

The Body Covering

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The body covering is sometimes known as the *integumentary system*.

The entire outer surface of the body is covered with *skin*, which is continuous with the linings of internal canals at their surface openings.

The skin serves four main purposes:

Protection. The skin protects the body from injury and from infection by microbes and other harmful substances.

Sensation. Nerve endings within the skin give the sensations of pain, heat, and touch, and indirectly protect against danger.

Temperature. The skin helps to regulate body temperature through the action of hairs and sweat glands.

Vitamin D. The skin contains a substance, 7-dehydrocholesterol, which is converted to Vitamin D by the action of ultra-violet light.

Structure of the Skin

There are two main layers to the skin: the epidermis, and the dermis. [Figure 2 - 1]

Epidermis

The *epidermis* is the outer layer of the skin. It is composed of varying thicknesses of stratified epithelium, being thickest on the palms of the hands and soles of the feet.

The epidermis contains no nerve endings or blood vessels; it relies on interstitial fluid from the dermis for cell nourishment.

The outermost layer of the epidermis is the *stratum corneum*, composed of dead cells. These cells are continually being rubbed away, to be replaced by cells from the immediately underlying *germinative layer*.

The stratum corneum is perforated by hairs, and by the ducts of sweat glands.

The surface of the epidermis is not flat, but follows an uneven pattern of cells in the dermis. This pattern differs from person to person, and on the fingers it forms the unique personal fingerprints.

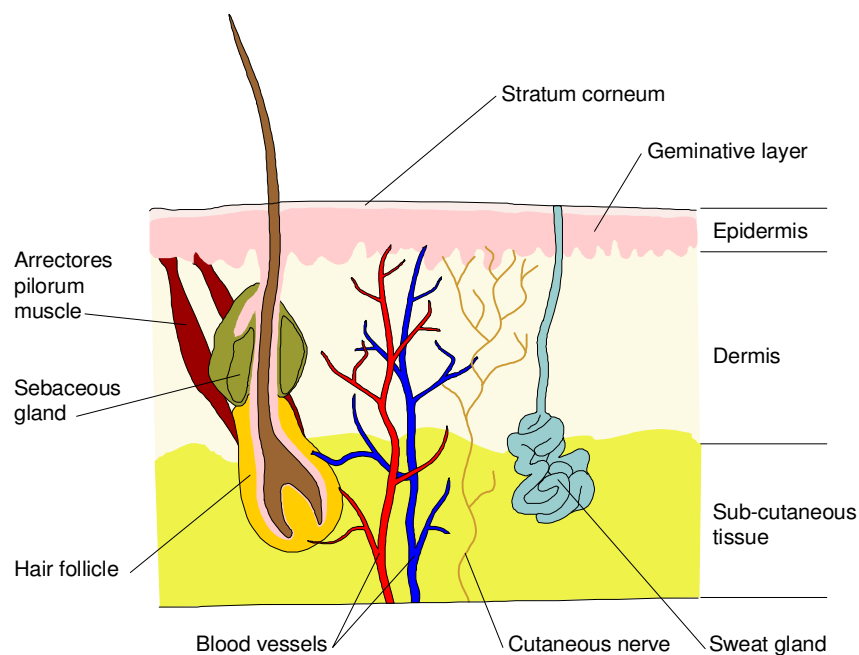
Dermis

The *dermis* is a tough, elastic layer under the epidermis. It is mainly composed of collagen fibres and elastic fibrous tissue. Beneath the dermis are layers of areolar and adipose tissue.

The dermis supports a variety of associated structures.

Figure 2 - 1 structure of the skin

A simplified view of the structure of the skin



Blood and lymph vessels

Arterioles, capillaries, and venules supply the structures of the skin, with interstitial fluid being drained away as lymph.

Sensory nerve cell endings

The sensations of touch, heat, and pain are detected by a vast number of sensory nerve endings distributed throughout the dermis.

Sweat glands

Sweat glands secrete a watery fluid onto the surface of the skin, in response to stimulation from the nervous system.

The main function of sweat secretions is in the regulation of body temperature through the loss of heat in evaporating the sweat.

Hair follicles

A hair follicle is a growth of epidermal cells into the dermis.

At the base of the follicle is the *bulb*, from which a hair formation grows.

Sebaceous glands

Secretory cells, of a similar nature to hair follicles, form *sebaceous glands*. They secrete sebum onto the skin surface, except on the palms of the hands and the soles of the feet.

Sebum is an oily secretion which keeps hair pliable, and provides some degree of water-proofing and anti-bacterial action.

