SURGICAL TECHNIQUES: ADVANCED WOUND CARE

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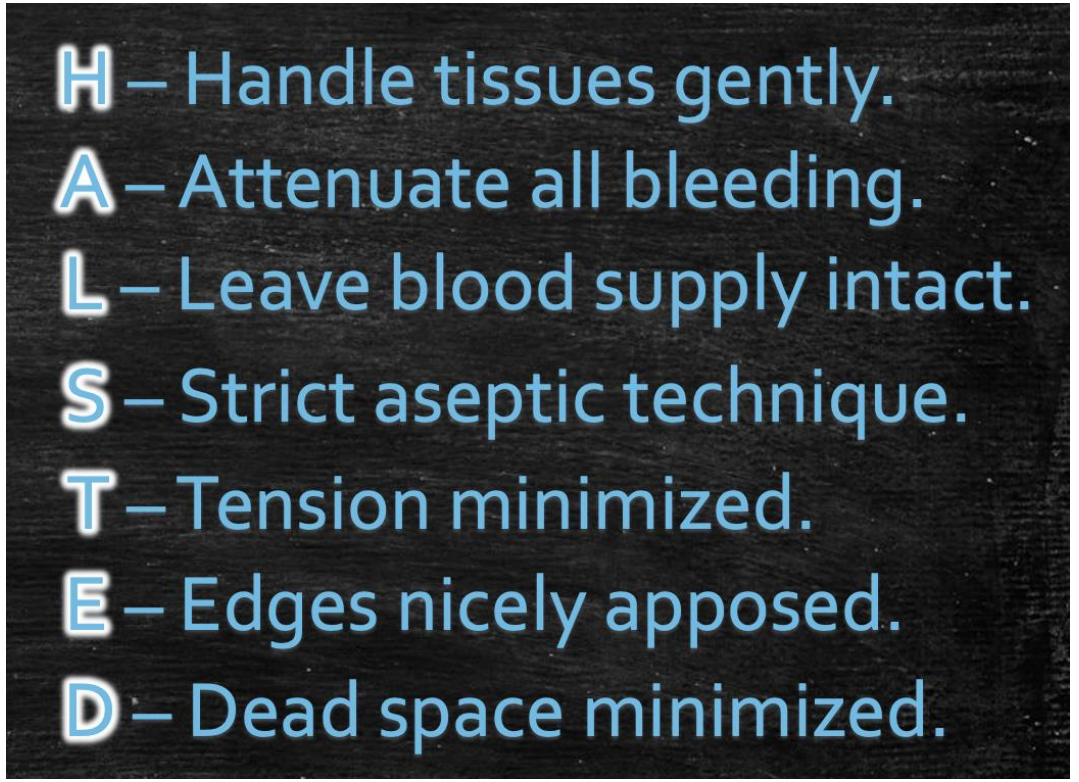
OUTLINE

- **CUTANEOUS VASCULAR ANATOMY**
- **PHASES OF WOUND HEALING**
- **WOUND MANAGEMENT STRATEGIES**
  - APPROACHES
  - DEBRIDEMENT
  - DRAINS: PENROSE & JACKSON PRATT
  - TISSUE VIABILITY
- **CLOSURE OF LARGE TISSUE DEFECTS**
  - STRETCHING & RELAXATION
  - SUBDERMAL PLEXUS FLAPS
  - AXIAL PATTERN FLAPS



CUTANEOUS VASCULAR ANATOMY

Three distinct plexuses

Parallel to skin surface

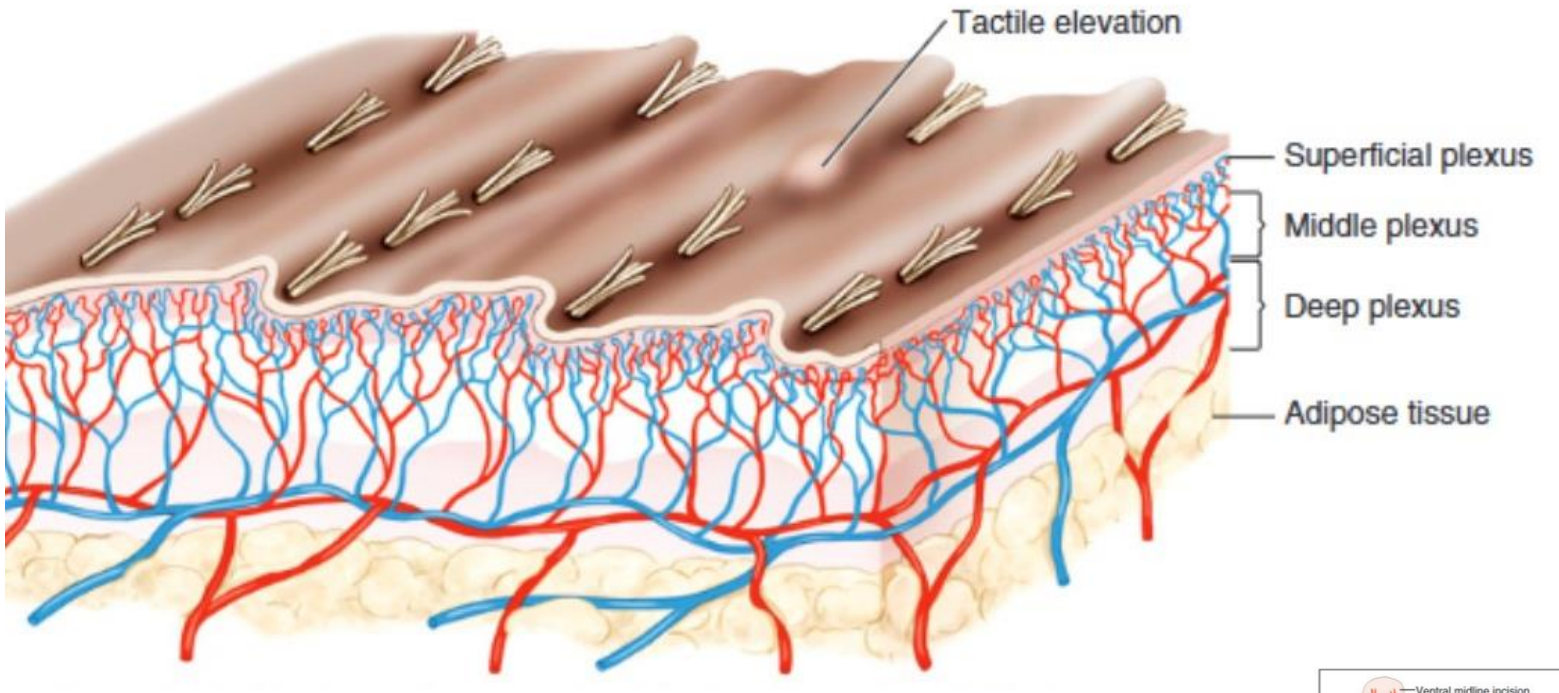
Supplied by simple and mixed cutaneous arteries

