Anatomy of Skin and Basic Skin Lesions

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Anatomy of Skin

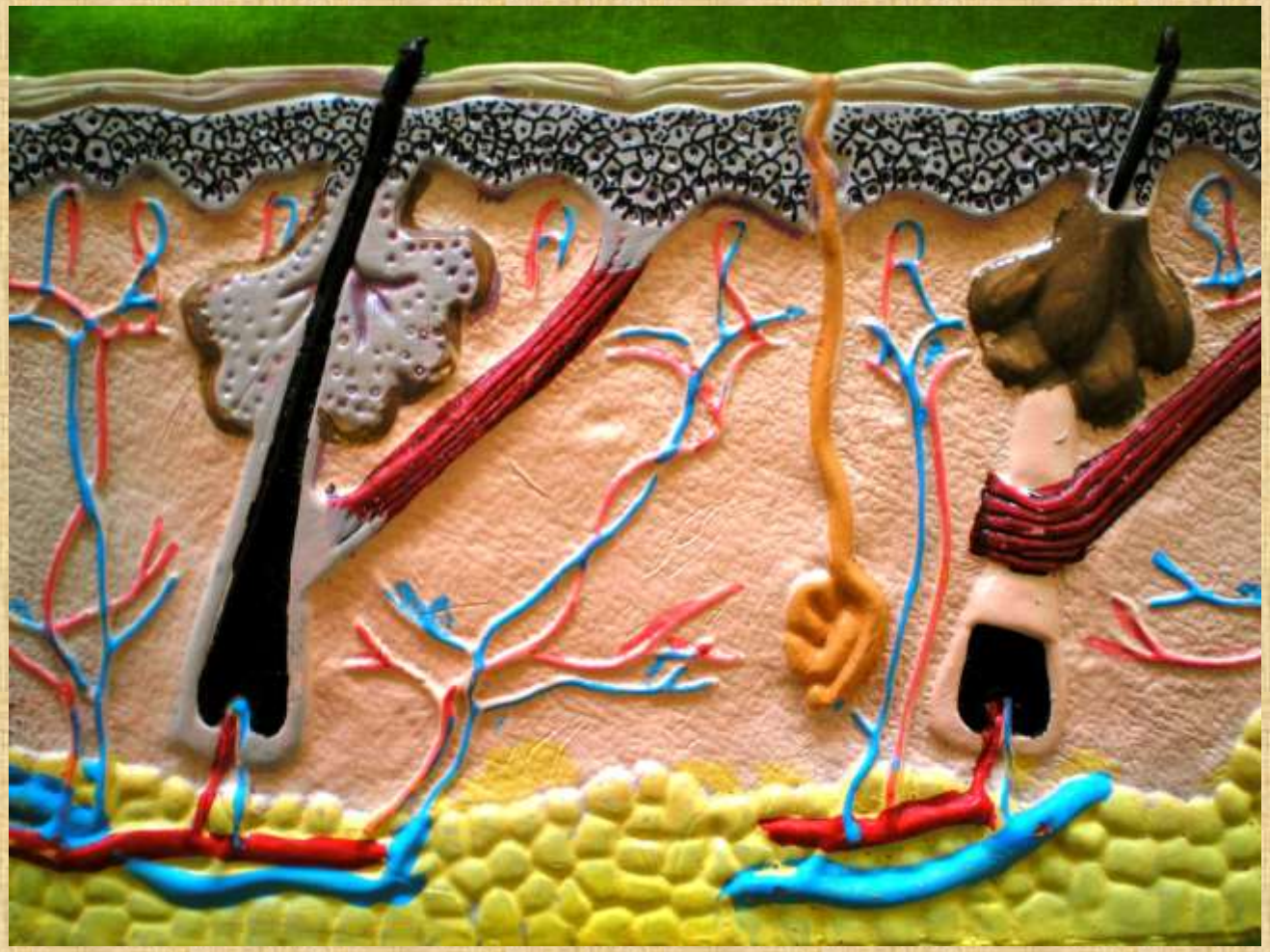
- Largest organ system
- Measures about 2.12 Sq m, Weighing 4.2kg
- Hair, Sebaceous and Eccrine glands, Nails, Mucous membranes make important components with specialized physiological functions

