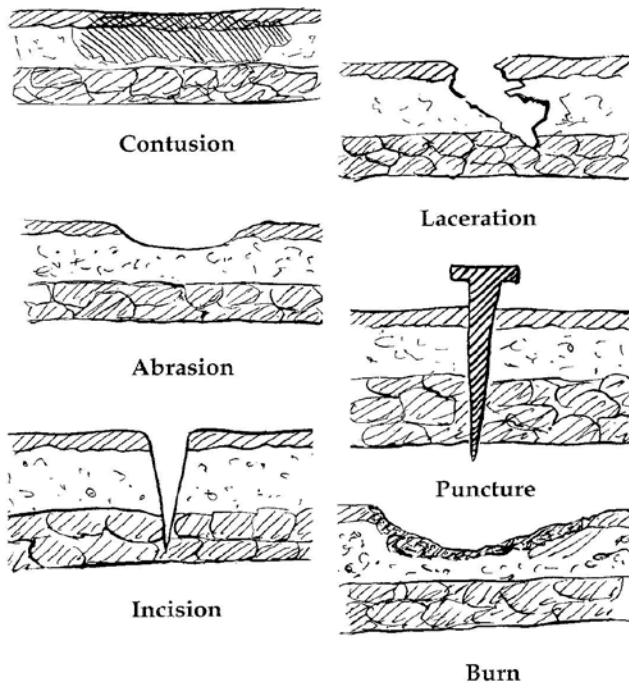


## Wounds

### 13.1 Wound Classification



**Wound:** disruption of the normal continuity of the body.

- **Open or closed wounds:** fractured bones can accompany either type of wound.
  - **Closed wounds:**
    - . Contusion: a bruise.
    - . Crushing injury.
  - **Open wounds:** include lacerations or skin loss.
    - . **Abrasions:** superficial loss of the epidermis and part of the dermis; usually caused by blunt trauma or shearing forces.
    - . **Avulsion:** tearing of the tissue from its attachment, resulting in a skin flap. An avulsion is usually caused by blunt trauma or shearing forces greater than those that cause abrasions. There usually is debris impregnated in such wounds.
    - . **Degloving injury:** an avulsion of the skin, usually on the limbs.
    - . **Incision:** wound caused by a sharp object.
    - . **Laceration:** an irregular wound through the skin and underlying tissue due to tearing.
    - . **Puncture wound:** penetration wound due to a sharp object.
    - . **Burns:** partial or full thickness wounds caused by heat or caustic chemicals.
- **Degree of contamination classification:**
  - **Clean wound:** minimally traumatized tissue with bacterial exposure aseptically controlled (e.g., surgical incision under aseptic condition).
  - **Clean contaminated wound:** can be effectively cleaned

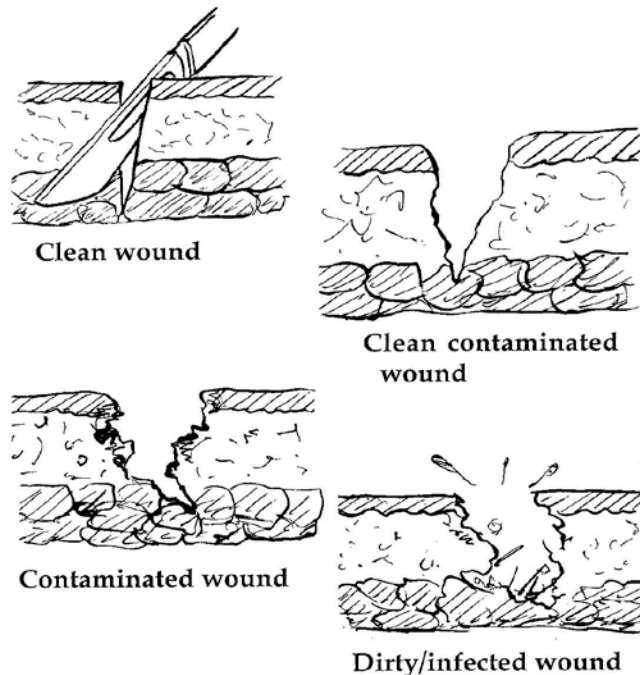
#### Wound Classification - Summary

- **Open or closed:**
  - Closed: contusions & crushing injuries
  - Open:
    - . Abrasions: loss of epidermis & part of dermis
    - . Avulsion: tearing from attachment
    - . Incision: caused by a sharp object
    - . Laceration: irregular tearing wound
    - . Puncture: sharp penetration
- **Degree of contamination:**
  - Clean: sharp aseptically controlled incision
  - Clean contaminated wound: can be cleaned
  - Contaminated wound: grossly contaminated
  - Dirty/infected wound: infection (all > 12 hr)