Lymphatics:

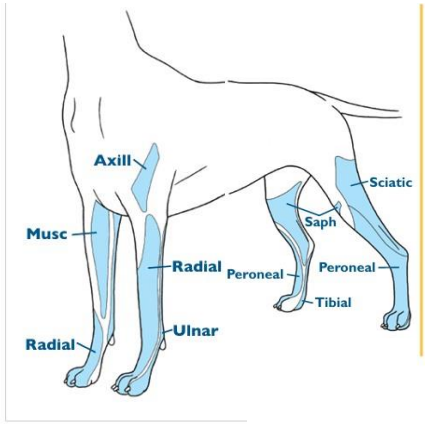
- Arise at superficial plexus
- Drain into SQ lymph plexus

Innervation:

- Segmental cutaneous distribution (head/trunk)
- Brachial & LS plexuses → regional limb inn



Dog; autonomous zones.



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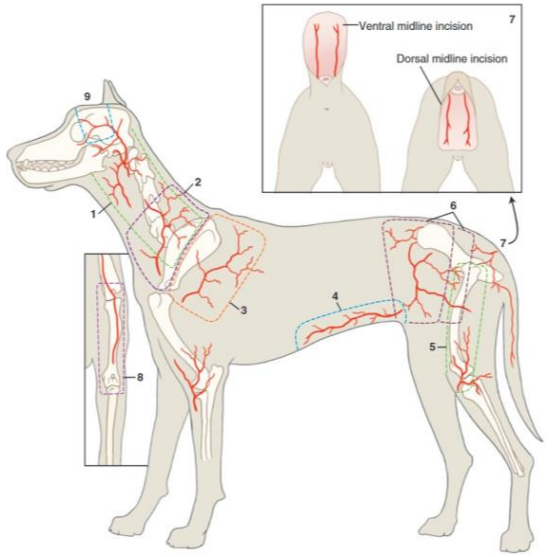
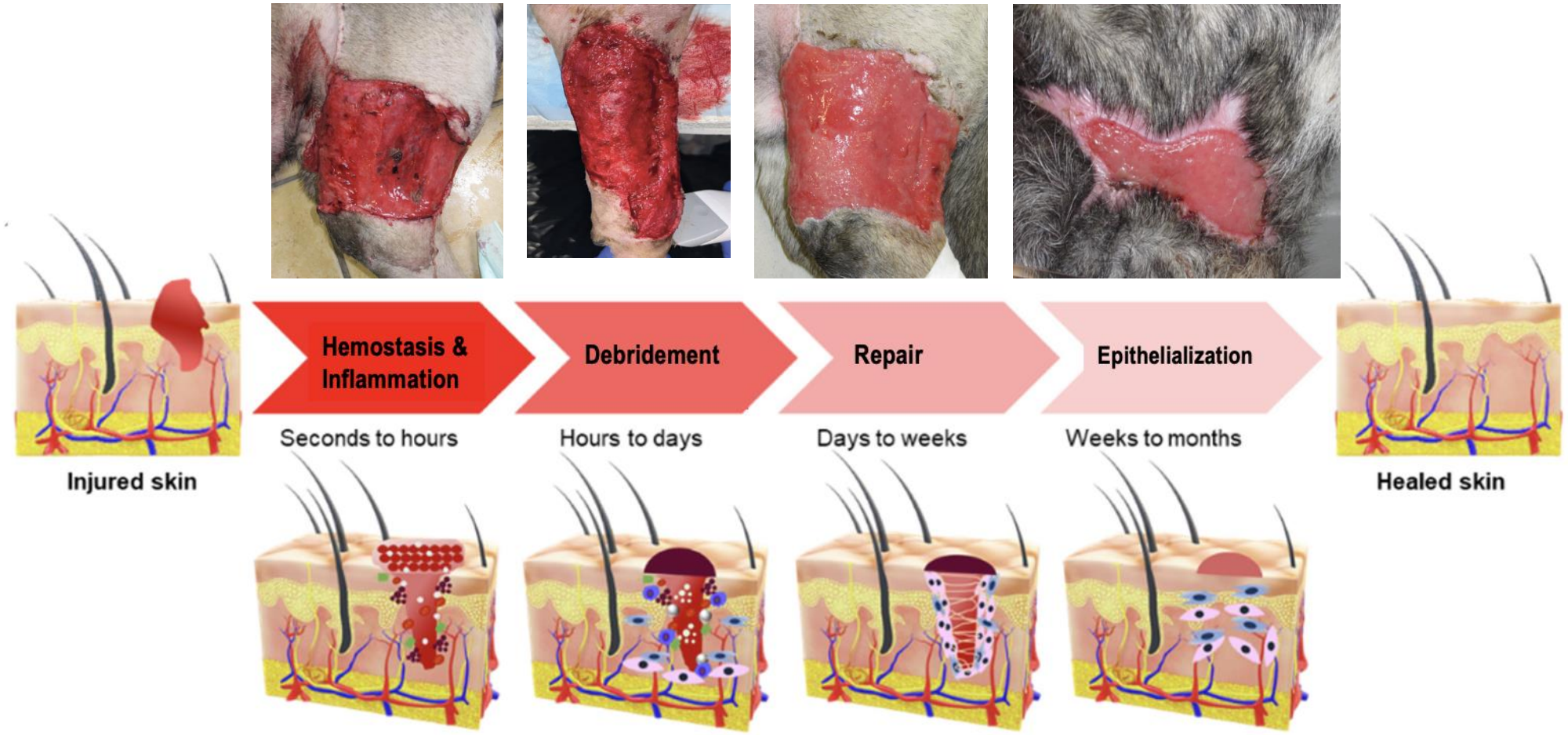


