

Integumentary System: Burns and Wounds

Clinical case study

A 22-year-old college student presented to the Emergency Room with burns on his face, neck, chest, and arms when the propane tank on the barbeque gas grill exploded. Upon arrival, he complained of intense pain to his head and neck, which exhibited extensive blistering and erythema (redness), rating it a 10 on a pain scale of 1-10 (with 10 being unbearable). These findings were curiously absent on the burned chest and arms which had a pale, waxy appearance.



Examination revealed the skin on the patient's chest and arms to be leathery and lacking sensation. The ER physician commented to an observing medical student that third-degree burns were present on the skin of these regions and that excision of the eschar (traumatized tissue) with subsequent skin grafting would be necessary. Further examination revealed an abrasion on the anterior left hand and a laceration on his right anterior forearm.

Burns

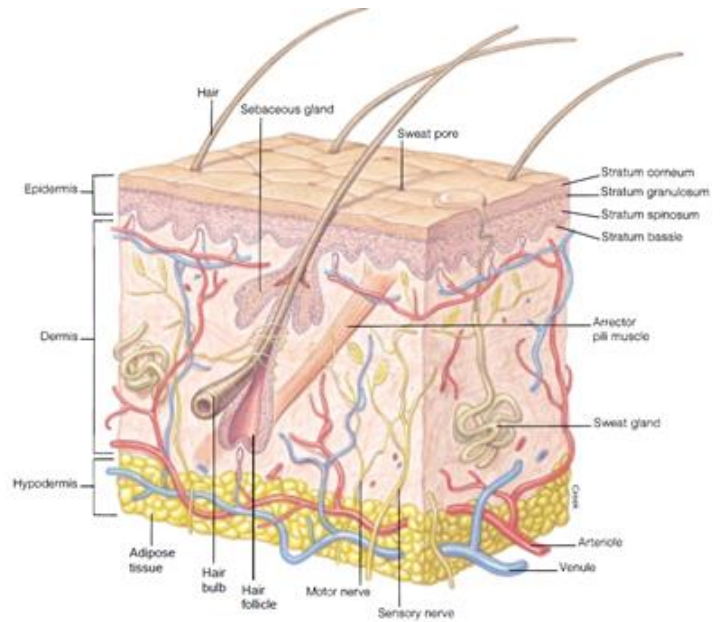
A burn is an epithelial injury caused by contact with a thermal, radioactive, chemical, or electrical agent. Burns generally occur on the skin, but they can involve the linings of the respiratory and GI tracts. The extent and location of a burn is frequently less important than the degree to which it disrupts body homeostasis. Burns that have a local effect (local tissue destruction) are not as serious as those that have a systemic effect (entire body which may threaten life). Systemic effects may include dehydration, shock, reduced circulation, urine production, and bacterial infections. There are three types of burns described below while fourth degree burns destroy all tissue, exposing muscle and bone.

Degree burn	Depth in Dermal Layers	Description	Image
First Degree Burn	<p>Epidermis Dermis Hypodermis</p>	Pain, redness and swelling; Tissue damage in the epidermis	
Second Degree Burn		Pain, redness, swelling and blistering; Tissue damage in the epidermis and partially in the dermis; blood vessels and nerves are spared	
Third Degree Burn		White or blackened, charred skin that may be numb; Tissue damage is deep dermis to hypodermal layer; blood vessels and nerves are destroyed; skin grafting necessary to prevent infection, gangrene and, eventually, death	

Wounds

The skin was designed to deflect as many injuries as possible while providing a barrier against pathogens. But, if a wound does occur, a sequential chain of events promotes rapid healing. The process of wound healing depends on the extent and severity of the injury. Trauma to the epidermal layers stimulates increased mitotic activity in the *stratum basale*, whereas injuries that extend to the dermis or subcutaneous layer elicit activity throughout the body, not just within the wound area.

In an open wound, blood vessels are broken and bleeding occurs. Through the action of blood platelets and protein molecules called *fibrinogen*, a clot forms and soon blocks the flow of blood. The scab that forms from the clot covers and protects the damaged area. Mechanisms are activated to destroy bacteria, dispose of dead or injured cells, and isolate the injured area. These responses are collectively referred to as inflammation and are characterized by redness, heat, edema (swelling), and pain. Inflammation is a response that confines the injury and promotes healing, releasing phagocytic cells that ingest dead cells and foreign debris. Connective tissues release fibroblasts at the wound margins to pull the tissue over the open wound and the scab eventually falls off. If the wound is severe enough, scar tissue will form which is dense skin tissue that lacks stratified squamous cells, has fewer blood vessels, and may lack hair, glands and sensory receptors. The closer the edges of the wound are, the less scarring there is, which is why suturing is used to close large breaks in the skin.



