



## Chapter 4: Wound Healing, Wound Management, and Bandaging

- n Please read CTVT pages 135-152
- n Large Animal Wound Mgmt will be covered in Equine/Food Animal.
- n Addition resources: VTDRG Chapter 10 Wound Care, pgs. 395-411



# Wound Terminology

- n Wound
- n Abrasion
- n Granuloma
- n Debridement
- n Avulsion
- n Necrotic
- n Laceration
- n Infection
- n Incision
- n Fibroblasts
- n Scar
- n Devitalized
- n Pus
- n Excised
- n Erythema
- n Puncture
- n En bloc



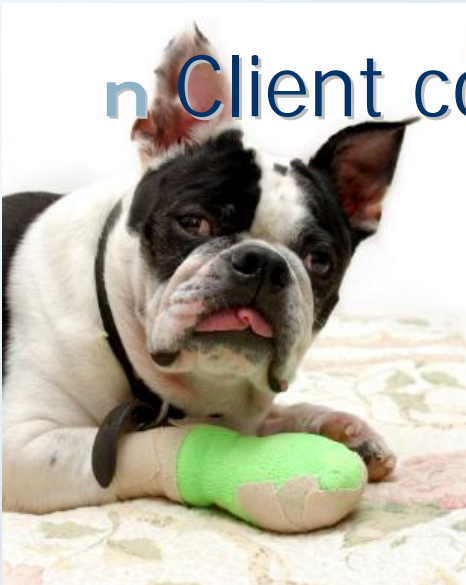
# Introduction

- n The Veterinary technician plays an important role in assisting the veterinary surgeon in the management of wounds.
- n The nature of the wound will dictate the method of wound management.
- n Knowledge of wound healing and the factors that alter wound healing is required to understand the methods of wound management.



# You need to be familiar with:

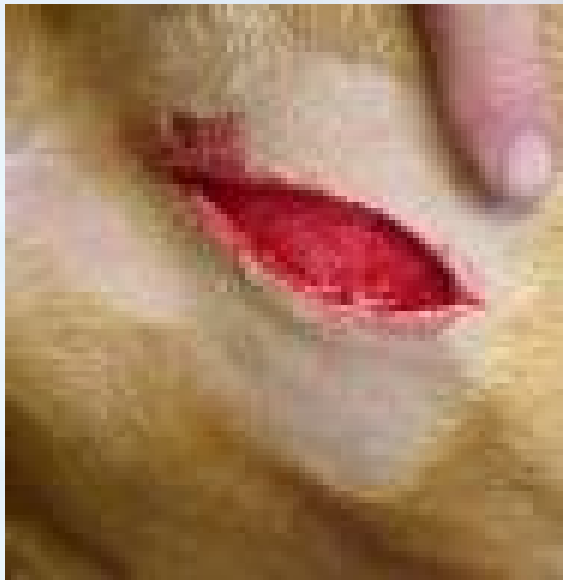
- n Wounds and Abrasions
- n Methods of wound management
- n The role of bandaging
- n Different types of bandages
- n Client communication



# “Wounds”

## n Intentional

n Surgical  
incision



## n Non-intentional

n Self-inflicted


n Accidents

n Trauma



**Anything that disrupts the normal integrity of the skin is called a wound.**





## 4 Physical phases of wound healing:

1. Inflammatory phase
2. Debridement phase
3. Repair phase
4. Maturation phase

**Wound healing is a dynamic process and more than one phase of wound healing is usually occurring at any time.**

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**Table 4-1 CHARACTERISTICS OF THE MICROSCOPIC PHASES OF WOUND HEALING**

<b>Phase</b>	<b>Characteristics</b>
Inflammatory	Begins immediately after injury; characterized by formation of blood clot; platelets stimulate other stages by release of growth factors
Debridement	Part of inflammatory phase; characterized by influx of white blood cells (macrophages, monocytes) into wound; occurs approximately 6 hours after injury; wound healing is sustained by release of growth factors from multiple cell types
Repair (fibroblastic)	Begins 3 to 5 days after wounding; characterized by invasion of fibroblasts and development of granulation tissue; wound strength increases exponentially
Maturation	Characterized by remodeling of the collagen of the scar and slow gain in wound strength; begins approximately 3 weeks after injury and may take weeks to years to complete