PHASES OF WOUND HEALING



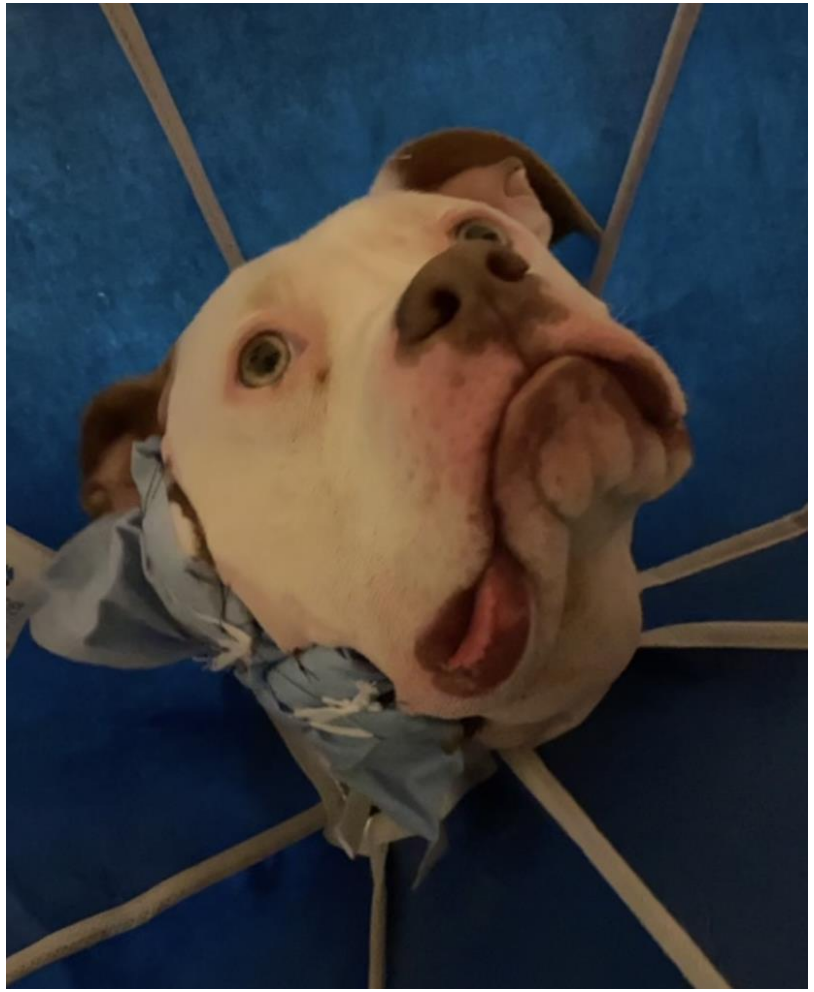
WOUND MANAGEMENT STRATEGIES

PRIMARY WOUND CLOSURE

- Acute trauma
- Little to no contamination
- Minimal tissue trauma
- Tension-free closure
- Contaminated wounds converted to “clean” wounds
  - Judicious debridement
  - Copious lavage
- En bloc resection of localized cutaneous wound beds

DELAYED PRIMARY CLOSURE

- Bandage changes for 3-5 days, then close
- **BENEFITS:**
  - Reduced inflammation
  - Improved resistance to infection
- **IDEAL CANDIDATES:**
  - Concern for contamination following initial explore/debridement
  - Moderate tissue trauma/infection risk
  - Initial questionable tissue viability
  - Wounds requiring serial debridement
  - Significant tissue swelling/tension