Embryology of Skin

- All constituents are derived from ectoderm and mesoderm
- Ectoderm and mesoderm begin to proliferate and differentiate at 4th week of intrauterine life
- The specialized structures of skin, teeth, hair, nails and glands begin to appear at this time

Layers of Skin

- **Epidermis** - stratum basale
  - stratum spinosum
  - stratum granulosum
  - stratum corneum
- **Dermis** - papillary dermis
  - reticular dermis
- **Subcutaneous tissue**



This illustration shows layers of skin- epidermis, dermis, subcutaneous tissue along with sebaceous gland, sweat gland and neuro-vascular bundle

Epidermis

- **Stratum basale (Basal cell layer, Stratum germinatum, Germinative layer) :** Cuboidal /columnar cells; large oval nuclei, dense basophilic cytoplasm,

- **Stratum spinosum (Stratum spinosum, Spinous layer, Prickle cell layer) :** 5-10 layers of Polygonal cells with delicate spinous processes (desmosomes) connecting adjacent keratinocytes

- **Stratum granulosum (Granular cell layer) :** 1-3 layers of Flattened diamond shaped cells filled with coarse basophilic keratohyaline granules

Epidermis

- **Stratum corneum :**

  Flattened, anuclear, eosinophilic corneocytes,

  Dead layer shed during epidermal turnover

- **Stratum lucidum :**

  Clear layer found in palms and soles in between stratum corneum and stratum granulosum

- **Epidermal turnover/ transit time :**

  Time taken for a cell to pass from basal layer to surface of skin is 40-56 days (normal skin)

Other Cells in Epidermis

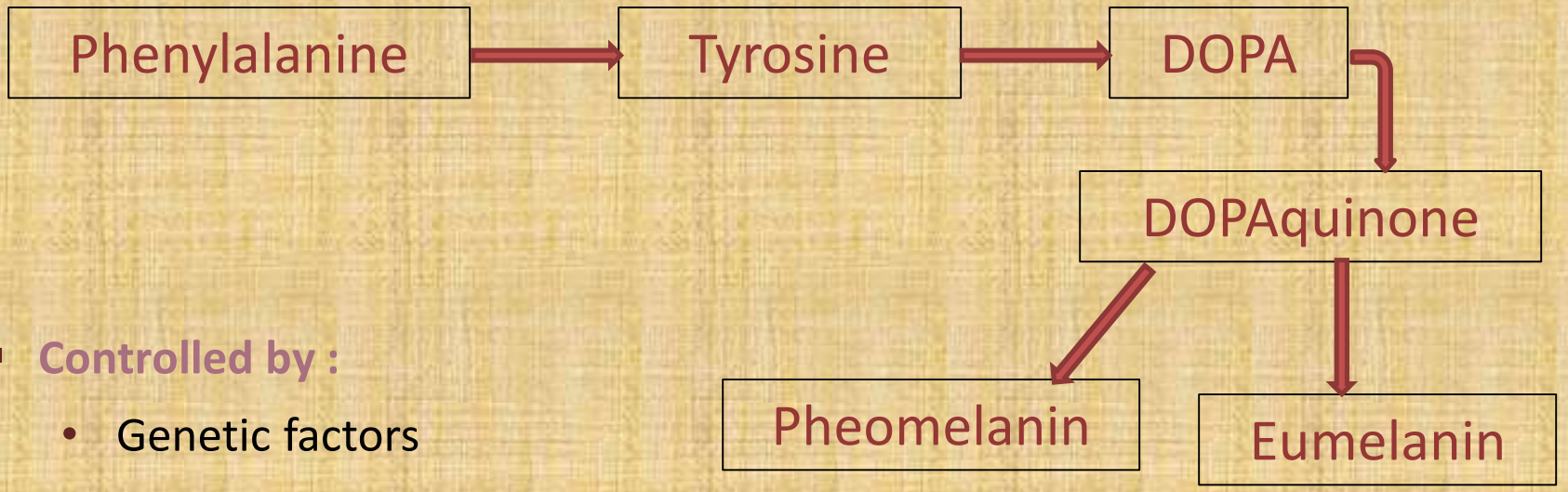
- Melanocyte
- Langerhans cell
- Merkel cell

Melanocytes

- Neural crest derived Dendritic cells
- Synthesize and secrete melanin containing organelles called ***melanosomes***
- Located in basal cell layer; **1:10 ratio**
- **Epidermal Melanin Unit :** A single melanocyte supplies melanosomes to 36 keratinocytes (**1:36**)
- Melanosomes vary in distribution and size according to skin type. However, the density of melanocytes in different races is the same.

