Wound

A **wound** is a type of injury which happens relatively quickly in which skin is torn, cut, or punctured (an *open* wound), or where blunt force trauma causes a contusion (a *closed* wound).

Classification:

According to level of contamination, a wound can be classified as:

1. Clean wound – made under sterile conditions where there are no organisms present, and the skin is likely to heal without complications.

2. Contaminated wound – usually resulting from accidental injury; there are pathogenic organisms and foreign bodies in the wound.

3. Infected wound – the wound has pathogenic organisms present and multiplying, exhibiting clinical signs of infection (yellow appearance, soreness, redness, oozing pus).

4. Colonized wound – a chronic situation, containing pathogenic organisms, difficult to heal (e.g. bedsore).

Open wound:

Open wounds can be classified according to the object that caused the wound:

1. Incisions or incised wounds – caused by a clean, sharp-edged object such as a knife, razor, or glass splinter.

2. Lacerations – irregular tear-like wounds caused by some blunt trauma. Lacerations and incisions may appear linear (regular) or stellate (irregular). The term *laceration* is commonly misused in reference to incisions.

3. Abrasions – superficial wounds in which the topmost layer of the skin (the epidermis) is scraped off. Abrasions are often caused by a sliding fall onto a rough surface such as asphalt, tree bark or concrete.

4. Avulsions – injuries in which a body structure is forcibly detached from its normal point of insertion. A type of amputation where the extremity is pulled off rather than cut off. When used in reference to skin avulsions, the term 'degloving' is also sometimes used as a synonym.

5. Puncture wounds – caused by an object puncturing the skin, such as a splinter, nail or needle.

6. Penetrating wounds – caused by an object such as a knife entering and coming out from the skin.

7. Gunshot wounds – caused by a bullet or similar projectile driving into or through the body. There may be two wounds, one at the site of entry and one at the site of exit, generally referred to as a "through-and-through."

Closed wound:

Closed wounds have fewer categories, but are just as dangerous as open wounds:

1. Hematomas (or blood tumor) – caused by damage to a blood vessel that in turn causes blood to collect under the skin.

* Hematomas that originate from internal blood vessel pathology are petechiae, purpura, and ecchymosis. The different classifications are based on size.

* Hematomas that originate from an external source of trauma are contusions, also commonly called bruises.

2. Crush injury – caused by a great or extreme amount of force applied over a long period of time.

Complications:

1. Bacterial infection of wound can impede the healing process and lead to life-threatening complications.

Workup:

Wounds that are not healing should be investigated to find the causes; many microbiological agents may be responsible. The basic workup includes evaluating the wound, its extent and severity. Cultures are usually obtained both from the wound site and blood. X-rays are obtained and a tetanus shot may be administered if there is any doubt about prior vaccination.

2. Chronic:

Non-healing wounds of the diabetic foot are considered one of the most significant complications of diabetes, representing a major worldwide medical, social, and economic burden that greatly affects patient quality of life.

Of those with diabetes, 6.5 million are estimated to suffer with chronic or non-healing wounds. Associated with inadequate circulation, poorly functioning veins, and immobility, non-healing wounds occur most frequently in the elderly and in people with diabetes—populations that are sharply rising as the nation ages and chronic diseases increase.

Although diabetes can ravage the body in many ways, non-healing ulcers on the feet and lower legs are common outward manifestations of the disease. Also, diabetics often suffer from nerve damage in their feet and legs, allowing small wounds or irritations to develop without awareness.

Management:

The overall treatment depends on the type, cause, and depth of the wound, and whether other structures beyond the skin (dermis) are involved.

Lacerations involves examining, cleaning, and closing the wound. Minor wounds, like bruises, will heal on their own, with skin discoloration usually disappearing in 1–2 weeks.

Abrasions, which are wounds with intact skin (non-penetration through dermis to subcutaneous fat), usually require no active treatment except keeping the area clean, initially with soap and water.