**(CTVT pg 136)**



# Inflammatory Phase

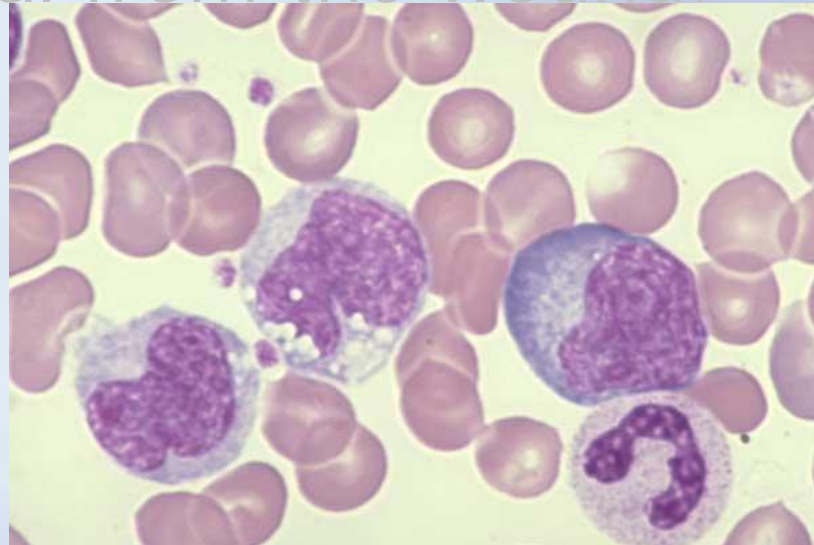
- n Begins immediately after injury.
- n Blood fills the wound and cleans the wound surface.
- n Hemorrhaging slows, and vasoconstriction occurs lasting about 5 to 10 minutes.
- n Blood vessels dilate and leak fluid that contains clotting elements into the wound. It's this fluid along with blood that causes a blood clot to form, thereafter a scab forms.
- n The scab alone does not provide wound strength. The severity of the wound dictates whether stitches are placed.





# Debridement Phase

- n Occurs about 6 hrs. after injury.
- n Neutrophils and monocytes appear in the wound. These guys remove necrotic tissue, bacteria, and foreign material from the wound.