Melanocytes - Melanogenesis

- Melanin formed through mediation of tyrosinase and DOPA from tyrosine



- **Controlled by :**
  - Genetic factors
  - UVR
  - Hormones (e.g. MSH)

Melanocytes - Functions

Melanin:

- Impart colour to skin and hair
- Protect the skin from UV radiation
- Biochemical neutralizer of toxic, free radical oxygen derivatives

Langerhans cells and Merkel Cells

- **Langerhans cells**
  - Dendritic cells
  - Type of macrophage
  - Role in various immune processes like - allergic contact dermatitis, immune tolerance, surveillance against viral infections and neoplasia
- **Merkel cell**
  - Non-Dendritic cells lying in or near basal layer or hair follicles
  - Neuritic cells
  - Fine touch receptors
  - Detect mechanical deformities of epidermis

Functions of Epidermis

- Cornification
- Barrier function
- Permeability
- Maintenance of fluid and electrolyte balance
- Thermoregulation
- Pigmentation
- Immune function
- Sensory receptor
- Vitamin D Synthesis

Epidermal Appendages

- Hair follicles
- Sebaceous glands
- Sweat glands
  - Eccrine glands
  - Apocrine glands
  - Apo-eccrine glands

Hair

Found over the entire surface of the body except palms, soles, glans penis, clitoris, labia minora, mucocutaneous junction and distal portions of the fingers and toe.

Types of Hair

- Lanugo hair : Fine, soft hair in fetus
- Vellus hair : Fine, short, non-medulated hair over most parts of the body
- Terminal hair : Long, coarse, medulatd hair over scalp, beard, and body depending on age and gender

