

Chronic wounds

Amanda Bergren, DVM, DACVS-LA

Stages of wound healing

Causes of delayed wound healing

Assessment of the chronic wound

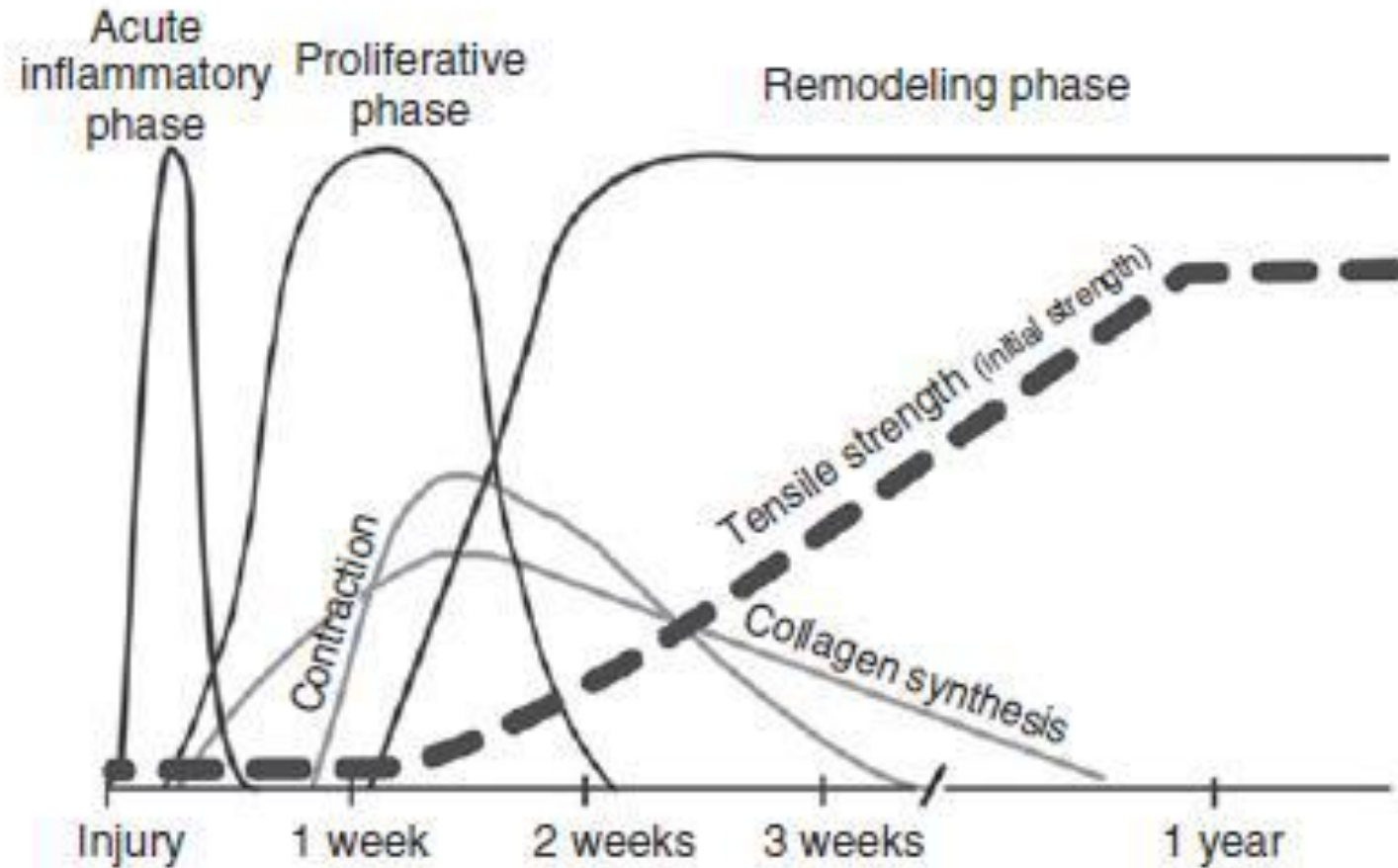
Treatment of the chronic wound

Scarring

Stages of Wound Healing

I'll keep it brief, I promise

Stages of wound healing



Stages of wound healing

- **Inflammatory**

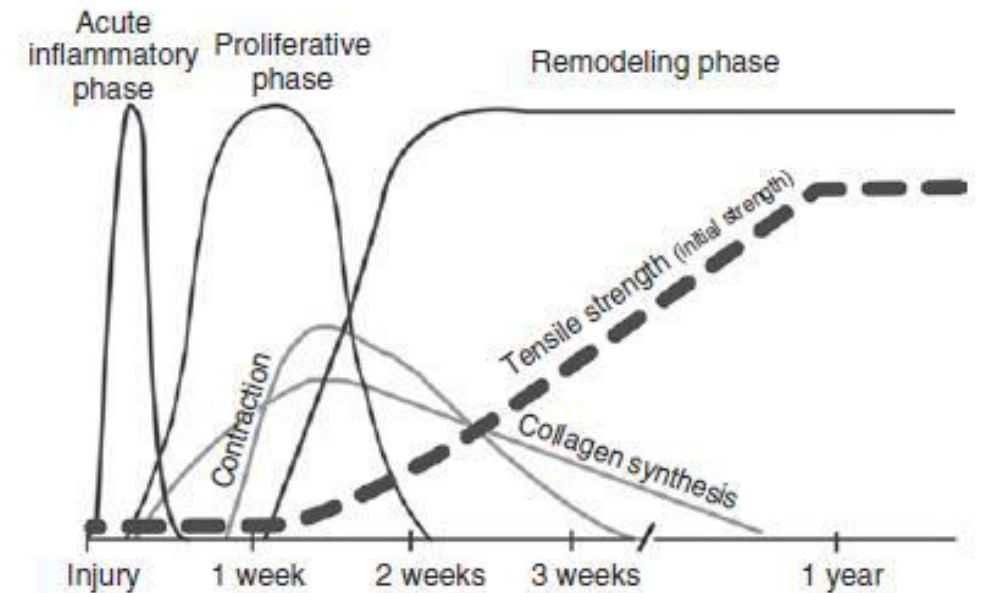
- First several days

- Hemostasis

- Vasoconstriction
- Platelet aggregation
- Fibrin deposition

- Acute inflammation

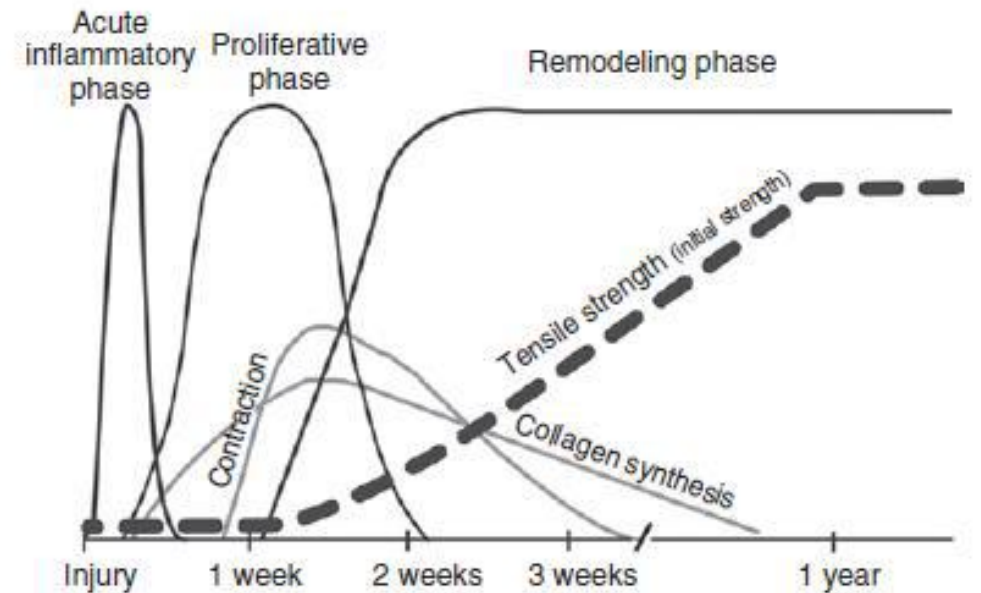
- Leukocyte influx
 - Neutrophils
