

terms are used to describe the skin pathology under the microscope. Some of those terms are :

- Hyperkeratosis** : Thickening of stratum corneum (lichen simplex chronicus)
- Parakeratosis** : Retention of nuclei by cells in stratum corneum (psoriasis)
- Acanthosis** : Thickening of the spinous layer (psoriasis, lichen planus)
- Hypergranulosis** : Thickening of the granular layer (lichen simplex chronicus, lichen planus)
- Spongiosis** : Interstitial oedema of the spinous layer (eczemas)
- Ballooning** : Intracellular oedema of keratinocytes (herpes infection)
- Acantholysis** : Separation of keratinocytes due to loss of intercellular bridges (pemphigus)
- Dyskeratosis** : Collection of abnormal keratin within keratinocytes (squamous cell carcinoma, inherited disorders of keratinisation like Darier's disease)

MCQs

1. **The most superficial layer of epidermis is:**
 - a. Stratum germinativum
 - b. Stratum corneum
 - c. Stratum lucidum
 - d. Stratum granulosum
2. **The lowermost layer of epidermis is:**
 - a. Stratum germinativum
 - b. Stratum corneum
 - c. Stratum lucidum
 - d. Stratum granulosum
3. **The germinative layer of epidermis is called:**
 - a. Stratum basalis
 - b. Stratum corneum
 - c. Stratum lucidum
 - d. Stratum granulosum
4. **The non-nucleated layer of epidermis is called:**
 - a. Stratum basalis
 - b. Stratum corneum
 - c. Stratum malpighi
 - d. Stratum granulosum
5. **The nucleated epidermis is called:**
 - a. Stratum basalis
 - b. Stratum corneum
 - c. Stratum malpighi
 - d. Stratum granulosum
6. **The term 'spines' in the epidermis refers to:**
 - a. Keratohyaline granules
 - b. Odland bodies
 - c. Hemidesmosomes
 - d. Desmosomes
7. **Cells of this layer of epidermis are columnar:**
 - a. Stratum gasalis
 - b. Stratum spinosum
 - c. Stratum malpighi
 - d. Stratum granulosum
8. **Cells of this layer of epidermis are polygonal:**
 - a. Stratum basalis
 - b. Stratum spinosum
 - c. Stratum germinativum
 - d. Stratum granulosum
9. **The main protein in the epidermis is called:**
 - a. Desmin
 - b. Collagen
 - c. Elastin
 - d. Keratin
10. **The cells of epidermis are held together by:**
 - a. Keratohyaline granules
 - b. Odland bodies
 - c. Hemidesmosomes
 - d. Desmosomes
11. **The barrier of the epidermis lies within the:**
 - a. Stratum basalis
 - b. Stratum spinosum
 - c. Basement membrane
 - d. Stratum corneum
12. **Which of the following is a function of the skin?**
 - a. Protect against mechanical, chemical or biological attack
 - b. Maintain water and electrolyte balance
 - c. Maintain body temperature
 - d. All of the above
13. **The term hypodermis refers to:**
 - a. Epidermis
 - b. Lower part of dermis
 - c. Reticular dermis
 - d. Subcutaneous fat
14. **The cell organelles that help in maintaining the barrier function of the skin are:**
 - a. Keratohyaline granules
 - b. Odland bodies
 - c. Hemidesmosomes
 - d. Desmosomes
15. **The layer of epidermis which is usually seen only on the palms and soles is:**
 - a. Stratum basalis
 - b. Stratum spinosum
 - c. Stratum lucidum
 - d. Stratum granulosum
16. **Apocrine glands are present at all the following sites except:**
 - a. Palms and soles
 - b. Areola
 - c. Perineum
 - d. Axillae
17. **The apocrine duct opens into:**
 - a. Acrosyringium
 - b. Infundibulum
 - c. Sebaceous duct
 - d. None of these

18. The process of secretion of apocrine sweat is called:

- | | |
|-----------------|-----------------|
| a. Pinching off | b. Apocoptation |
| c. Merocrine | d. Holocrine |

19. The process of secretion of eccrine sweat is called:

- | | |
|-----------------|-----------------|
| a. Apocoptation | b. Holocrine |
| c. Merocrine | d. Pinching off |

20. Maximum density of eccrine glands is found on:

- | | |
|--------------------|------------|
| a. Palms and soles | b. Areola |
| c. Perineum | d. Axillae |

21. The spiral part of the eccrine duct within the epidermis is called:

- | | |
|------------------|-----------------|
| a. Apocrine duct | b. Eccrine pore |
| c. Acrosyringium | d. Infundibulum |

22. Which of the following skin glands has a lobulated structure?

- | | |
|-------------|--------------|
| a. Apocrine | b. Sebaceous |
| c. Eccrine | d. Merocrine |