Hair : Anatomy

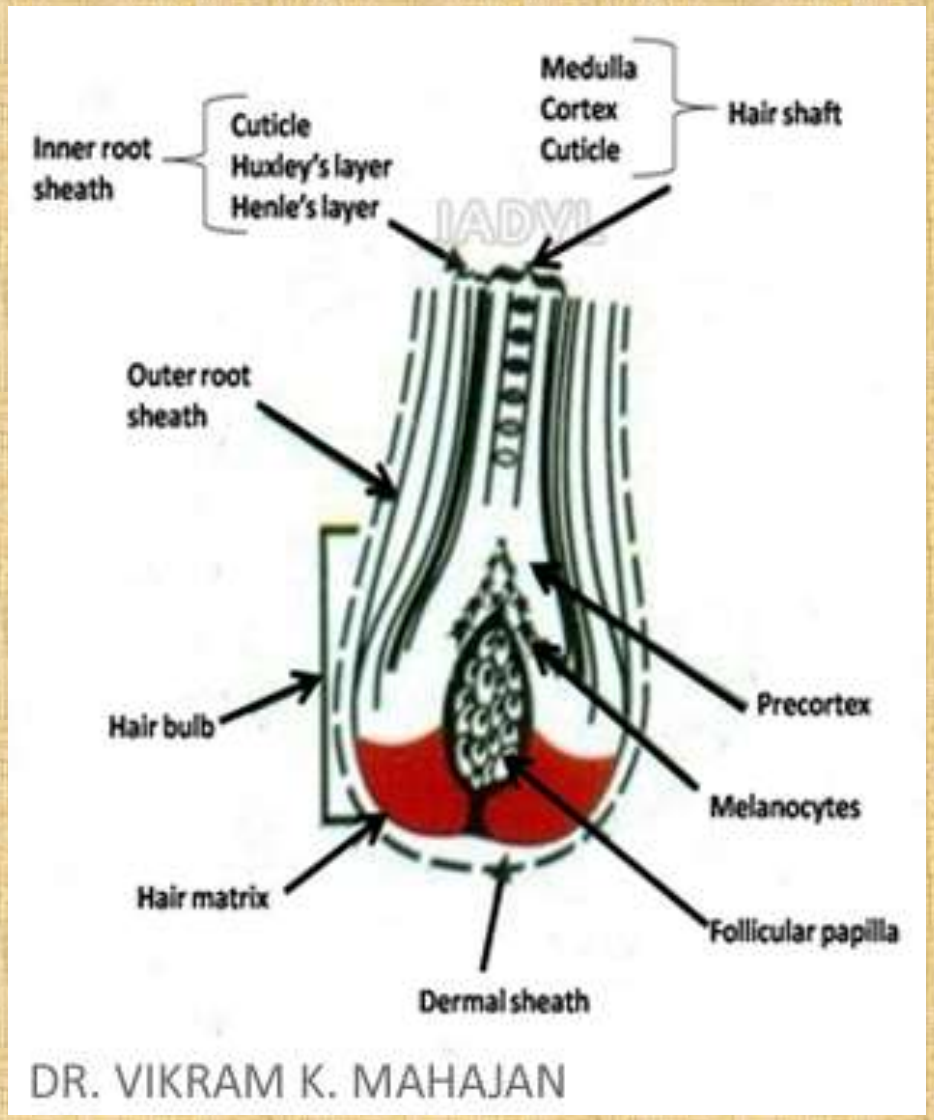
Longitudinal section

- Infundibulum
- Isthmus
- Stem
- Bulb

Hair : Anatomy

Cross section

- Outer sheath
- Inner sheath
  - Henle's layer
  - Huxley's layer
  - Cuticle
- Cortex
- Medulla



Hair Growth Cycle

Hair cycle consists of three phases:

- **Anagen :** Phase of growth and activity, lasts for 2-10 years

  About 90% of hair are in anagen at a given time

- **Catagen :** Phase of transition, lasts for 1-3 weeks.

  About 1% hair are in catagen

- **Telogen :** Resting phase lasts for about 3 months.

  About 10% hair are in telogen

- Telogen hair is shed and anagen hair replaces it
- Average hair loss is 100/day

Sebaceous Glands

- Lipid producing holocrine, multi-lobed glands
- Arise from the hair follicle at the junction of the infundibulum and the isthmus
- Distributed all over the body except the palms and soles
- Numerous, large and productive over the face and scalp
- Stimulated by androgens and mature at puberty

Sebaceous Glands

- Consists of lobules of epithelial cells that differentiate toward lipid producing cells in a centripetal manner
- Enlarged, vacuolated cells in the center of the lobule disintegrate into an amorphous mass – the sebum
- **Major components of sebum :** Triglycerides, wax esters, squalene, cholesterol esters, and cholesterol
- **Acne, Rosacea, Seborrheic dermatitis**

Sweat Glands

Depending on mode of secretion these are –

- **Eccrine** sweat glands and **Apocrine** sweat glands
- **Apo-eccrine** glands have features of both
- All have 2 parts
  - Secretary coil
  - Duct

Eccrine Sweat Glands

- These are present all over body except over the lips, external ear canal and labia minora
- Most concentrated in the palms, soles and axillae
- The secretary coil lies deep in the dermis that connects with the surface by a duct
- **Major role is in Thermoregulation**

Control of sweating

- Innervated by sympathetic cholinergic nerve fibers
- The central control of sweating lies in preoptic hypothalmic sweat centre
- Temperature, Emotions, Hormones (antidiuretic hormone, aldosterone), Gustatory (hot spicy foods)

Apocrine Sweat Glands

- These are mainly present in axillae, nipples, peri-umblical skin, perineum and genitalia
- Modified apocrine glands are -Ceruminous glands (external ear canal), Moll's glands (eyelids) and Mammary glands
- The secretary coil lies at junction of dermis and subcutis
- The duct opens into the mid part of hair follicle just above the entrance of sebaceous gland
- Innervated by adrenergic sympathetic nerve fibers
- **Vestigial sexual function and represent Scent glands**

Dermis

- Constitute 15-20% of body weight
- **Papillary dermis -** thin zone beneath epidermis
- **Reticular dermis -** thick zone which extends from base of papillary dermis to the surface of subcutaneous fat
- The upward projection of dermis, the **dermal papillae**, strongly inter digitate with the downward , the **rete pegs**, of epidermis to form **Dermo-epidermal junction.**
- 3 components : **Cells, Fibers and Ground substance.**