# Repair Phase

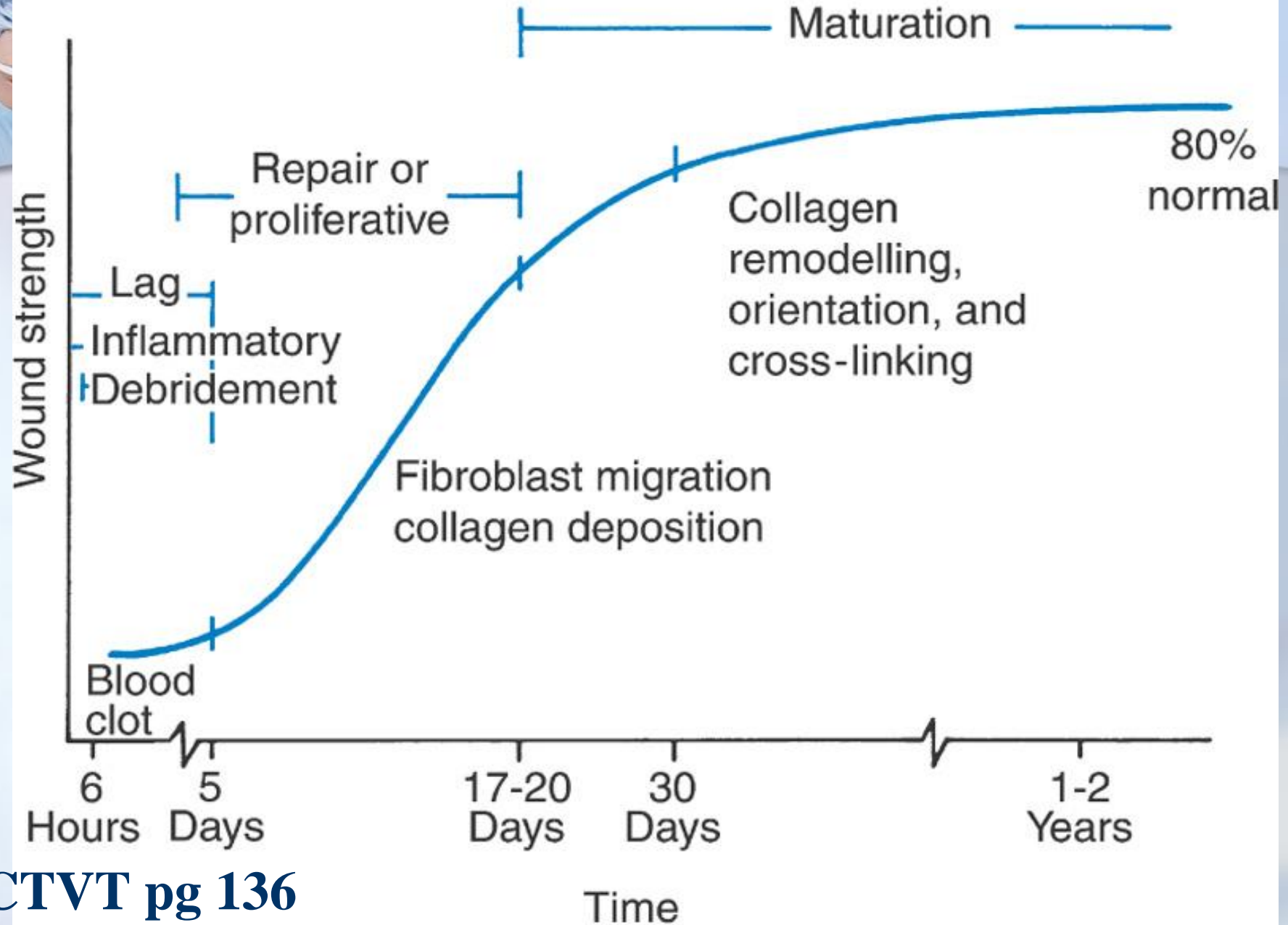
- n Occurs 3 to 5 days after injury
- n Fibroblasts invade the wound and produce collagen that will mature into fibrous or scar tissue.
- n Granulation tissue bed begins to form filling in the wound.
- n New epithelium forms on the wound surface.
- n Suturing wounds bypasses the repair phase with epithelialization occurring almost immediately, as early as 24-48 hrs.

# Maturation Phase




- n The final phase of healing where wound strength increases to its max.
- n This phase begins once collagen has been adequately deposited in the wound and may continue for several years.
- n Be aware that the wound never regains the strength of normal tissue.

# Phases of Wound Healing



CTVT pg 136





# Factors Affecting Wound Healing

- I. Host Factors
- II. Wound characteristics
- III. External Factors

Dog fight wounds





# I. Host Factors

- n Geriatric animals
- n Malnourished
- n Diseased: Cushing's disease  
(Corticosteroids delay all phases of wound healing)
- n Diabetes mellitus-predisposed to infections and delayed wound healing





## II. Wound Characteristics

- n Foreign material in the wound: sutures, drains, surgical implants, etc., can cause intense inflammatory reactions.
- n Intentional surgical incisions: scalpel blade -vs- electroscalpel or electrocoagulation
- n Contaminated tissue: infection stops the wound repair phase.
- n Bacterial toxins and associated inflammation directly damage cells.



## Cont. Wound Characteristics

- n Blood supply: important for wound healing because it is responsible for supplying oxygen and metabolic substrates (a substance upon which an enzyme acts) to the cells.
- n Do not use tight bandages as they can compromise the wound's blood supply.
- n Movement across a wound should be limited because it disturbs the fine cellular structures of the healing tissue.