 - Macrophages



Stages of wound healing

- **Proliferative**

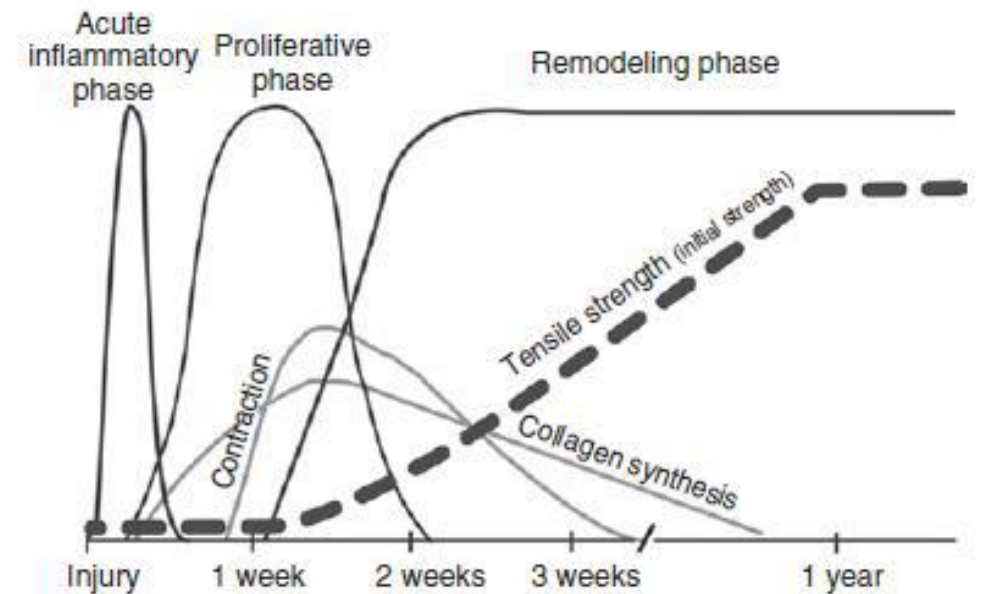
- Starts by day 3 after injury
- Angiogenesis
- Formation of fibrous and granulation tissue
- Collagen deposition
- Epithelialization
- Wound contraction



Stages of wound healing

- **Remodeling**

- Begins in 2nd week, ends 1-2 years later
- Remodeling, reorientation, collagen cross-linking
- New tissue 15-20% weaker than original tissue
 - 20% strength at 3 weeks
 - 50% strength at 3 months
 - 70-80% strength at 1 year



Causes of delayed wound healing

Why won't the wound heal?