Dermis - Structure

Cellular contents

- Fibroblasts, mast cells, histiocytes, Langerhans cells, lymphocytes and eosinophils

Non-cellular connective tissue

- Collagen (80%), elastic fibers (2%) and ground substance (mucopolysaccharides, glycoproteins, chondroitin sulphate)
- Embedded nerves, blood vessels, lymph vessels, muscles and pilo sebaceous, apocrine and eccrine units

Dermis - Variation in thickness

- Difference of thickness of the skin is dependent largely on dermal thickness, with the palms and soles being thickest (1.5 mm) and thinnest in the eyelids and post-auricular region (0.05 mm).
- Males have thicker skin than females
- Children and elderly have thinner skin than adults

Dermo-epidermal Junction

(Basement Membrane Zone)

Consists of

- Basal lamina
- Lamina lucida
- Lamina densa
- Anchoring filaments
- Anchoring fibrils
- Dermal microfibril bundles

Dermo-epidermal Junction

Functions

- Attachment of dermis to epidermis
- Mechanical support to epidermis
- Regulation of permeability for nutrients and exogenous substances
- Influence growth, differentiation and migration of basal keratinocytes
- **Autoantibodies to proteins in the dermo-epidermal junction responsible for Bullous pemphigoid**
- **Inherited defect in Epidermolysis bullosa**

Nerves & Innervation

- Rich network of nerves with 2 types of sensory endings – 'The Corpuscles (Mechano-receptors)' and 'Free nerve endings (Nociceptors)'

Mechano-receptors

- **Light touch :** Merkel cells of the epidermis, Meissner's corpuscles in dermal papillae
- **Pressure :** Pacinian corpuscles in deep dermis or subcutaneous tissue

Nerves & Innervation

Nociceptors

- **Pain and Itch :** Transmitted through naked fine free nerve endings located in the basal layer of the epidermis close to the dermo-epidermal junction
- **Temperature :**
  - Krause bulbs detect cold, Ruffini end organs detect heat
  - Heat, cold and proprioception also located in the superficial dermis

Adjacent dermatomes often overlap, important for local anesthesia

Blood & Lymphatic Supply

- Extensive subdermal and dermal plexuses
- Dermal plexus: 2 horizontal plexuses connected by vertical communicating vessels–
  - **Superficial horizontal plexus** lies in the papillary dermis, feeding arterioles/capillary loops in dermal papillae
  - **Deep horizontal plexus** lies deep just above the subcutis, supplies to sweat gland and hair follicles
- **Cutaneous vasculature important in thermoregulation**
- Cutaneous lymphatics parallels the blood supply

Basic Skin Lesions

Classification

- Primary lesions
- Secondary lesions
- Special lesions

Primary Lesions	Secondary Lesions	Special Lesions
▪ Macule ▪ Papule ▪ Nodule ▪ Plaque ▪ Vesicle ▪ Bulla ▪ Pustule ▪ Cyst	▪ Scales ▪ Crust ▪ Erosion ▪ Ulcer ▪ Excoriation ▪ Fissure ▪ Sinus ▪ Scar ▪ Lichenification ▪ Atrophy	▪ Erythema/Purpura ▪ Wheal ▪ Burrow ▪ Comedone ▪ Milium ▪ Telangiectasia ▪ Sclerosis ▪ Poikiloderma ▪ Target lesions

Macule

Definition: Circumscribed alteration in the colour of the skin of any size or shape that is non-palpable and without depression and has no alteration in the skin texture or scaling within the lesion

- Macule > 1-2cm in diameter is “LARGE MACULE”
- Macule > 2cm in diameter is “AREA”
- Margins can be well defined or ill defined
- Shape can be circular, oval, or irregular

Colour of Macule : Erythematous, Hypopigmented (e.g. Nevus hypochromicus), Hyperpigmented (e.g. Melasma), depigmented (e.g. Vitiligo)

Depigmented and hypopigmented macules

Vitiligo

Hyperpigmented macules

Melasma

Papule

Definition : Small, solid, elevated, palpable lesion up to **0.5 cm** in size formed either by localized proliferation of tissue cells or infiltration with inflammatory cells.