23. Sebaceous glands are a type of:

- | | |
|---------------------|---------------------|
| a. Eccrine glands | b. Apocrine glands |
| c. Holocrine glands | d. Merocrine glands |

24. Glands involved in the pathogenesis of acne are:

- | | |
|---------------------|--------------------|
| a. Eccrine glands | b. Apocrine glands |
| c. Sebaceous glands | d. Thyroid glands |

25. Receptors responsible for fine touch sensation are:

- | |
|-------------------------|
| a. End bulb of Krause |
| b. Pacinian corpuscle |
| c. End organ of Ruffini |
| d. Meissner's corpuscle |

26. Receptors responsible for pressure sensation are:

- | |
|-------------------------|
| a. Free nerve endings |
| b. Pacinian corpuscle |
| c. End organ of Ruffini |
| d. Meissner's corpuscle |

27. Receptors responsible for pain sensation are:

- | |
|-------------------------|
| a. End bulb of Krause |
| b. Merkel cells |
| c. Free nerve endings |
| d. Meissner's corpuscle |

28. Which of the following is not a dendritic cell in the epidermis?

- | | |
|--------------------|----------------------|
| a. Langerhans cell | b. Merkel cell |
| c. Melanocyte | d. Dermal dendrocyte |

29. The part of the hair follicle to which the arrector pilorum muscle is attached is called:

- | | |
|-----------------|------------|
| a. Infundibulum | b. Isthmus |
| c. Bulge | d. Bulb |

30. The part of the hair follicle in which the follicular stem cells reside is:

- | | |
|-----------|----------------------|
| a. Matrix | b. Germinative layer |
| c. Bulge | d. Bulb |

31. The germinative cells of the hair follicle reside in:

- | | |
|-----------------|------------|
| a. Infundibulum | b. Isthmus |
| c. Bulge | d. Bulb |

32. The part of the hair follicle which is lined by layers resembling the epidermis is:

- | | |
|-----------------|---------|
| a. Infundibulum | b. Stem |
| c. Isthmus | d. Bulb |

33. The growth phase of the hair follicle cycle is called:

- | | |
|------------|------------|
| a. Anagen | b. Catagen |
| c. Telogen | d. Nanogen |

34. The number of scalp hair follicles at birth is approximately:

- | | |
|--------------|---------------|
| a. 10,000 | b. 100,000 |
| c. 10,00,000 | d. 10,000,000 |

35. The resting phase of the hair follicle cycle is called:

- | | |
|------------|------------|
| a. Anagen | b. Catagen |
| c. Telogen | d. Nanogen |

36. In healthy scalp at any given time the proportion of telogen follicles is about:

- | | |
|---------|--------|
| a. 1–2% | b. 5% |
| c. 10% | d. 25% |

37. The nail plate is mainly produced by matrix cells located in the:

- | | |
|---------------------|-----------------------|
| a. Nail bed | b. Proximal nail fold |
| c. Distal nail fold | d. Lateral nail fold |

38. The nail plate is made of:

- | |
|---------------------------|
| a. Hard collagen |
| b. Calcium and phosphorus |
| c. Keratin |
| d. Elastin |

39. The rate of growth of nail is related to:

- a. Length of finger
- b. Age of person
- c. Physiological state
- d. All of the above

40. Which of the following cells is derived from the neural crest?

- a. Langerhans cells
- b. Keratinocyte
- c. Melanocytes
- d. Adipocytes

41. The basement membrane zone consists of all of the following except:

- a. Lamina lucida
- b. Desmosomes
- c. Anchoring filaments
- d. Lamina densa

42. Thickening of the spinous layer is called:

- a. Parakeratosis
- b. Acanthosis
- c. Spongiosis
- d. Dyskeratosis

43. The pigment responsible for absorbing harmful radiation is:

- a. Haeme
- b. Melanin
- c. Rhodopsin
- d. Carotene

44. The majority of the vellus hair is on:

- a. Axilla
- b. Scalp
- c. Face
- d. Perineum

45. The longest phase of the hair cycle is:

- a. Anagen
- b. Telogen
- c. Catagen
- d. Nanogen

ANSWERS

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1-b, | 2-a, | 3-a, | 4-b, | 5-c, | 6-d, | 7-a, | 8-b, | 9-d, | 10-d, |
| 11-d, | 12-d, | 13-d, | 14-b, | 15-c, | 16-a, | 17-b, | 18-a, | 19-c, | 20-a, |
| 21-c, | 22-b, | 23-c, | 24-c, | 25-d, | 26-b, | 27-c, | 28-b, | 29-c, | 30-c, |
| 31-d, | 32-a, | 33-a, | 34-b, | 35-c, | 36-c, | 37-b, | 38-c, | 39-d, | 40-c, |
| 41-b, | 42-b, | 43-b, | 44-c, | 45-a | | | | | |