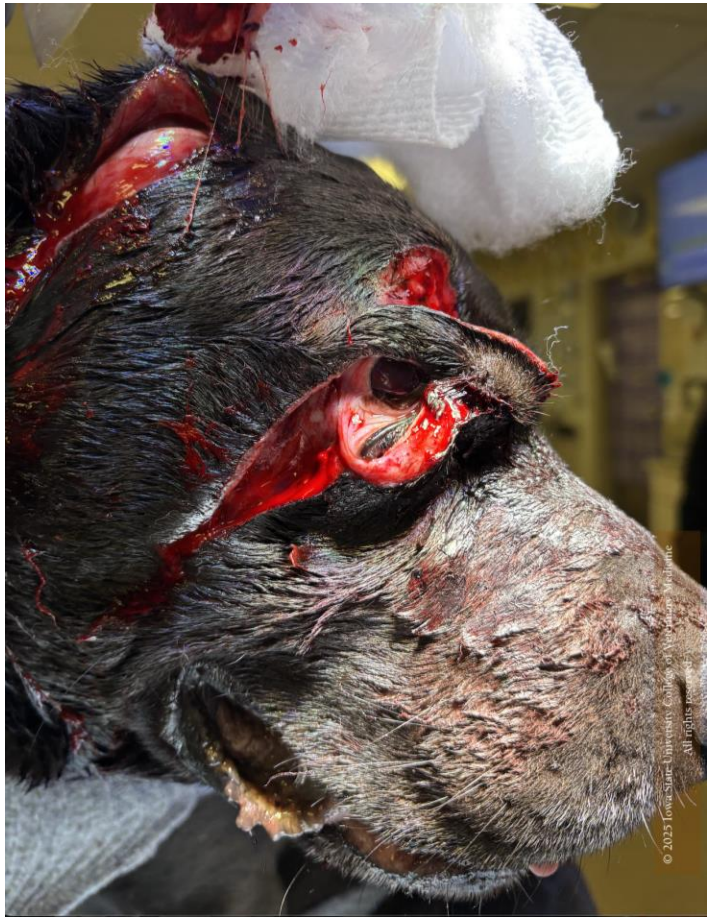
APOLLO: DELAYED PRIMARY CLOSURE AFTER 4 DAYS

3-Hours

48-Hours

96-Hours

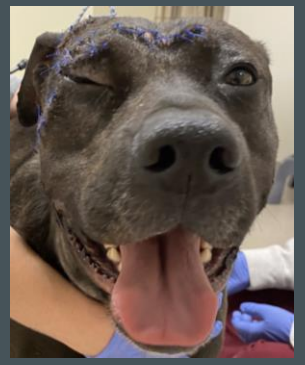
BOY: MULTI-FOCAL TRAUMATIC LACERATIONS



BOY: INITIAL WOUND MANAGEMENT

- Cold lavage & manual pressure
- Fascial reapposition
- Modified tie-over bandage
  - Hydrogel
  - Telfa
  - Moistened gauze
  - +/-Drape
- Stented horizontal mattress sutures oversewn dressing

BOY: 24-HOURS LATER (SURGICAL CLOSURE)