- **Possible causes:**
 - Infection
 - Necrotic tissue
 - Foreign material
 - Exuberant granulation tissue
 - Excessive motion
 - Repetitive mechanical trauma
 - Neoplasia
 - Arrested healing response

Infection

- Presence of replicating microorganisms in wound
- Delays healing
- Reduces gains in tensile strength
- Increases risk of dehiscence



Infection

- Presence of replicating microorganisms in wound
- Delays healing
- Reduces gains in tensile strength
- Increases risk of dehiscence



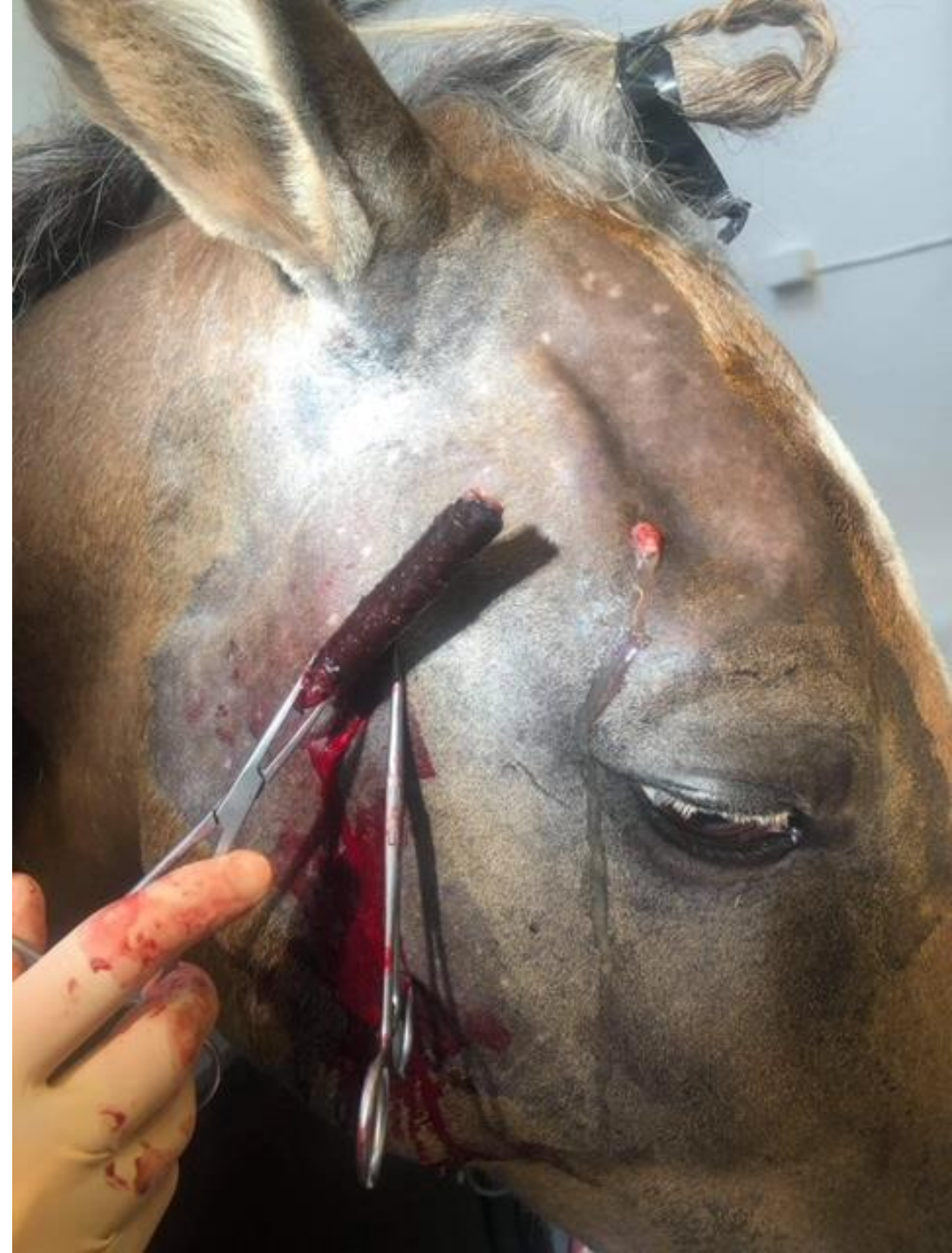
Necrotic tissue

- Sequestrum formation common in wounds with exposed bone



Foreign material

- Substrate for bacterial growth



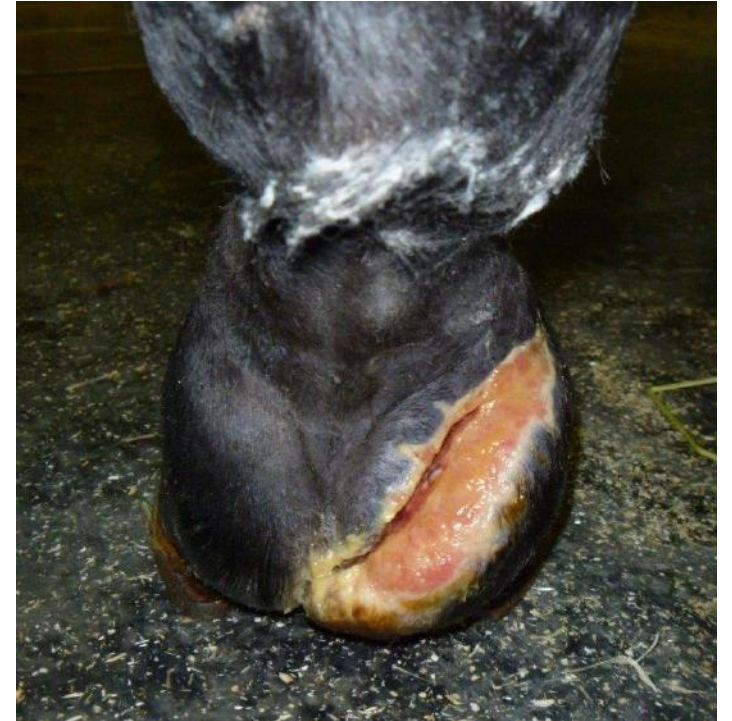
Exuberant granulation tissue