Papules sized **1-2 mm** are called “Micropapules”

Shape : Sessile, Pedunculated, Dome-shaped, Flat-topped,

Filiform, Acuminate, Umbilicated

Papule

Colour : Varies-

- Brownish : Verruca vulgaris
- Yellowish orange : Xanthoma
- Violaceous purple : Lichen planus
- Pearly white : Molluscum Contagiosum
- Blue-black : Malignant melanoma

Surface : Rough or smooth surfaced

Examples : Warts (Rough surface), Lichen nitidis (micropapules), Mollascum contagiosum (Umblicated)

Nodule

Definition : Solid, elevated, palpable lesion **>0.5 to 1 cm** in size formed either by localized proliferation of tissue cells or infiltration with inflammatory cells.

A nodule sized **>1.0 cm** is better be called a “Large nodule”

Shape : Ellipsoid or Globular, Pedunculated or Sessile

Surface : Smooth, Keratotic, Ulcerated, or Fungating

Types : Depending anatomical component involved -

Epidermal, Epidermal-dermal, Dermal,

Dermal-subdermal or Subcutaneous

Other features : Depending on underlying pathology –

Warm, Hard, Soft, Fluctuant, Tender, Movable, or Fixed

Examples : Neurofibroma, Leprosy, Erythema nodosum

Papules and Nodules of varied Morphology and Size in neurofibromatosis

Shiny, Pearly Umblicated Papules in Molluscum contagiosum

Plaque

Definition : Solid, elevated, palpable lesion >**1 cm** in diameter with a flat plateau like surface. =

Plaque sized >2cm are “Large plaques”

Shape : Round, Oval, Discoid (uniformly thickened), or Annular with regular or irregular borders

Types : Depending on anatomical component involved –

Epidermal, Epidermal-dermal, Dermal,

Dermal-subdermal or Subcutaneous

Surface changes : Depending on underlying pathology –

Scaling, Necrosis, Erosion, Ulceration, Crusting, Eschcar formation

Examples : Psoriasis, Leprosy, Granuloma annulare

Well-defined, erythematous, scaly large plaques of psoriasis vulgaris

Annular Plaques in Leprosy

Vesicles and Bulla (Blister)

Definitions :

- Vesicle: An elevated fluid-filled lesion sized < 0.5 cm
- Bulla: Fluid filled lesion sized > 0.5 cm

Formation : Vesicles or bullae arise from the cleavage at either intraepidermal or sub epidermal level by -

  - Formation of cavity
  - Collection of fluid

- In Bulla, the fluid in the cavity exerts equal pressure in all directions giving spherical shape
- Contents of vesicle: Clear, Serous, Turbid, Haemorrhagic

Examples : Herpes simplex, Pemphigus, Scalds, Bullous pemphigoid, eczema

Pustule

Definition : A circumscribed raised Pus filled lesion.

- Pustules may vary in size and in certain conditions like pustular psoriasis they may coalesce to give "***lake of pus***" appearance

Purulent exudate contain : either cellular debris, leukocytes, or bacteria or may be sterile

- They can be located at the opening of hair follicles as in folliculitis
- Pustules are superficial- heal without scarring

Examples : Bacterial (folliculitis), Pustular psoriasis

Pustules in pustular psoriasis

Cyst

Definition : A closed cavity or sac (normal or abnormal) that has an epithelial, endothelial or membranous lining and contain fluid or semisolid material

Examples : Sebaceous cyst, Epidermal cyst (Milia), Pilar cyst

Abscess

Definition : It is localized accumulation of pus deep in dermis or sub cutis. Usually not visible on the surface of skin.