Puncture wounds may be prone to infection depending on the depth of penetration. The entry of puncture wound is left open to allow for bacteria or debris to be removed from inside.

Cleaning:

For simple lacerations, cleaning can be accomplished using a number of different solutions, including tap water and sterile saline solution. Infection rates may be lower with the use of tap water in regions where water quality is high. Cleaning of a wound is also known as 'wound toilet'.

Closure:

If a person presents to a healthcare center within 6 hours of a laceration they are typically closed immediately after evaluating and cleaning the wound. After this point in time, however, there is a theoretical concern of increased risks of infection if closed immediately.

Thus some healthcare providers may delay closure while others may be willing to immediately close up to 24 hours after the injury. Using clean non-sterile gloves is equivalent to using sterile gloves during wound closure.

If closure of a wound is decided upon a number of techniques can be used. These include bandages, glue, staples, and sutures, absorbable sutures have the benefit over non absorbable sutures of not requiring removal.

Adhesive glue and sutures have comparable cosmetic outcomes for minor lacerations <5 cm in adults and children. The use of adhesive glue involves considerably less time for the doctor and less pain for the person. The wound opens at a slightly higher rate but there is less redness. The risk for infections (1.1%) is the same for both. Adhesive glue should not be used in areas of high tension or repetitive movements, such as joints or the posterior trunk Split-thickness skin grafting (STSG) is also a surgical technique that features rapid wound closure, multiple possible donor sites with minimal morbidity.

Dressings:

In the case of clean surgical wounds, there is no evidence that the use of topical antibiotics reduces infection rates in comparison with non-antibiotic ointment or no ointment at all. Antibiotic ointments can irritate the skin, slow healing, and greatly increase the risk of developing contact dermatitis and antibiotic resistance. Because of this, they should only be used when a person shows signs of infection and not as a preventative.

The effectiveness of dressings and creams containing silver to prevent infection or improve healing is not currently supported by evidence.

Wound Healing

Wound healing refers to a replacement of destroyed or damaged tissue by newly produced tissue.

In undamaged skin, the epidermis (surface layer) and dermis (deeper layer) form a protective barrier against the external environment. When the barrier is broken, a regulated sequence of biochemical events is set into motion to repair the damage. This process is divided into predictable phases: blood clotting (hemostasis), inflammation, tissue growth (cell proliferation), and tissue remodeling (maturation and cell differentiation). Blood clotting may be considered to be part of the inflammation stage instead of a separate stage.

Stages:

1. Hemostasis (blood clotting): Within the first few minutes of injury, platelets in the blood begin to stick to the injured site. They change into an amorphous shape, more suitable for clotting, and they release chemical signals to promote clotting. This results in the activation of fibrin, which forms a mesh and acts as "glue" to bind platelets to each other. This makes a clot that serves to plug the break in the blood vessel, slowing/preventing further bleeding.

2. Inflammation: During this phase, damaged and dead cells are cleared out, along with bacteria and other pathogens or debris. This happens through the process of phagocytosis, where white blood cells engulf debris and destroy it. Platelet-derived growth factors are released into the wound that cause the migration and division of cells during the proliferative phase.

3. Proliferation (growth of new tissue):

In this phase, angiogenesis, collagen deposition, granulation tissue formation, epithelialization, and wound contraction occur. In angiogenesis, vascular endothelial cells form new blood vessels.

In fibroplasia and granulation tissue formation, fibroblasts grow and form a new, provisional extracellular matrix (ECM) by excreting collagen and fibronectin. Concurrently, re-epithelialization of the epidermis occurs, in which epithelial cells proliferate and 'crawl' atop the wound bed, providing cover for the new tissue.

In wound contraction, myofibroblasts decrease the size of the wound by gripping the wound edges and contracting using a mechanism that resembles that in smooth muscle cells. When the cells' roles are close to complete, unneeded cells undergo apoptosis.