- Both cause and effect of delayed healing
- Prolonged inflammatory phase → excessive proliferative phase
 - Wound expansion
 - Delayed contraction
 - Inhibits epithelialization



Excessive motion

- Delays contraction and epithelialization



Neoplasia

- Neoplastic transformation uncommon
 - Squamous cell carcinoma
 - Sarcoids



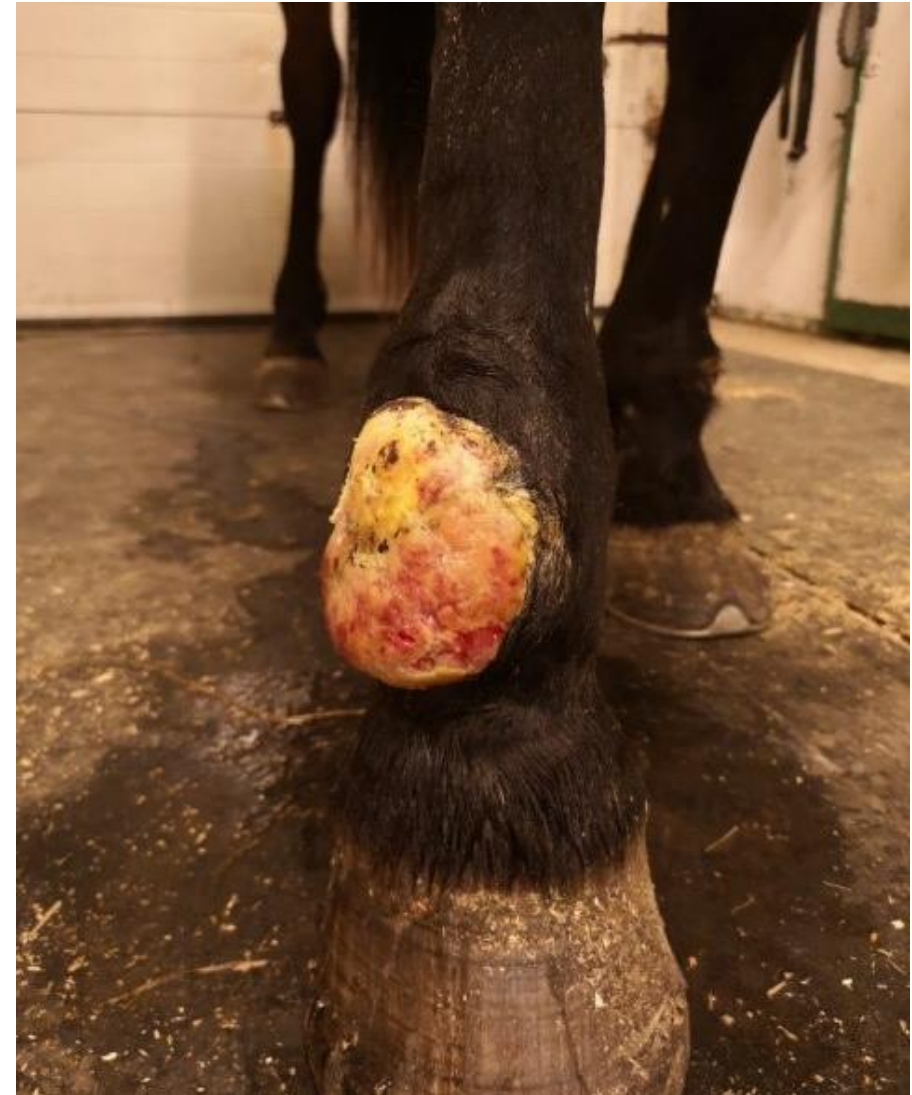
Neoplasia

- Neoplastic transformation uncommon
 - Squamous cell carcinoma
 - Sarcoids



Neoplasia

- Neoplastic transformation uncommon
 - Squamous cell carcinoma
 - Sarcoids



Assessment of the chronic wound

Assessment of the chronic wound

- Digital exploration

Assessment of the chronic wound

- **Diagnostic imaging**
 - Radiographs
 - Sequestrum
 - Metallic or mineral foreign bodies