# III. External Factors

## Delay Wound Healing!

### n Certain Drugs

n Corticosteroids (delays all phases of wound healing and increase the chance of infection)

n Anti-inflammatory drugs  
Aspirin (prolonged therapy delays blood clotting)

n Ibuprofen (suppresses early inflammation-but has little effect on wound strength)

n Radiation therapy

n Chemotherapeutic drugs



CTVT pg 137-138



# Wound Management

## Immediate Wound Care

- n Cover the wound with a clean dry bandage to prevent further contamination.
- n Water soluble antibiotic ointments may be applied. Do not use creams or powders as they act as foreign bodies and delay wound healing.
- n The above should be done until definitive treatment is initiated. **Life-threatening injuries and stability of the animal must be attended to first.**



The wound is temporarily closed with towel clamps to allow aseptic preparation of the surrounding skin. CTVT pg. 138





# Wound Lavage (Performed by the RVT)

- n Reduces the amount of bacteria by removing debris and loose particles and tissue from the wound.
- n Bacterial cultures can be taken from tissue samples.
- n Large volumes of warm sterile, balanced electrolyte solution are preferred for lavage.
- n Do not use soaps, detergents or antiseptic solutions. Do not add antibiotics to fluids.
- n The mechanical action of the lavage is the most important factor for successful lavage.



# Wound Lavage

Pulsating high-pressure (70 psi)  
Lavage-most effective in reducing  
the bacterial population.



Connection of a 35ml syringe and 19 g needle to a 3-way stopcock and bag of sterile balanced electrolyte solution (moderate pressure of 7 psi)





# Wound Debridement (Performed by the Veterinarian)

- n Is necessary to remove all contaminated devitalized or necrotic tissue and foreign material from the wound.
- n Surgically: excise the affected tissue in layers, beginning at the surface and progressing to the wound depths.

## Table 4-3 METHODS AND INDICATIONS FOR WOUND DEBRIDEMENT

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### Method

### Indications

Layered debridement

Conservative debridement beginning at superficial layers of wound and progressing to depths; indicated for large wounds with substantial tissue trauma; may be repeated for heavily contaminated/traumatized wounds

En bloc

Complete excision of wound; indicated

Excised en bloc:  
removed by cutting the  
whole mass out.



for small wounds in areas with loose skin that can be closed primarily

Enzymatic

Use of trypsin products that dissolve necrotic tissue; very slow method of

Debridement.





# Wound Closure

(One of the 4 methods are performed by the Veterinarian)

**Table 4-4 METHODS OF WOUND CLOSURE**

Method	Comments
Primary closure	Closure of a wound with sutures; indicated for fresh clean wounds with minimal contamination/trauma or surgically created wounds; results in <i>first-intention healing</i>
Delayed primary closure	Closure of a wound before 3-5 days after injury; that is, before development of granulation tissue; indicated for moderately contaminated/traumatized wounds
Contraction and epithelialization	Wound allowed to heal without surgical closure; wound closes as a result of contraction and epithelialization; may not be possible or desirable in all wounds; results in <i>second-intention healing</i>
Secondary closure	Closure of a wound after 3-5 days; that is, after granulation tissue has developed in the wound; indicated in severely contaminated/traumatized wounds that require considerable debridement and prolonged wound management; takes advantage of the positive effects of granulation tissue; results in <i>third-intention healing</i>

Suture or graft

1-3 days post trauma

Dirty or contaminated wounds

3-5 days post trauma

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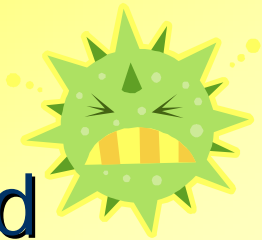
## Healing Method: Dependent on the age and condition of the wound

- n 1<sup>st</sup> Intention Wound Healing (Primary closure)
  - n Wound is sutured closed, used when wounds are 6-8 hrs. old with minimal tissue damage and contamination.
- n 2<sup>nd</sup> Intention Wound Healing (Healing by contraction and epithelialization)
  - n Wound is left to heal open. These wounds are 5 days or older and have significant tissue damage or are excessively contaminated. Note: New skin may not contain hair follicles.
- n 3<sup>rd</sup> Intention Wound Healing (Secondary closure)
  - n Delayed primary closure. Wound is sutured closed after the granulation tissue has formed. 3-5 day old wounds and are heavily contaminated or infected.