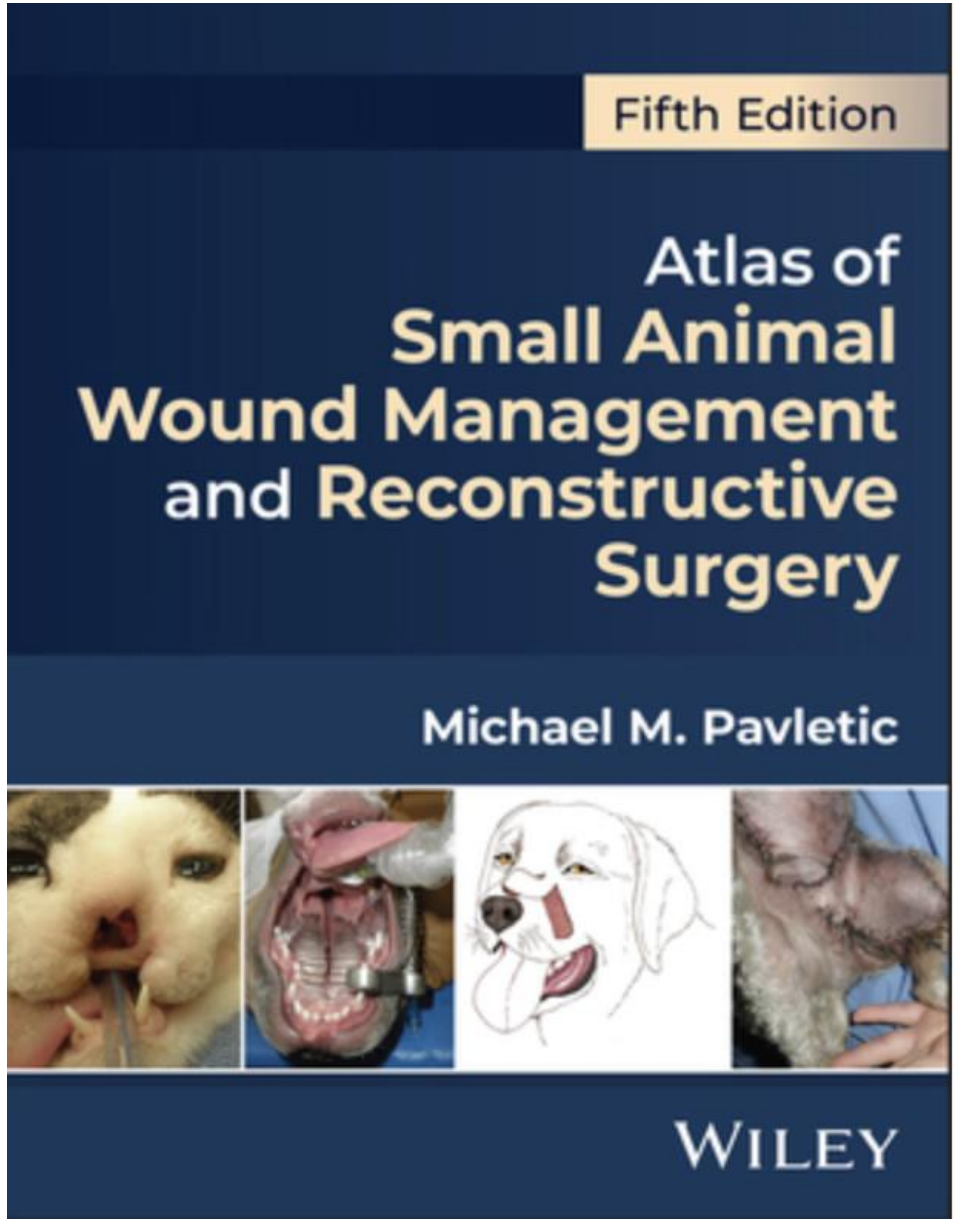


SECONDARY CLOSURE

- Reserved for problematic wounds
  - Persistent infection
  - Necrotic tissue
  - Moderate to severe inflammatory response
- Two methods
  - Direct apposition of two granulation surfaces
  - Granulation bed excision & primary closure

SECOND INTENTION HEALING: CONTRACTION & EPITHELIALIZATION

- **BENEFITS**: Practical, economic*
- **RISKS**:
  - Prolonged healing
  - Total costs may exceed surgical closure
  - Not all wounds close optimally
- **RESERVED FOR FOLLOWING WOUNDS**:
  - Dirty/infected wounds
  - High tension, increasing risk of:
    - Biologic tourniquet
    - Dehiscence
  - Inadequate viable skin
  - Financial constraints



PAVLETIC'S SIX STEPS FOR WOUND MANAGEMENT

1. Prevent further contamination
   - Cover upon arrival, clip/clean liberally
2. Debride necrotic tissue
3. Remove foreign debris & contaminants
4. Provide adequate drainage
5. Establish a viable vascular bed
6. Select the appropriate closure method

WOUND DEBRIDEMENT STRATEGIES

NONSELECTIVE: More aggressive, Faster, Less precise

- Scalpel or Surgical Excision
- Wet-to-Dry bandages

SELECTIVE: Less aggressive, Slower, Targeted

- Autolytic: Topical gels, dressings
- Enzymatic: Topical enzymes
- Biotherapeutic: Maggot debridement

AUTOLYTIC DEBRIDEMENT: PRIMARY LAYERS FOR MOIST WOUND HEALING

- Moisture-retaining gels & dressings
  - Hydrogel, Manuka honey, & sugar
- Semi-occlusive to occlusive moisture-retaining barriers
  - Hydrocolloids, hydrogels, & alginates
- Primary layer choice depends on:
  - Stage of wound healing
  - Degree of exudate

MEDICAL GRADE HONEY
- Antibacterial activity
- Stimulates angiogenesis & fibroblast growth
- Must have K Factor >10 and <25

DRESSING SELECTION BY WOUND NEEDS

TABLE 4.

Guidelines for Dressing Selection Based on Exudate Level & Wound Needs

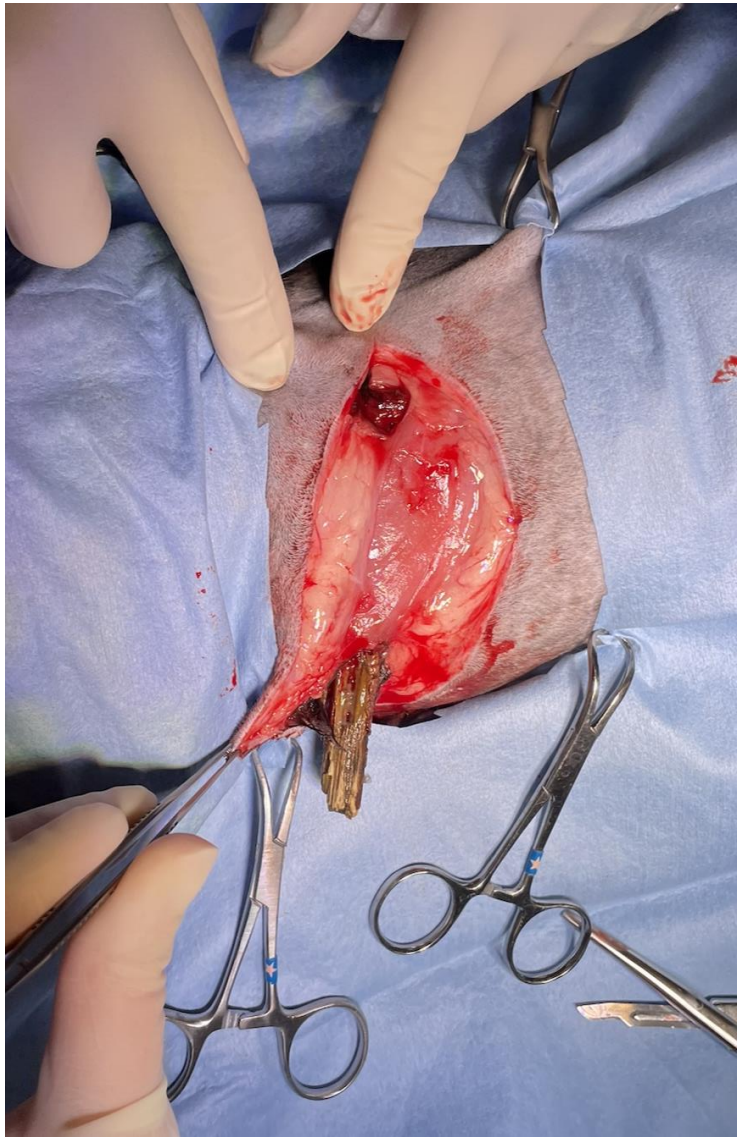
EXUDATE LEVEL	Wound Requires DEBRIDEMENT OR GRANULATION	Wound Requires EPITHELIALIZATION & CONTRACTION*
High	Calcium alginate	Not applicable; high exudate very unlikely at this phase
Moderately high	Polyurethane foam	Polyurethane foam
Moderate	Hydrocolloid	Hydrocolloid Saline-moistened polyurethane foam†
Moderately low	Hydrocolloid	Saline-moistened polyurethane foam† Hydrogel
Low to minimal	Hydrogel	Saline-near-saturated polyurethane foam† Hydrogel