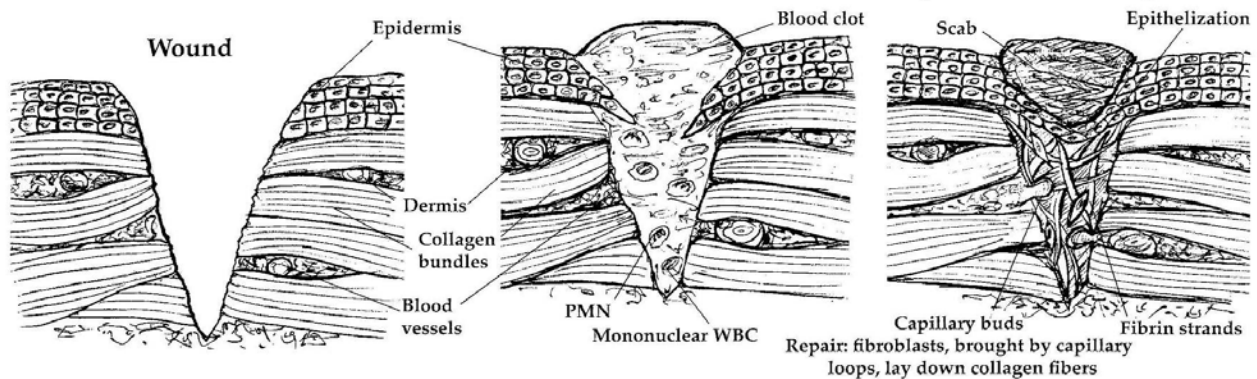
by lavage and debridement. Its potential to heal by primary intention is related to the bacterial numbers in the wound. The so called "golden period" is from zero to 6 hours post wounding, in which there is usually little bacterial multiplication.

- **Contaminated wound:** grossly contaminated wound with foreign debris.
- **Dirty/infected wound:** contaminated wound with an existing infection. Signs of an infected wound are inflammation, pain, purulent exudate (pus), and possibly fever. After twelve hours, all wounds are considered to be infected. Whenever in doubt about classification of a wound, consider it infected.

#### Degree of Contamination



## 13.2 Wound Healing - Phases



**13.2 Wound healing:** can be divided into inflammation, debridement, repair, and remodelling phases which overlap each other.

- **Inflammatory phase:** the first stage of wound healing shows little increase in wound strength in the first 3 to 5 days of healing, thus, is also called the lag phase.
  - **Vessels:** initially, after an injury, the blood vessels constrict to limit bleeding (5-10 minutes).
  - . The vessels then dilate to bring blood with platelets and clotting factors that promote clotting to stop bleeding and stabilize the wound.
  - **Clot:** consisting of dried blood cells, protein, and debris, often dries (dehydrates) to form a **scab** that protects the wound during healing.
- **Debridement phase:** begins within 6 hours of the injury.
  - **White blood cells** (neutrophils and monocytes): debride the wound by removing bacteria and necrotic and foreign material.
  - **Exudate:** seen during this phase, consists of white blood cells in the fluid leaking into the wound.
- **Repair phase:** going strong within 3 days of the injury.
  - **Granulation tissue:** red, fleshy tissue that appears in 3 to 6 days of an injury. It consists of **capillary loops** covered with fibroblasts and other cells that grow into the area. In large, open wounds the capillary loops or "knuckles" give the tissue a granular appearance. In small wounds the granulation tissue forms under the scab. Granulation tissue fills the defect, protects the wound, and provides a base for epithelial cells to grow over.
  - **Fibroblasts:** cells that lay down **collagen fibers** that mature to form a **scar**, increasing the strength of the wound.
  - **Wound contraction:** begins around 5 to 9 days after the injury, as special fibroblasts (myofibroblasts) in the granulation tissue contract and pull the wound margins closer together. Wound contraction benefits healing by decreasing the size of the defect, but may compromise the function of a joint or body opening.
  - **Epithelialization:** the dividing and migration of epithelial cells to fill an epithelial defect after debridement and granulation has occurred. In large, open wounds, it

### Healing phases - Summary

- **Inflammatory phase** (lag phase)
  - Platelets & clotting factors
  - Clot
  - ± Scab
- **Debridement phase:** within 6 hrs.
  - WBC debride wound
- **Repair phase:** strong within 3 days
  - Granulation tissue: (3 - 6 ds) - capillary loops covered with fibroblasts
  - Fibroblasts: form collagen scar
  - Wound contraction: (5 to 9 ds)
  - Epithelialization: covers defect
    - . Sutured incision: 48 hrs.
    - . Open wound: days to weeks
- **Remodeling phase:** strengthens, but still weaker

begins in 4 to 5 days and may take days to weeks to cover the granulation tissue. If there is a scab, the epithelial cells migrate between the granulation bed and the scab, excreting collagenase, which dissolves the deep layer of the scab, allowing its eventual removal. Epithelialization of a sutured incision wound can be complete in 48 hours, as there is no defect that needs to be filled with granulation tissue first.