It is erythematous, warm, tender, fluctuant nodule

From Staphylococcal, Streptococcal infections

	Secondary Lesions	
	▪ Scales ▪ Crust ▪ Erosion ▪ Ulcer ▪ Excoriation ▪ Fissure ▪ Sinus ▪ Scar ▪ Lichenification ▪ Atrophy	

Scale

- It is visible exfoliation of flake of stratum corneum
- Morphology varies with type of skin disease
- Examples –
  - **Silvery, loose scales -** Psoriasis
  - **Fine powdery scales -** Pityriasis versicolor
  - **Fish-like scales -** Ichthyosis
  - **Collarette scales -** Pityriasis rosea, Seborrhoeic dermatitis

Ichthyotic Scales

Crust

- Crust is dried up exudates (blood, serum, pus)
- Removal of crusts leave moist surface/ erosion beneath
- Colour of crust varies with nature of exudate:
  - **Yellow-brown -** dried serous secretions
  - **Turbid yellow-green -** purulent secretion
  - **Reddish black -** hemorrhagic secretion

Hemorrhagic Crusts

Erosion

- Raw, moist lesion left from a complete or partial loss of epidermis or mucosal epithelium
- Results from trauma, rupture of vesicles or bullae, or epidermal necrosis
- Heal without scar unless secondarily infected
- **Examples :** in Pemphigus, SJS-TEN

Erosions in a Pemphigus patient

Ulcer

- Ulcer forms from breach and destruction of skin (epidermis, dermis with basal layer, adnexal structures) or Mucosa
- Heals with scarring.
- May be superficial or deep.
- **Margins of ulcer :** overhanging- tubercular Punched out - gumma
- Light pink granulation tissue at floor- healing

Ulcer

Excoriations

- Linear or circumscribed erosions formed from surface excavations of epidermis due to scratching
- Frequent finding in patients having disorders with pruritus

Linear and punctate excoriations on the back induced by scratching.

Fissure

- It is a linear, triangular crack in the skin/mucosa
- Results from excessive tension or decreased elasticity of the involved tissue
- Can be superficial or deep
- Deep fissures are painful
- Common over palms and **soles** due to thick Stratum corneum
- **Examples :** In Palmoplantar psoriasis, Keratodermas, Irritant CD

Fissures of heels

Sinus

- It is a tract connecting a deep cavity to the surface of the skin
- Contents of the deep cavity are usually pus, epithelial debris
- These contents drain to the surface when such a channel exits

Multiple sinuses in Nocardiosis

Scar

- It is the proliferation of fibrous tissue that replaces the normal collagen after the ulcer involving the reticular dermis heals
- Epidermis is thinned and wrinkled, and adnexa like hair are destroyed
- **Hypertrophic scars :** typically take form of plaques or nodules. It does not grow beyond the limit of original lesion
- **Keloid :** exceeds the limit of original lesion

Keloid

Lichenification

Definition : Thickening of skin due to repeated and prolonged rubbing/ scratching of skin characterized by:

- Thickening of epidermis/dermis
- Accentuated of skin markings
- Hyperpigmentation

Examples : Lichen simplex chronicus (LSC), Lichenified chronic (atopic) dermatitis

Lichenification (LSC)

Atrophy

Definition : A loss of cutaneous mass from diminution in size of any of the components of skin.

- **Epidermal atrophy:** Glossy, transparent, cigarette-paper like thinning and wrinkling, loss of normal skin lines
- **Dermal atrophy:** Circumscribed area of depressed skin, normal in colour and surface
- **Subcutaneous atrophy:** Substantial depression of skin

Epidermal atrophy

		Special Lesions
		▪ Erythema ▪ Purpura ▪ Wheal ▪ Burrow ▪ Comedone ▪ Milium ▪ Telangiectasia ▪ Sclerosis ▪ Poikiloderma ▪ Target lesions

Erythema and Purpura

- **Erythema :** Blanches redness of skin, and is due to vascular congestion or increased perfusion e.g. Facial erythema in Rosacea,
- **Purpura :** Non-blanching reddish to purple discolouration of skin due to extravasation of RBCs in dermis e.g. Vasculitis, Bleeding disorders
- **Petechiae :** 1-2 mm small pupuric lesions, Occur in crops e.g. Clotting disorders
- **Ecchymosis :** Larger purpuric lesions from extrvasation of blood
- **Diascopy :** differentiates erythema from purpura

Vasculitis- purpura

Wheal (Hives, Urticaria) & Angioedema

- **Definition :** An evanescent (lasting 48-72 hrs) erythematous, elevated lesion due to edema of dermis (**Wheal**) frequently with central pallor, or dermo-hypodermis with loose dermal tissue e.g. lips, eyelids, scrotum (**Angioedema**)
- Results due to vasodilatation and increased permeability of dermal capillaries leading to edema
- **Specific of Urticaria**