* *Dressings with adhesive borders may slow contraction when used in the later part of the repair phase.*[17]

† *Polyurethane foam supports epithelialization and contraction, but its strong absorptive capacity may dry out a wound with low exudate. In such cases, polyurethane foam can be premoistened with saline.*

REMOVE FOREIGN DEBRIS & CONTAMINANTS

- Manually remove gross debris
  - Image before PRN
  - Excise adherent debris (dirt)
    - Preserve SQ of skin
- Copious pressurized lavage
  - 18 g needle on 35 mL syringe
  - 18 g catheter tip on pressure bag



PROVIDE ADEQUATE DRAINAGE

KEY DETERMINANTS

- SURFACE AREA
- WOUND LOCATION
- ANTICIPATED EXUDATE VOLUME

PENROSE	JACKSON PRATT
Gravity-Dependent	Independent of Gravity
Passive Drainage	Active Suction
HIGHER Ascending Infection Risk	LOWER Ascending Infection Risk
Smaller, superficial pockets	Deep tissue pockets, Avulsions (if viable)
Economical	More Costly

PENROSE DRAINS

CLINICAL INDICATIONS

- Wounds with significant dead space, anticipated fluid production, or questionable tissue viability
- Superficial wounds which do NOT cross midline or penetrate a body cavity

POTENTIAL COMPLICATIONS

- Ascending infection
- Wound dehiscence
- Skin irritation & excoriation (if not bandaged)
- Drain breakage requiring further surgery
  - Measure & record in chart!

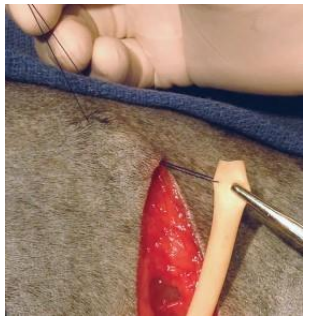
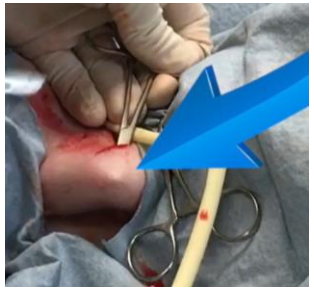
PENROSE DRAINS: COMMON PITFALLS

- **NO dorsal/proximal ingress**
  - Penrose drains are EXIT only
  - Entry site increases risk of contamination, infection, & dehiscence
- **Drain must exit ventral/distal to wound**
  - Ensures passive drainage
  - Minimizes risk of ascending infection
- **Drain must NOT exit through the wound**
  - Always create a separate egress point
  - Exiting through wound/incision increases dehiscence & infection risk
- **Bandage to protect drain & collect drainage/exudate**
  - Risk of drain tears/ingestion or severe skin excoriations
- **Remove within 3-5 days**