Assessment of the chronic wound

- **Diagnostic imaging**

- Contrast sinography

- Contrast injected into sinus tract
- Delineate wound tract
- Identify foreign bodies in tract
 - Contrast surrounds FB creating filling defect
 - Useful for radiolucent material (e.g. wood)



Equine Wound Management

Assessment of the chronic wound

- **Diagnostic imaging**
 - Contrast sinography
 - Contrast injected into sinus tract
 - Delineate wound tract
 - Identify foreign bodies in tract
 - Contrast surrounds FB creating filling defect
 - Useful for radiolucent material (e.g. wood)



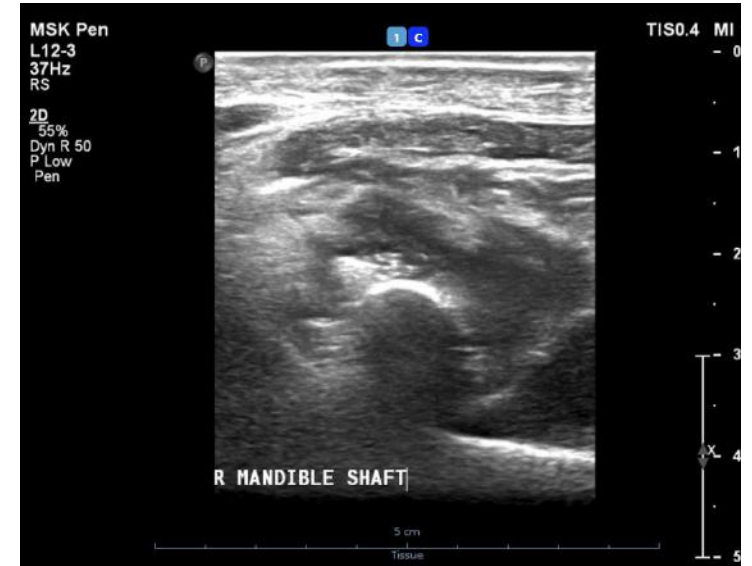
Assessment of the chronic wound

- **Diagnostic imaging**
 - Ultrasound
 - Radiolucent foreign material
 - Fluid pockets



Assessment of the chronic wound

- **Diagnostic imaging**
 - Ultrasound
 - Radiolucent foreign material
 - Fluid pockets



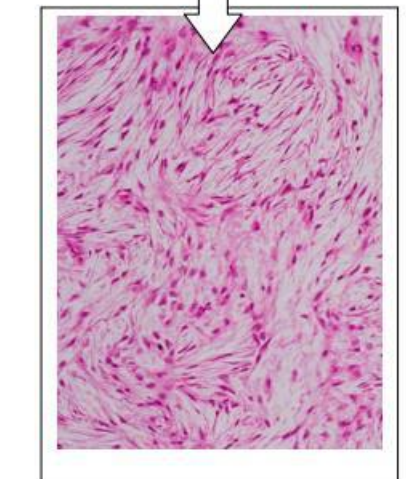
Assessment of the chronic wound

- **Culture**
 - Tissue samples or exudate
 - Can be misleading with draining tracts
 - Secondary colonization
 - Bacteria on FB likely different



Assessment of the chronic wound

- **Biopsy**
 - Requires deep samples
 - Superficial tissue often not useful
 - Excisional
 - More tissue for pathologist
 - Submit everything
 - Can still be difficult to differentiate
 - Neoplastic cells may not be everywhere



Knottenbelt, NAVC 2007

Treatment of the chronic wound

Treatment of the chronic wound

- **Possible treatment options:**
 - Wound revision
 - Immobilization
 - Skin grafting



Wound revision

- Returns the wound to the acute phase



Wound revision

- Returns the wound to the acute phase
- Debridement
 - Reduce bacterial numbers
 - Remove foreign material
 - Remove necrotic tissue



Wound revision

- Returns the wound to the acute phase
- Debridement
- Secondary closure
 - Wound closure > 5 days after injury
 - Requires excision of granulation tissue and epithelial edges



Immobilization

- Splinting
- Casting

- **Indications**
 - Wounds in pastern/heel bulb region
 - Wounds in high motion areas
 - Dorsal fetlock
 - Dorsal carpus/tarsus
 - Wound overlying extensor tendons

Immobilization: splints

- **Material for splints**

- PVC pipe

- Inexpensive, lightweight, can cut to size for each case

- Fiberglass cast

- Specifically made to fit each horse
- Expensive, less rigid than PVC



Eggleston, *VCNA Eq.* 2018

Immobilization: splints

- **Principles of application**

- Placement

- Distal limb: proximal metacarpus/tarsus to ground
- Carpus: proximal radius to fetlock joint, place caudally
- Tarsus:
 - One splint from point of hock to ground, place caudally
 - One splint from stifle to ground, place laterally

- Secure with non-elastic tape

- Sports tape, silver tape
- Not tensoplast!