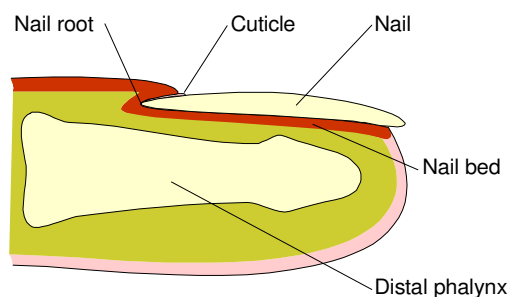
Nails

The nails on the fingers and toes take the place of claws in animals. [Figure 2 - 2]

They are formed as translucent plates of hard keratinised cells, attached (except at their tips) to the underlying epidermis.

Like the epidermis, nail growth is continuous, although that of the toe nails is slower than that of the finger nails.

Figure 2 - 2 structure of a nail



Hair

Hair covers, to a greater or lesser extent, the vast majority of the body.

Hairs grow from the bulbs of hair follicles. As hair cells are pushed out towards the skin they die and convert into keratin.

A central core in each hair may contain pigment, giving the hair its colour. If this pigment is absent, its place is taken by minute air bubbles and the hair is grey or white.

Small muscles, *arrectores pilorum*, attached to hair follicles raise the hairs and skin around them when stimulated through the sympathetic nervous system, in response to cold or fear.

Skin Colour

The colour of the skin is dependent on three main factors:

Melanin. This is a dark pigment secreted in the germinative layer.

The amount of melanin present varies across different races. Irrespective of this, sunlight darkens melanin, and promotes further secretion.

Haemoglobin. The level of blood Oxygen affects the colour of the blood, and this, together with the level of circulating blood itself, provides a varying pink colour.

Bile pigments. These in the blood, together with carotenes in subcutaneous fat, provide a yellow colour.

Temperature Control

The body covering serves important functions in maintaining normal body temperature of 36.9°C or 98.4°F.

If the body temperature is raised, heat is lost.

The blood vessels supplying the skin dilate, bringing more blood - and thus heat - to the surface, where it dissipates through radiation, conduction and convection.

Sweat glands produce greater amounts of sweat, which cools the body through evaporation.

If the body temperature is lowered, heat is preserved.

The blood vessels supplying the skin constrict, thus holding heat deeper in the tissues.

The arrectores pilorum muscles contract to cause hairs to stand up and reduce the movement of air close to the skin, thus forming a warm layer.

Burns

A *burn* occurs through the action of energy on the skin and the underlying tissue.

Types of burns

Burns are generally typed according to the form of energy which causes them:

Thermal burns. These are caused by heat, which coagulates protein and damages the normal tissue structure, destroying its ability to function, and leading to its death.

A temperature as low as 45 - 50°C - for any significant length of time - can lead to a burn. Heating to over 100°C will further damage tissue by boiling the water in its structure.

A *scald* is a thermal burn caused by hot liquid or vapour.

Electrical burns. These are caused by the passage of electric current through body tissue. This leads to heat and to thermal burns along the path of the current.

In addition, a current of 200mA, or more, passing through tissue can cause cells to draw in water molecules to the point of rupturing.

Chemical burns. These are caused when reactive substances come into contact with the body and break down the tissue structure into simpler compounds, causing extensive destruction.

Radiation burns. These are caused by certain frequencies of electromagnetic radiation, for example: X-rays, Gamma radiation, microwaves, or sunlight, which can alter tissue cell structures, as well as leading directly to heat as its energy is absorbed by the tissues.

Flash burns may be caused to the eyes by intense light energy, for example: light produced in a large electric arc, in an explosion, or prolonged exposure to very bright sunlight.

Friction burns. These are caused by the rubbing action of an object - usually abrasive, against the body.

The rubbing action causes heat through friction; it may also cause direct tissue damage by physically breaking apart the layers of the skin.

Cryogenic burns. These are caused by contact with very cold substances such as 'dry ice' (solid Carbon Dioxide), liquefied gases, or prolonged exposure to ice and snow.

Tissue damage occurs mainly through the direct effects of freezing the water in the tissue, but can also occur through the passage of heat energy from within the body to the cold substance.

Depth of burns

Burns may be classified according to the depth of tissue damage.

Superficial Burns. (*erythema*) These are burns where tissue damage is minor and is restricted to the epidermis.

Partial thickness burns. These involve damage to the dermis as well as the epidermis.

Full thickness burns. These involve damage to, and maybe destruction of, epidermis, dermis, subcutaneous tissues, and possibly even deeper tissues, including bone.

Complications

Burns may be complicated by a variety of other factors, and related injuries.

Hypovolaemic shock is a risk with any burn of greater than 20% of total body area and results from fluid loss - as serum into burned tissue, and as whole blood in full thickness burns.

Any burn which causes, or leads to, broken or damaged skin removes the body's first line of defence against infection.