Types of Wounds			
Name	Image	Causes	Healing
Laceration		Tissue tearing; Caused by blunt force	Tend to have jagged edges which scar more than an a straight-edge incision
Abrasion		Skin is rubbed off by a rough surface; "Road rash"	Little to no scarring depending on depth
Avulsion		Skin catches on an object while same body part continues in motion, tearing skin away from tissues below	May be surgically reattached or may be removed and replaced by a skin graft; moderate scarring
Puncture		Injury that is deeper than it is wide	Surface may heal too fast, trapping infection inside; little scarring

Design Challenge: Burns or Wounds

Using the materials provided, your small group will be tasked to design and execute a way to demonstrate one of the following types of injuries: first-degree burn, second-degree burn, third-degree burn, laceration, abrasion, avulsion, or puncture. You will be provided with the following materials but do not limit yourself to only these materials: 1-ply toilet paper, Vaseline, popsicle stick, cocoa powder, fake blood, food coloring, gauze (optional: yellow Jell-O, lipstick).

Type of wound: _____

Select a wound location: _____

Examples of wound location:

- Inferior to the antecubital region of the left arm
- Proximal, posterior region of the right arm
- Superior to the olecranal region on the posterior side of the left arm
- Medial side of the distal end of the right leg
- Posterior side of the right hand
- Posterior part of the right metacarpal region
- Distal end, anterior side of the left arm
- Lateral side of left leg, in the middle of the fibular region

Sketch your Injury below:

Post Analysis

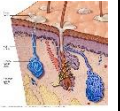
Directions: Use the prompt on the left to fill in the incomplete information on the right.

Prompt	Response
1. What is the primary role of skin?	
2. What is a possible cause to the injury that you recreated?	
3. Which layers of skin does your wound affect?	

<p>4. How would you treat your wound?</p>	
<p>5. What type of complications may occur with your injury during the healing process?</p>	
<p>6. How much scarring would result in the type of wound that you created?</p>	
<p>7. Referring to the clinical case study at the beginning of this activity, why would the areas that sustained second-degree burns be red, blistered, and painful while the third-degree burns were pale and insensate (without sensation, including pain)?</p>	
<p>8. Referring to the clinical case study at the beginning of this activity, why would the chest and arms require skin grafting, but probably not the face and neck?</p>	
<p>9. Referring to the case study, sketch where the laceration would be found.</p>	
<p>10. Referring to the case study, sketch where the abrasion would be found.</p>	
<p>11. Referring to the clinical case study, how would you treat the laceration and abrasion that you examined on your patient?</p>	

Skin Damage Application

During the Integumentary System unit, you were able to explore characteristics of the skin and its features which help maintain homeostasis. If the skin is damaged or injured, the physiology of the skin may also become affected. Using claim, evidence and reasoning to guide your argument, research and discuss how the following attributes may be affected by the burn or the wound that you have created.



https://www.mayoclinic.org/-/media/kcms/gbs/patient-consumer/images/2013/08/26/10/41/_bhtestimage.jpg

Skin Injury	Claim	Evidence	Reasoning
1. How would your burn and/or wound affect the ability to protect your skin against pathogens and foreign substances that may disrupt homeostasis, cause disease, infection or inflammation?			
Skin Injury	Claim	Evidence	Reasoning
2. How would your burn and/or wound affect the ability to protect your skin against UV radiation and, therefore, your risk for skin cancer?			
Skin Injury	Claim	Evidence	Reasoning
3. How would your burn and/or wound affect the sweat glands in the skin which would also, therefore, affect excretion and evaporative cooling for thermoregulation?			
Skin Injury	Claim	Evidence	Reasoning
4. How would your burn and/or wound affect the mechanoreceptors (pressure), thermoreceptors (temperature), and nociceptors (pain) and, therefore, dermal nerve distribution in the skin?			

Clinical Case Study Answer

The blistering and erythema characteristic of second-degree burns is a manifestation of intact and functioning blood vessels, which exist in abundance within the spared dermis. In third-degree burns, the entire dermis and its vasculature are destroyed, thus explaining the absence of these findings. In addition, nerve endings and other nerve end organs that reside in the dermis are destroyed in third-degree burns, resulting in a desensitized area. By contrast, significant numbers of these structures are spared and functional in second-degree burns, thus preserving sensation—including pain. The third-degree burn areas will all require skin grafting in order to prevent infection, one of the skin's most vital functions. In second-degree burns, the spared dermis serves somewhat of a barrier to bacteria. Consequently, skin grafting is usually unnecessary, especially if sufficient numbers of skin adnexa (hair follicles, sweat glands, and so forth), which generally lie deep within the dermis, are spared. These structures serve as starting points for regeneration of surface epithelium and skin organs.