Palmer, AAEP 2012

Immobilization: casts

- **Benefits of casting**
 - Limits motion much better than bandages
 - Less expense than frequent bandage changes



Immobilization: casts

- **Benefits of casting**

- Limits motion much better than bandages
- Less expense than frequent bandage changes

- **Downsides of casting**

- Requires vigilant client
- Cast sores
 - 45% of horses
 - 48% of traditional casts, 26% of bandage casts
 - Increased if limb casted in flexed position
- Long-term use can cause changes in bone, cartilage and periarticular tissues
 - Decreased bone density, decreased range of motion, persistent lameness



Levet, EVJ 2009

Immobilization: casts

- **Types of casts**
 - Traditional
 - Foot cast
 - Distal limb cast
 - Bandage cast
 - Standard
 - Bivalved

Immobilization: casts

- **Foot casts**

- Encompass hoof and pastern
- Best used for heel bulb and coronary band injuries



Immobilization: casts

- **Foot casts**

- Encompass hoof and pastern
- Best used for heel bulb and coronary band injuries



Immobilization: casts

- **Distal limb casts**

- Extend from foot to just below carpus/tarsus
- Best used for pastern and fetlock injuries



Immobilization: casts

- **Bandage cast**
 - Intermediate stability between traditional cast and bandage
 - Increased padding
 - More room for error
 - Less likely to develop cast sores
 - Standing application allows normal weight bearing position
- **Bivalved bandage cast**
 - Allows for continued access to wound
 - Repeat joint lavage
 - Continued debridement
 - Large amounts of exudate



Skin grafting

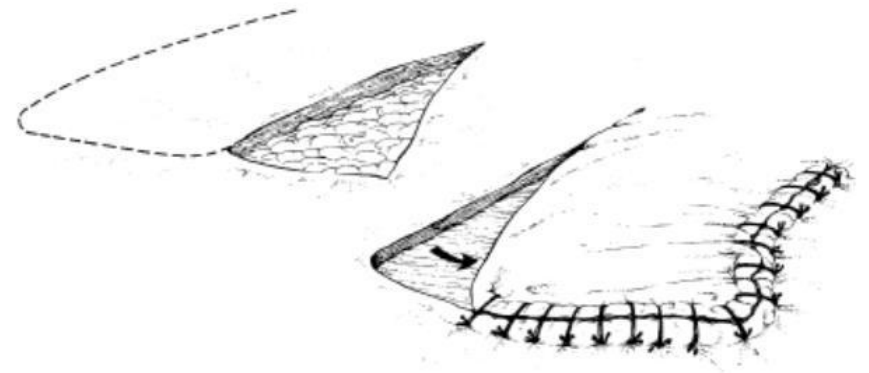
Why graft?

- Inexpensive
 - Cost of procedure offset by savings on wound care and bandage material
- Better cosmesis and better quality tissue
 - Contains epidermis, dermis, adnexal structures
 - More resilient tissue than wound healed by epithelialization
- Requires only basic techniques and equipment
- Should not regard as a last resort treatment option!

Skin grafting

Types of grafts

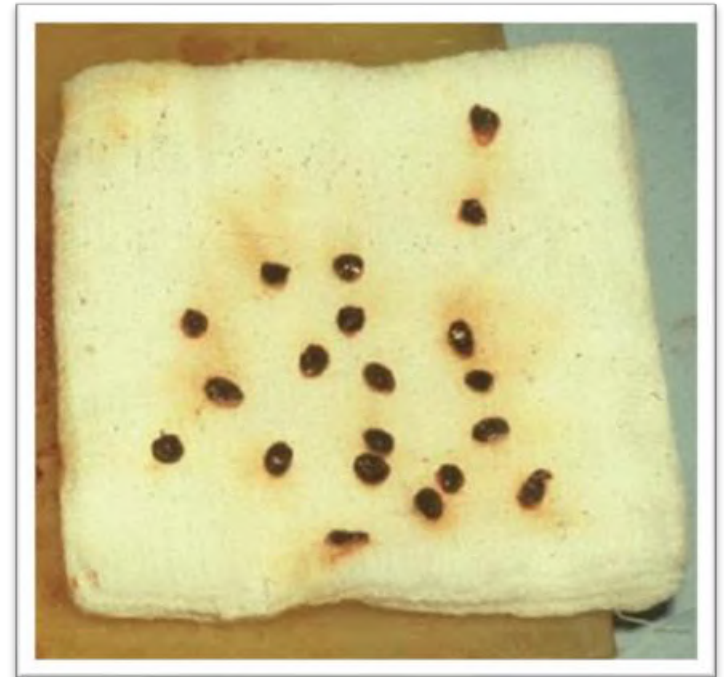
- Pedicle grafts
 - Remain connected to donor site
 - Useful for poorly vascularized sites
 - Rarely used due to limited mobility of equine skin



Skin grafting

Types of grafts

- Free grafts
 - Completely separated from donor site and transferred to new site
 - Must establish new vascular connections
 - Island grafts most commonly used in horses