Burrow

- **Definition :** It is wavy, thread like tunnel excavated in the stratum corneum by Scabies mite
- It measures only few mm in length
- **Characteristic of Scabies** and particularly seen over palms and soles, wrists, and genitalia in infants and very young children

Comedo (Pl. Comedones)

Definition : A dilated pilosebaceous orifice plugged by keratin and sebum

- **Open Comedo :** Pilosebaceous opening is open to the surface of skin by black keratinous plug
- **Closed Comedo :** Closed pilosebaceous opening is unapparent, accumulates the whitish keratin
- **Characteristic and primary lesion of acne**

Comedones in acne

Milium

Definition : A tiny white superficial cyst with epidermal lining containing lamellated keratin.

- Sometimes arise on blistered or damaged skin e.g. after dystrophic epidermolysis bullosa, Porphyria, Dermabrasion.

Telangiectasias

Definition : Visible and persistent dilatations of small capillaries in the superficial dermis that appear as fine, bright non-pulsatile, net like pattern on the skin

- May or may not disappear with diascopy
- **Types :** Mat-like, Punctate, Linear
- Examples : In - rosacea, Collagen vascular diseases

Sclerosis

Definition: A diffuse induration and hardening of skin due to dermal fibrosis. The skin feels firm board like, immobile and difficult to pick up

Examples: Morphea, Systemic sclerosis.

Poikiloderma

Definition : A dappled appearance of skin from combination of atrophy, telangiectasia, and pigment changes (hypo or hyperpigmentation)

Example : Rothmund Thompson syndrome, Xeroderma pigmentosa

Poikiloderma in Xeroderma pigmentosa

Target Lesions

Definition : These have 3 zones:

- Central: dusky, blistered or purpuric zone
- Middle: pale zone of edema
- Outer: Erythematous zone with well defined edge
- **Example :** Erythema multiforme

Further Description

- **Shape of lesions :** The shape of each lesion - Dome-shaped, Flat topped, Umbilicated, Acuminate, Pedunculated, Verrucous,
- **Distribution of lesions :** The overall distribution of lesions - Scattered, Disseminated, Wide spread, Confluent, Symmetrical or Asymmetrical, Acral
- **Pattern of lesions :** The arrangement of individual lesions - Annular, Arcuate, Linear, Grouped, Discoid, Reticulate, Gyrate,
- **Colour of skin and of lesions :** e.g. Purplish (LP), yellowish (xanthoma), etc

Further Description

- **Arrangement :** Linear, Grouped, Dermatomal, Serpiginous
- **Zosteriform :** Grouped vesicles arranged in a dermatome
- **Corymbose :** grouped arrangement with a central cluster of lesions beyond which are scattered individual lesions
- **Un-patterned grouped lesions :** As in Verruca plana, Lichen planus, Urticaria, Insect bites(often in groups of three).
- **Spared areas :** As in Photodermatitis

MCQ'S

Q.1) One Keratinocyte-Melanin Unit comprises

A. One melanocyte and 10 keratinocytes

B. One melanocyte and 36 keratinocytes

C. One melanocyte and 40 keratinocytes

D. None of the above

E. Answer "A" and "B" above are correct

Q.2) Langerhans cells -

A. are non-dendritic cells

B. are a fine touch receptors

C. are involved skin immune surveillance

D. are Neuritic cells

E. detect mechanical deformities of epidermis

MCQ'S

Q.3) Average hair loss is?

A. About 200 per day
B. About 100 per day
C. No hair are shed normally
D. All are true
E. None is true

Q.4) Eccrine sweat gland are most concentrated over

A. Trunk
B. Extremities
C. Scalp
D. Palms, sole and axillae
E. Groins

MCQ'S

Q.5) Downward projections of epidermis are called?

A. Reticular dermis
B. Papillae
C. Rete pegs
D. Stratum spinosum
E. Stratum corneum

Photo Quiz

Q. Identify the lesion over forehead of the child in the image?

Photo Quiz

Q. Identify the type of lesion in the image?

Photo Quiz

Q. Identify the lesion?

Thank You!