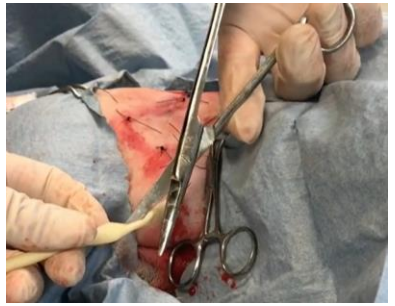
PENROSE DRAINS: PLACEMENT TECHNIQUE

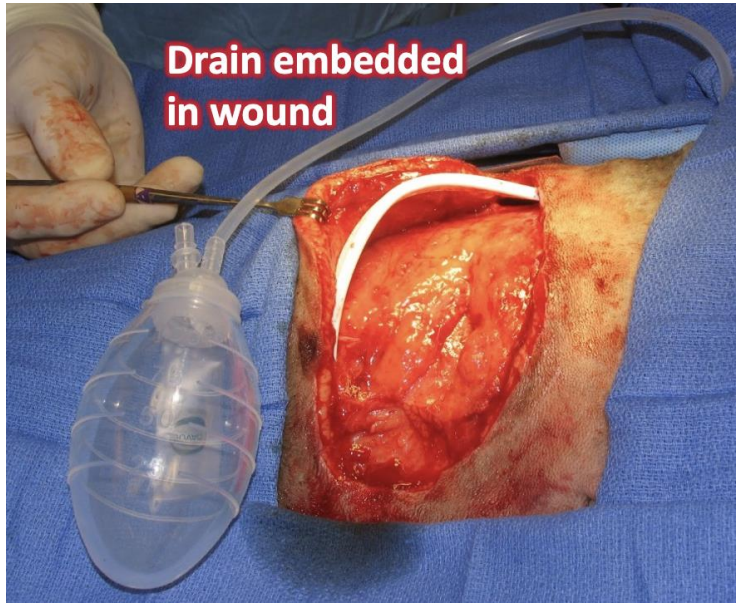
- STEP 1: PREPARE & ASSESS WOUND BED
  - Clip wider than expected (bite wounds)
  - Confirm Penrose drain amenability
- STEP 2: SECURE PROXIMAL DRAIN END DORSALLY
  - Blind tacking suture (monofilament nonabsorbable)
- STEP 3: SELECT EXIT SITE
  - Most dependent aspect of wound pocket
  - Separate from primary wound closure
- STEP 4: PASS DRAIN VIA STAB INCISION
- STEP 5: TRIM & TACK VENTRALLY
- STEP 6: WOUND CLOSURE & BANDAGE

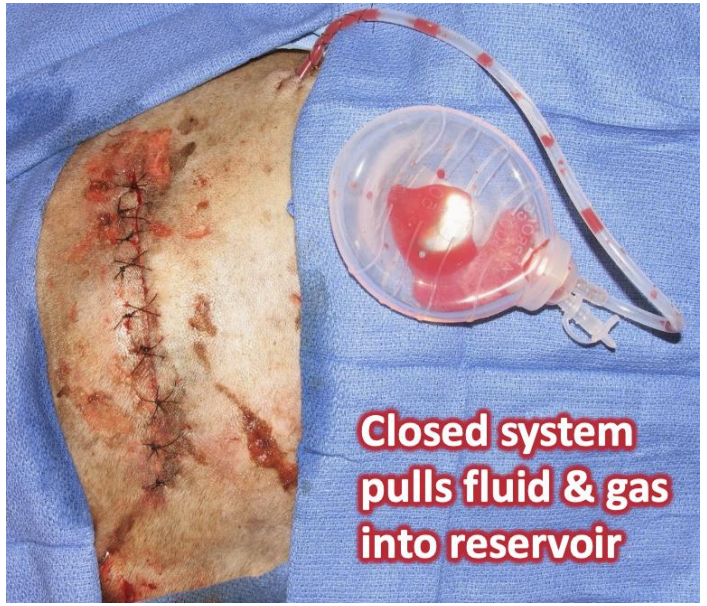


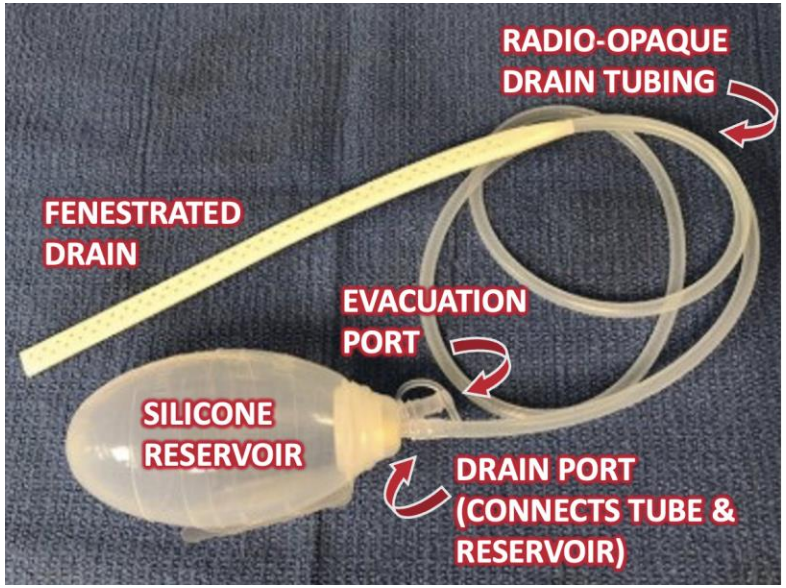










JACKSON PRATT DRAINS

HOW THEY WORK

- Active, closed-system drainage via:
  - Creation of negative-pressure gradient (suction)
  - Continuous removal of gas and fluid from wound
  - Vacuum effect pulls adjacent tissue planes together

JACKSON PRATT DRAINS

CLINICAL INDICATIONS

- Traumatic or surgical wounds with excessive dead space and/or deep pockets
  - Tension-free closure REQUIRED (airtight seal)
- Low to moderate expected fluid viscosity
- Abdominal drainage & monitoring (septic peritonitis)

POTENTIAL COMPLICATIONS

- Obstruction of drain tubing (e.g. blood clots, tissue)
- Wound dehiscence → drain failure
- Premature drain removal or breakage
- Ascending infection (significantly lower risk than Penrose)
- Seeding of neoplastic cells (use with caution)