Skin grafting

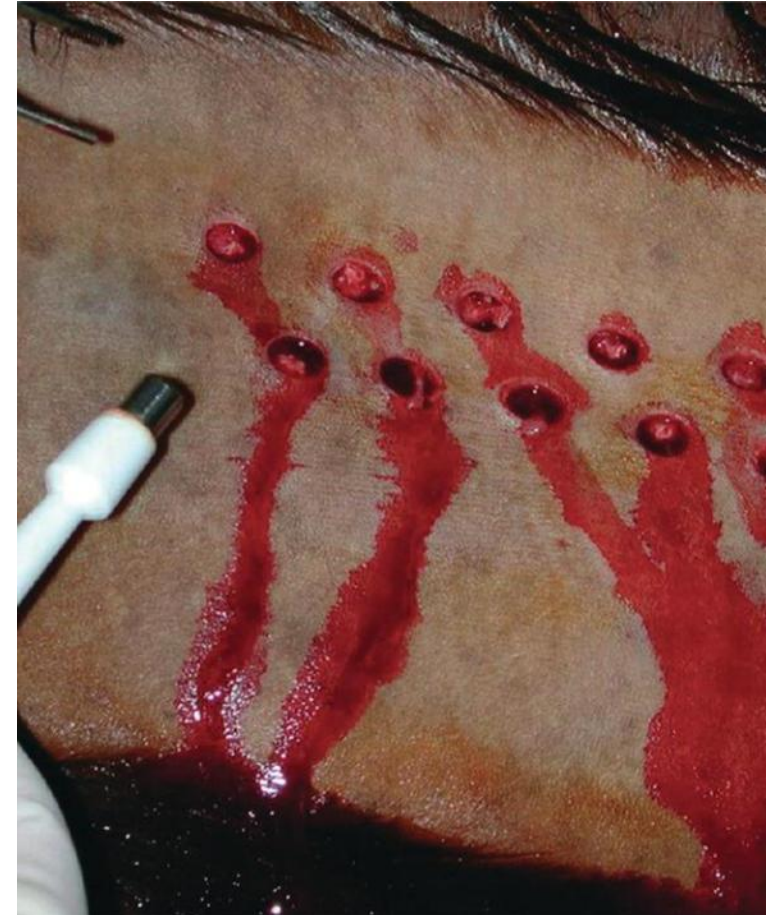
Types of grafts

- Free grafts
 - Full thickness
 - Epidermis + entire dermis
 - Split thickness
 - Epidermis + portion of dermis
 - Percentage of dermis influences durability, acceptance and cosmesis
 - More dermis = more durable, better cosmesis
 - Less dermis = better acceptance

Skin grafting

Types of grafts

- Punch grafts
 - Harvest using biopsy punch
 - Full thickness
 - Donor sites: under mane, lumbar region



Skin grafting

Types of grafts

- Pinch grafts
 - Harvest by elevating & excising small cone of skin
 - Partial thickness
 - Donor site: pectoral skin



Skin grafting

Case selection

- Large wounds where contraction has ceased
- Open wound which cannot be sutured

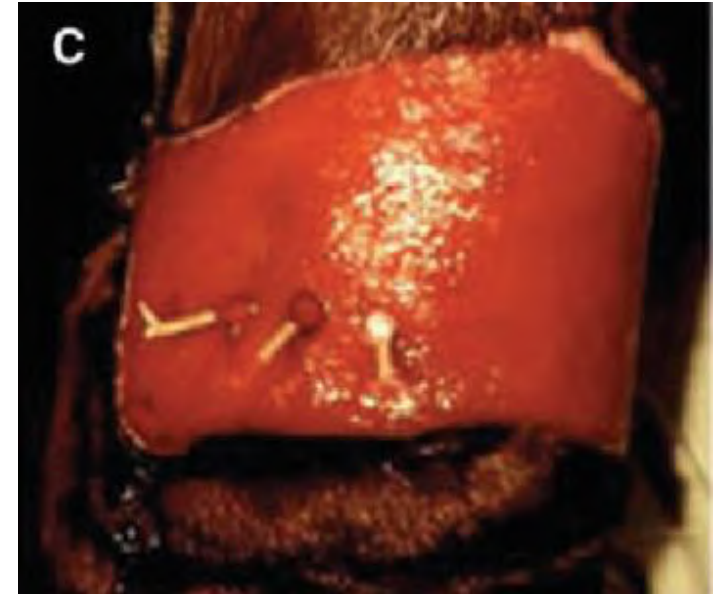
- Healthy granulation bed
 - Good vascular supply
 - No devitalized tissue
 - Free of infection



Skin grafting

Technique

- Wound bed prepared 24-48 hours ahead – excise excess granulation tissue
- Create recipient holes prior to harvesting grafts
 - Allows for hemostasis
 - Place holes ca. 6mm apart
 - Slightly smaller hole than graft
 - Fill hole with Q-tip