- **Remodeling (maturation) phase:** the rearranging of the collagen fibers to strengthen the scar. The scar becomes paler as the number of capillaries decreases. Even when at full strength, a scar is 15-20% weaker than normal adjacent tissue.
- **Factors that delay healing:**
  - Old age
  - Undernourishment
  - Debilitating diseases (e.g., liver or kidney disease)
  - Corticosteroid (steroid) treatment or excess corticosteroids seen in Cushing's disease
  - Diabetes mellitus, also predisposes to wound infection along with delayed healing
  - Excessive movement
  - Tight bandages (decrease blood supply)
  - Foreign material in wound leads to infection
  - Wound infection stops healing.



## Wounds

### 13.3 Wound Evaluation

**Wounds** must be cleaned and evaluated to decide whether they should be sutured or left open to heal.

- **Preparation:** collect and place out the equipment and supplies (see box) that will be needed to evaluate the wound:
- **Restraint:** use the minimum amount of restraint that allows assessment of the wound. Assess the condition of the animal (will he bite?). Use a muzzle for dogs. A towel for cats can be used if the wound can still be reached.
- ± Analgesia/anesthesia may be required (A).
- **Hemostasis:** **stop any bleeding** using gauze and pressure or a pressure bandage. Stabilize the animal.

#### Prep: Wound evaluation

- ± Analgesic or anesthetics
- Sterile gloves
- Standard general surgical pack
- Sterile water soluble lubricant (K-Y jelly®)
- Cotton balls
- Tweezers
- Scissors & clippers
- Surgical scrub\*
- Lavage: water pick or syringe & 18 g needle
- Suture material
- Bandage material

#### Wound care/evaluation - Summary

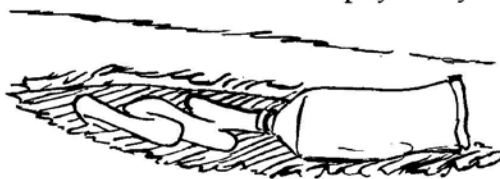
- **Restraint (A):** ± muzzle dogs, towel cats
- ± Analgesia/anesthesia
- **Stop bleeding & protect wound**
- **PE:** treat life threatening disorders first (vet)
- History
- **Wear gloves**
- ± Direct smear & culture (B)
- ± Systemic antibiotics
- **Clip & clean area around wound**
- K-Y jelly® or moist sponges in wound (C)
- Bathe dirty animals
- Clip area (#40 clipper & vacuum) (D)
- Surgical scrub around, not in wound (D)
- **Clean wound:**
- Remove K-Y jelly or sponges, dirt & grit
- Lavage repeatedly (E)
- ± 0.05% Nolvasan® or 1% Betadine®
- ± Debride
- Dab dry
- ± Topical antibiotics: controversial
- **Surgeon decides further treatment (F):**
- Suture?
- Bandage?
- **Monitor**



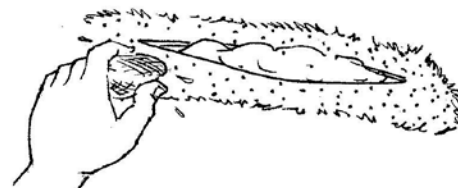
A. Restrain, stabilize & take a history & do a physically exam



B. Vet may order a direct smear & culture



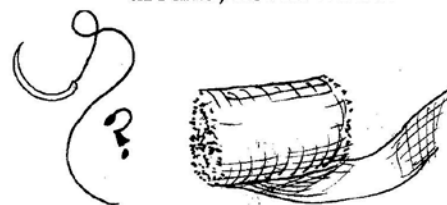
C. K-Y jelly® to protect wound before clipping & cleaning



D. Clip & surgical scrub around, not in wound



E. Clean wound: lavage, ± debride, dab dry



F. Suture?, Bandage?

\* Chlorhexidine gluconate (Nolvasan®) or povidone-iodine (Betadine®) and alcohol