4. Maturation (remodeling): During maturation and remodeling, collagen is realigned along tension lines, and cells that are no longer needed are removed by programmed cell death, or apoptosis.

Factors effecting wound healing:

Many factors controlling the efficacy, speed, and manner of wound healing fall under two types: local and systemic factors.

Local factors:

- Moisture; keeping a wound moist rather than dry makes wound healing more rapid and with less pain and less scarring.
- Oedema.
- Ionizing radiation.
- Faulty technique of wound closure.
- Ischemia and necrosis.
- Foreign bodies.
- Low oxygen tension.

Systemic factors:

- Inflammation.
- Diabetes – Individuals with diabetes demonstrate reduced capability in the healing of acute wounds. Additionally, diabetic individuals are susceptible to developing chronic diabetic foot ulcers, a serious complication of diabetes which affects 15% of people with diabetes and accounts for 84% of all diabetes-related lower leg amputations.

- Nutrients – Malnutrition or nutritional deficiencies have a recognizable impact on wound healing post trauma or surgical intervention. Nutrients including proteins, carbohydrates, arginine, glutamine, polyunsaturated fatty acids, vitamin A, vitamin C, vitamin E, magnesium, copper, zinc and iron all play significant roles in wound healing. Fats and carbohydrates provide the majority of energy required for wound healing. Glucose is the most prominent source of fuel and it is used to create cellular ATP, providing energy for angiogenesis and the deposition of new tissues. As the nutritional needs of each patient and their associated wound are complex, it is suggested that tailored nutritional support would benefit both acute and chronic wound healing.
- Metabolic diseases.
- Immunosuppression.
- Connective tissue disorders.
- Smoking – Smoking causes a delay in the speed of wound repair notably in the proliferative and inflammatory phases. It also increases the likelihood of certain complications such as wound rupture, wound and flap necrosis, decrease in wound tensile strength and infection. Passive smoking also impairs a proper wound healing process.
- Age – Increased age (over 60 years) is a risk factor for impaired wound healing. It is recognized that, in older adults of otherwise overall good health, the effects of aging causes a temporal delay in healing, but no major impairment with regard to the quality of healing.
- Alcohol – Alcohol consumption impairs wound healing and also increases the chances of infection. Alcohol affects the proliferative phase of healing. A single unit of alcohol causes a negative effect on re-epithelialization, wound closure, collagen production and angiogenesis.

Scar

A scar is the body's natural way of healing and replacing lost or damaged skin. A scar is usually composed of fibrous tissue. Scars may be formed for many different reasons, including as a result of infections, surgery, injuries, or inflammation of tissue. Scars may appear anywhere on the body, and the composition of a scar may vary. A scar may appear flat, lumpy, sunken, or colored. It may be painful or itchy. The final look of a scar depends on many factors, including the skin type and location on the body, the direction of the wound, the type of injury, age of the person with the scar, and his or her nutritional status.

Hypertrophic:

Hypertrophic scars occur when the body overproduces collagen, which causes the scar to be raised above the surrounding skin. Hypertrophic scars take the form of a red raised lump on the skin for lighter pigmented skin and the form of dark brown for darker pigmented skin. They usually occur within 4 to 8 weeks following wound infection or wound closure with excess tension and/or other traumatic skin injuries.

Keloid:

Keloid scars are a more serious form of excessive scarring, because they can grow indefinitely into large, tumorous (although benign) neoplasms.

Hypertrophic scars are often distinguished from keloid scars by their lack of growth outside the original wound area, but this commonly taught distinction can lead to confusion.

Keloid scars can occur on anyone, but they are most common in dark-skinned people. They can be caused by surgery, accident, acne or, sometimes, body piercings. In some people, keloid scars form spontaneously. Although they can be a cosmetic problem, keloid scars are only inert masses of collagen and therefore completely harmless and not cancerous. However, they can be itchy or painful in some individuals. They tend to be most common on the shoulder and chest.

Surgical removal of keloid is risky and may exacerbate the condition and worsening of the keloid.