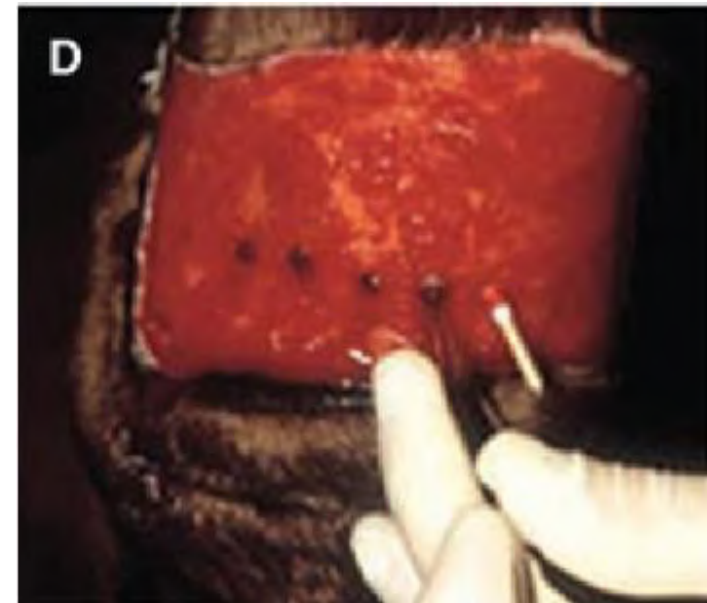


Dahlgren, 2006

Skin grafting

Technique

- Harvest grafts
- Insert grafts into recipient holes
- Bandage
 - Initial change after 4 days



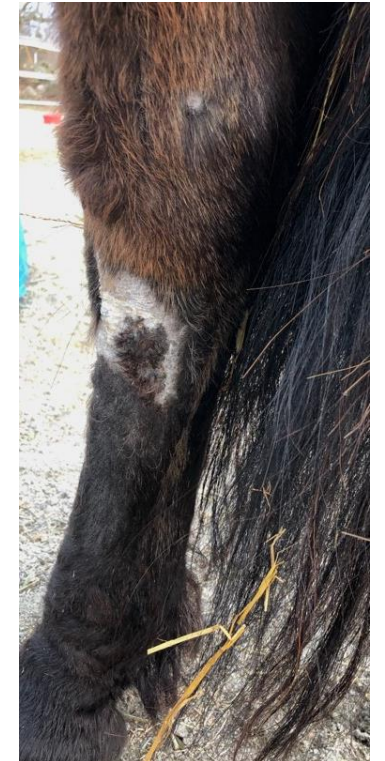
Skin grafting

- Success rate: 50-60%
- Causes for graft failure:
 - Infection
 - Fluid accumulation
 - Motion
 - Inflammation

Skin grafting: case example



Skin grafting: case example



Scarring

Scar tissue

- Reduced bursting strength
- Reduced extensibility
- Reduced toughness

When do we need to treat scars?

- Restricted movement
- Pain
- Hypertrophic scarring?



What we know from human medicine

- Physical scar management beneficial
 - Massage
 - Silicone gel
 - Laser
 - ESWT
 - Scar taping
- Improved pain, pruritis, pliability, thickness

What is feasible for horses?

- **Massage**

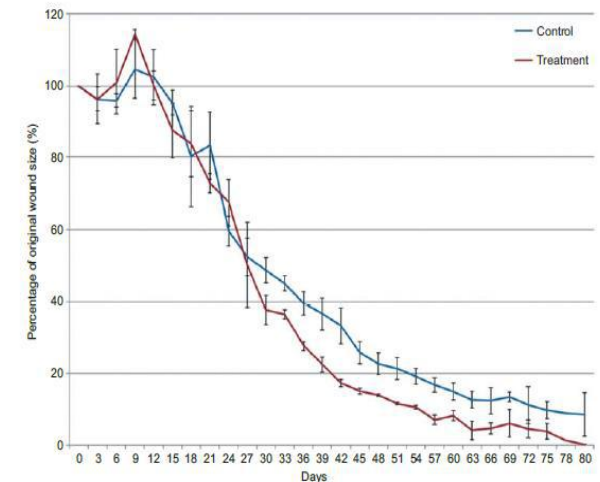
- Pros: inexpensive, owner can perform
- Cons: friction can be irritating to tissues
- Varied protocols – 10 minutes twice daily to 30 minutes once weekly
- Weak evidence

What is feasible for horses?

- Massage
- Laser
 - Best used in newly revised wounds?
 - As early in process of wound healing as possible
 - Daily? Every other day?
 - Poor evidence for use in equine medicine

Equine wound healing: influence of low level laser therapy on an equine metacarpal wound healing model

Wundheilung beim Pferd: Untersuchungen zur Wirksamkeit der Low-Level-Laser-Therapie am Wundheilungsmodell (Mittelfußregion)



What is feasible for horses?

- Massage
- Laser
- **ESWT**
 - Improved elasticity in hypertrophic scars
 - Equine studies focus on acute phase
 - Decreased granulation tissue
 - Increased rate of healing?
 - Once weekly



What is feasible for horses?

- Massage
- Laser
- ESWT
- **Silicone gel sheets**
 - Increased tissue hydration and pliability
 - Readily available, reasonable cost
 - Daily use to cover healing wound or scar



Summary



Identify cause of delayed healing

Infection? Necrosis?
Foreign material?
Excess motion?
Other?



Formulate treatment plan

Wound revision?
Immobilization?
Skin grafting?



Bjerke Dyrehospital

www.bjerkedyrehospital.no

E-post: info-rkb@rikstoto.no

Sentralbord: 22 95 60 10 | 24/7 akuttvakt