Vet Tech Daily Ref. pg 400 Skill  
Box 10.1/Wound Care

# The “Golden Period”

- n Wounds treated within 6 to 8 hours of injury are treated within the “golden period”, meaning that bacterial levels have not multiplied to critical numbers yet and the tissue has not become infected.
- n Wounds treated after the golden period should not be closed, because infection is likely.





# Degloving incident

After surgical debridement and open wound management, the wound healed by second intention with contraction and epithelialization.

Commonly seen in small HBC animals and dragged over the road surface. Skin and varying amounts of deep tissue are torn off a limb. Intensive management over a prolonged period is required.



A





After several weeks, the wound is completely closed. Note the hairless, shiny new epithelium. The epithelium will thicken over time but will always remain fragile.



# Client Communication

- n Be prepared for clients to call the clinic for instruction prior to bringing their animal in. RVTs most often talk to clients over the phone.
- n For wound care, advise them to cover the wound with a clean, dry cloth, or bandage.
- n Advise to them to bring the animal into the clinic immediately.



# Your responsibilities:

- n Client communication
- n Setup for patient
- n Preparing the wound for treatment
- n Cleaning the wound
- n Assisting the veterinarian with debridement
- n Assisting the veterinarian with closure
- n Relaying aftercare instructions to the client

## **Box 4-1** FACTORS IMPORTANT IN WOUND MANAGEMENT DECISION MAKING

- Time since injury
- Degree of wound contamination
- Degree of tissue trauma
- Thoroughness of initial debridement
- Blood supply of wound
- Animal's physical status
- Wound tension and possibility of closure
- Location of wound





**We Will Now Cover:  
Wound Bandaging**

# Specific Wound Management

- n Abrasions
- n Lacerations
- n Burns
- n Puncture Wounds
- n Degloving Injuries
- n Decubitus Ulcers

**Read pgs. 147, 151, 152 in  
Your CTVT book**





# Abrasions

- n The topmost layer of the skin (epidermis) is scraped off leaving exposure of the deep dermis.
- n They can be very painful, have minimal bleeding and minimal exudate.
- n Can be caused by a sliding fall onto a rough surface
- n Keep moist and covered with nonadhesive, semioclusive, hydrophilic layers. This promotes epithelialization. Abrasions heal by reepithelialization. No scabs wanted here.
- n Change bandages every 3 to 4 days until the surface has completely resurfaced with new epithelium.



# Lacerations

- n Characterized by sharply incised edges with minimal tissue trauma. Irregular tear-like wounds. These can be superficial or deep.
- n Superficial pertains to the skin, and Deep pertains to tendons and muscle
- n If tissue is torn away, the wound is called an avulsion.







## Cont., Lacerations

- n Presented within 12 hrs: perform minimal debridement of the tissue tissues, lavage of wound, and a primary closure.
- n Over 12 hrs. old: en bloc debridement of the wound and primary closure.
- n Heavily contaminated/old lacerations: debridement, lavage and delayed primary closure. These are uncommonly seen.



# Burns

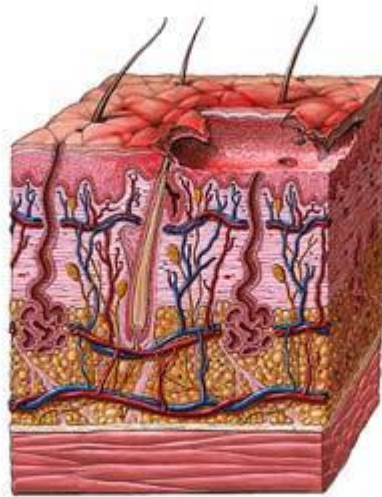
- n Burns are classified by the degree of tissue injury.
- n The most common causes of burns in companion animals are fire, cage dryers, prolonged contact with heating pads, heat lamps, spillage of hot liquid, and contact with electrical cords.
- n Animals with more than 50% of the body surface burned rarely survive.