The risk of infection is further increased because damaged tissue immobilises infection fighting cells known as *neutrophils* - these then release their infection control agents at random, missing their 'targets', and inhibiting the movement of further neutrophils to the site of infection.

A long term complication of radiation burns may be that mutated cells become cancerous.

Chicken Pox

Chicken pox (varicella) is an infection by the varicella zoster virus.

The condition usually causes a slight fever, and then affects the skin, first showing as pink spots, leading to raised pimples, in an itchy spotty rash all over the body, with a slightly elevated temperature. Watery blisters then lead to crusted scabs as the disease begins to subside.

Melanoma

A *melanoma* is a tumour in the *melanocytes*, the melanin forming cells. Melanoma mainly affects the skin, but can also occur in the eyes and mucous membranes.

Melanoma is typically highly malignant and, unless treated, may well spread to other areas of the body - particularly lymph nodes or the liver.

A major contributory factor in causing melanoma is excessive exposure to ultra-violet rays in sunlight.

Scabies

Scabies is a contagious skin infection caused by the *Sarcoptes scabiei* mite. The mite burrows into the skin and breeds. The mites, their eggs, and their faeces trigger an allergic reaction which causes intense itching and red spots.

Wounds

Any abnormal break in the skin is termed a *wound*. Wounds may be classified according to their cause and nature:

Incision. This is caused by a sharp edge or blade, resulting in a single clean wound, often with profuse bleeding.

Abrasion. This is caused by friction with a rough surface, and leads to multiple - usually minor - wounds to the skin surface only.

Laceration. This is caused by multiple sharp edges or points, and leads to multiple wounds, and maybe tearing of tissues.

Puncture. This is caused by a thin or pointed object, and results in a deep wound with a small entry point. There is usually minimal external bleeding.

Contusion. This is caused by an impact with a blunt object or a surface. The skin is usually unbroken, but bleeding into tissues causes bruising.

Gunshot. This is caused by a bullet or similar projectile. Typically, there will be a small entry wound; extensive tissue damage along the projectile's path through body tissue, and maybe a large exit wound with extensive bleeding.

Complications

Complications - depending on the nature of the wound of a wound - may include:

Significant blood loss and hypovolaemic shock.

Internal bleeding.

Damage to tissues such as muscles and tendons.

Damage to internal tissues and organs.

Contamination from a variety of foreign matter.

A heightened risk of infection, given that the protective layer of the skin has been broken.

Healing of a wound

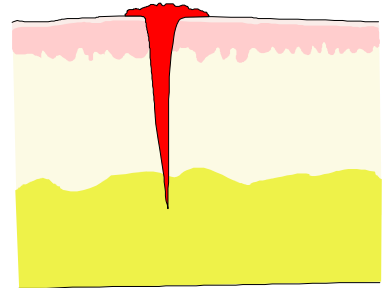
When a wound occurs, a healing process begins once blood loss has been halted through the formation of a blood clot. (with or without external assistance).

The healing process follows four main stages.

Stage 1

The cut surfaces of the wound become inflamed.

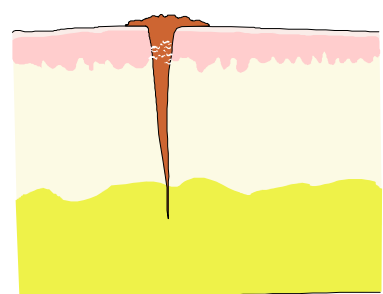
A blood clot fills the wound.



Stage 2

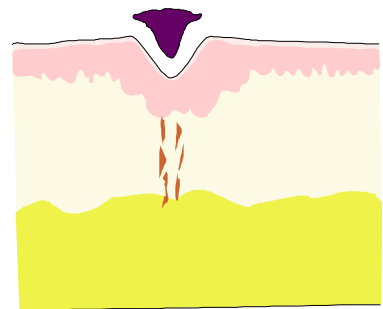
Phagocytosis of the blood clot begins, reducing its size.

Dermal cells begin to spread through the clot, and new fibrous tissue starts to form.



Stage 3

New epidermal cells bridge the wound, and the remaining blood clot (now in the form of a scab) separates, leaving a fresh 'scar'.

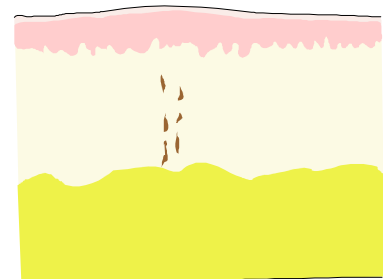


New fibrous tissue continues to grow, giving strength to the tissue under repair.

Stage 4

Full epidermal thickness is restored.

As the repair strengthens, the fibrous tissue is re-absorbed.



Any scarring which appeared at stage 3 becomes less evident over a period of time, ranging from a few days to many years.