**Table 4-6 CLASSIFICATION OF THERMAL BURNS**

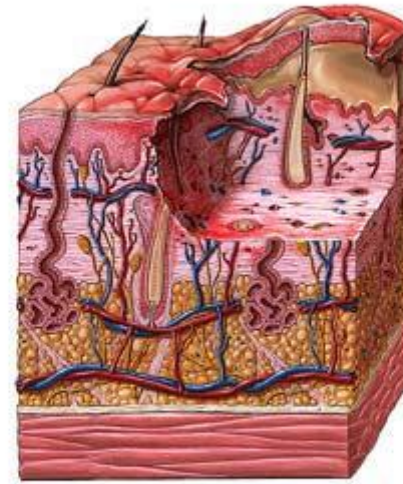
<b>Classification</b>	<b>Description</b>
First degree	Very superficial burn that involves only the epidermis. Does not blister but becomes erythematous because of dermal vasodilatation and is painful. Over 2 to 3 days, the pain subsides, and the damaged epidermis desquamates. (sheds)
Second degree	Superficial burn that involves all layers of dermis. Characteristically forms blisters with fluid collection at the interface of the epidermis and dermis. Blistering may not occur for several hours after injury.
Third degree	Full-thickness burn that involves all layers of the dermis. The surface may appear white or black and leathery, firm, and depressed compared with surrounding skin.
Fourth degree	Full-thickness burn that involves not only the dermis, but also subcutaneous fat and deeper structures





1st degree burn

ADAM.



2nd degree burn

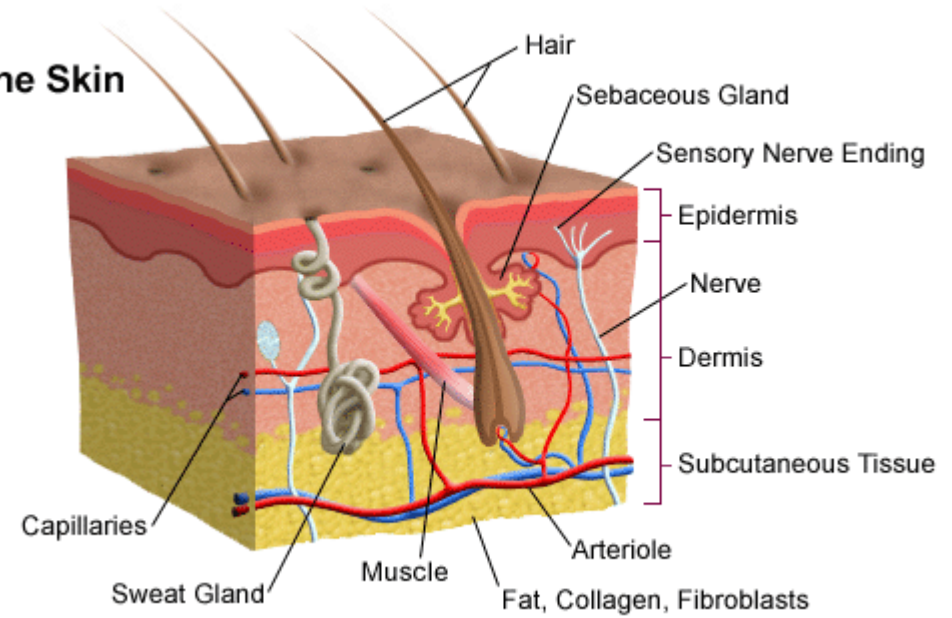
ADAM.



3rd to 4<sup>th</sup> degree

ADAM.

### The Skin

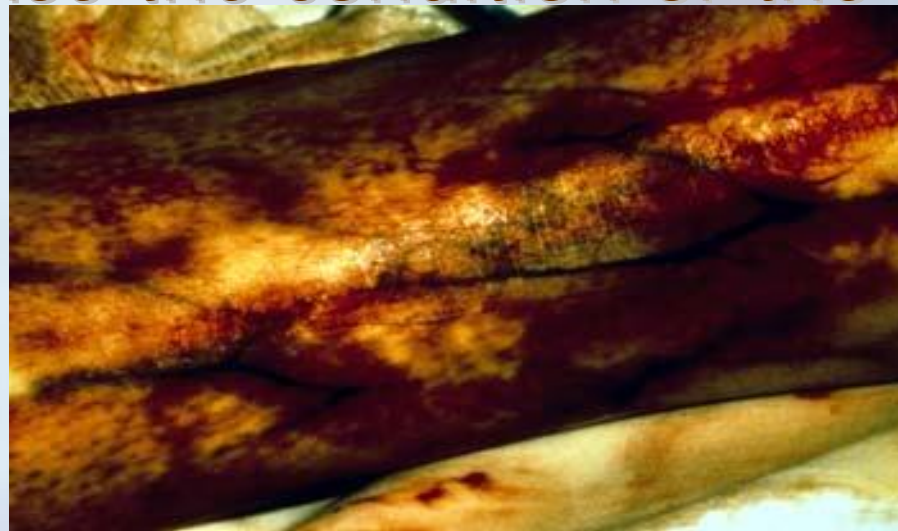






# Fourth Degree Burns

- n Prone to infection because of the extensive tissue damage
- n Are exposed to environment contamination
- n Result in large volumes of electrolytes and protein loss through the wound surface.
- n Compromise the condition of the animal





# Treatment of severe Burn Victims

- n Intravenous crystalloid and colloid fluid administration
- n Antibiotic administration
- n Nutritional support (very important because the metabolic requirement of the animal may increase up to 200%)
- n Intensive wound management





# Burn Victim



# Chemical Burn



Please be sure to read the “Burn” section in your CTVT pg. 151-152





A healthy granulation tissue wound bed on the dorsum of a dog after open wound management of a thermal burn injury (the dog's head is toward the top)

The wound will be Closed in stages.

A

Staged, partial closure of the wound over the granulation tissue allows third-intention healing of the wound (the dog's head is to the right).



**B**

Closure of the remaining portion of  
the wound.





# Puncture Wounds

- n Small skin openings with often extensive deep tissue damage.
- n Penetrating injuries caused by sharp objects
- n Can you give me some examples?







# Puncture Wounds

- n Gunshots
- n Bite wounds
- n Insect stings
- n Sticks
- n Arrows



Caused by a tree branch

## Treatment of Puncture Wounds

- n Debridement, lavage and primary closure if all the damaged contaminated tissue and all foreign material can be removed.
- n May require placement of a drain or two. Typically if not a chest wound, these are not bandaged but allowed to drain, unless there is excessive bleeding.
- n Dead space: space remaining in tissues as a result of failure of proper closure that allows the accumulation of blood or serum.

# Decubitus Ulcers



n A Decubital ulcer is an abscess or pressure wound similar to bed sores and form over bony prominences. They occur in dogs and other large and small animals. These wounds occur when a bony part of the body such as an elbow rests for long periods against a hard surface, restricting blood flow to the area. "Without blood flow the tissue dies and begins to detach from the body."



# Treatment

- n Prevention is the key to management!
- n Water beds or soft bedding
- n “Turning over” your patient. Animals that are unable to move need to be turned periodically, q4hrs. This needs to be recorded in their treatment record.
- n Pressure points should be checked daily.
- n Physical therapy and hydrotherapy promote peripheral circulation.
- n Maintain the animal on a high protein, high carb diet.





Human Decubitus ulcer



Decubitus ulcer on the elbow of a dog



# Home Care Instructions

- n Elizabethan Collars, No Chew vet wrap, and no chew sprays
- n Exercise should be restricted to brief leash walks
- n Protective plastic coverings should not remain on for more than 30 minutes
- n Monitor bandages for foul odors and exudate seepage
- n Monitor those toes for warmth, color, and swelling
- n Owners should contact their veterinarian immediately should any abnormalities occur



# Tips for the Future

- n Always clip the fur/hair when dealing with wounds. On this note:
- n If in the field working on large animals and clippers are not available, you would lather the wound edges with an antiseptic scrub and shave the hair with a razor or scalpel blade.
- n Basic wound care for large animals is the same as in small animals.
- n Wounds on the limbs of large animals should always be bandaged.
- n *Proud flesh* is excessive granulation tissue that can form on the limbs of horses during wound healing.





**Proud Flesh:  
Granulation tissue  
On the metatarsus of  
A horse.**

Open wounds on the distal aspect of the limb (below the carpus or tarsus) of the horse are notorious for developing this type of granulation tissue.