JP DRAIN PLACEMENT: TECHNIQUE

STEP 1: PREPARE & ASSESS WOUND BED

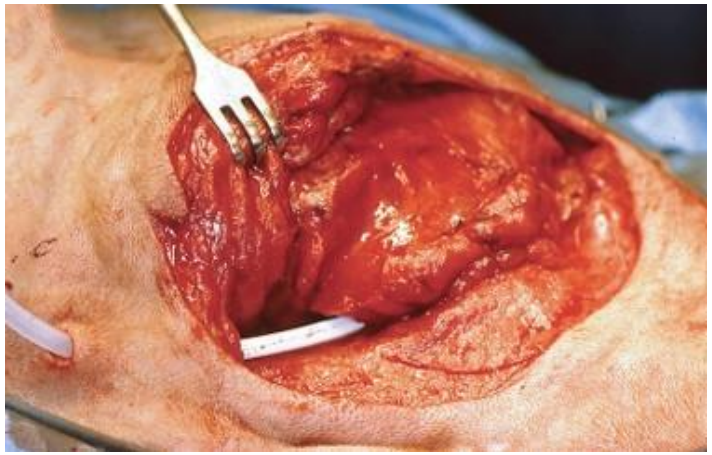
- Aseptic prep for tension-free closure

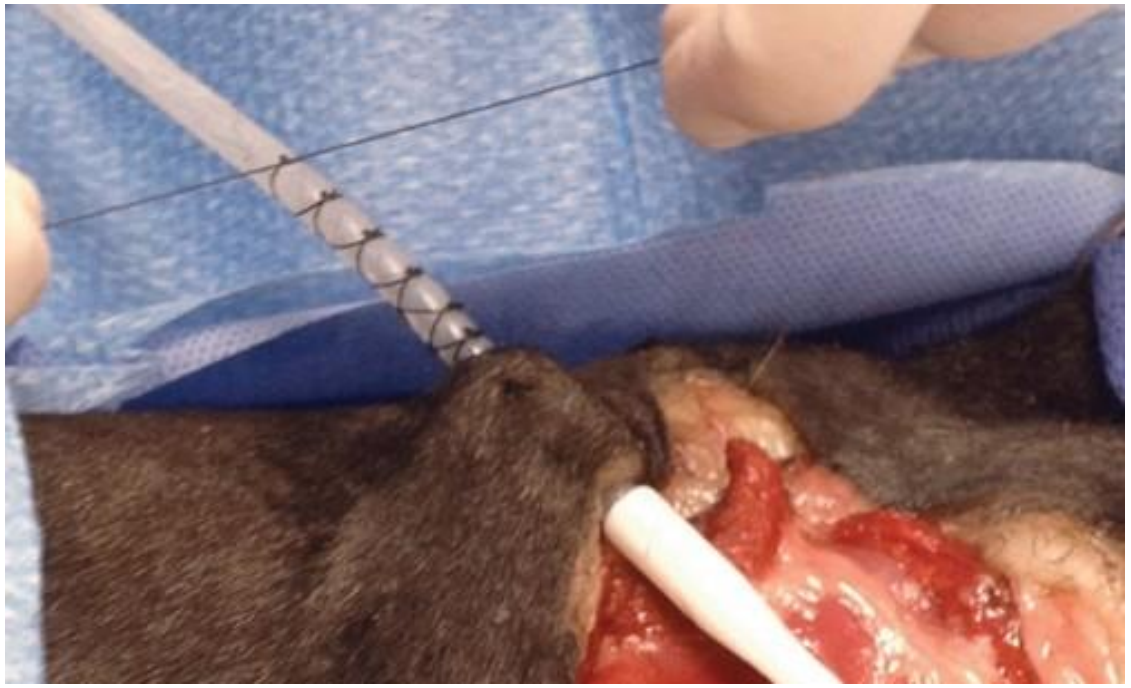
STEP 2: PLAN DRAIN LOCATION & EXIT

- Place in deepest recess of wound
- Ideal exit site:
  - Healthy skin, at least 2 cm from wound
  - Minimizes drain motion/pull-out
  - Readily accessible

STEP 3: PLACE DRAIN IN WOUND BED

- Avoid placement directly beneath closure
- Do NOT suture in place
- Lay flat, avoiding kinks



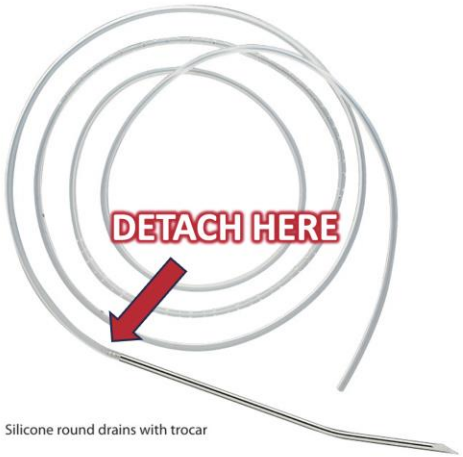


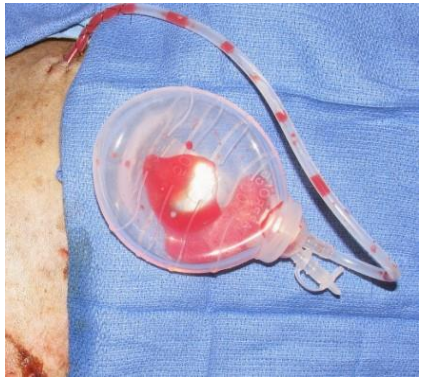
JP DRAIN PLACEMENT: TECHNIQUE

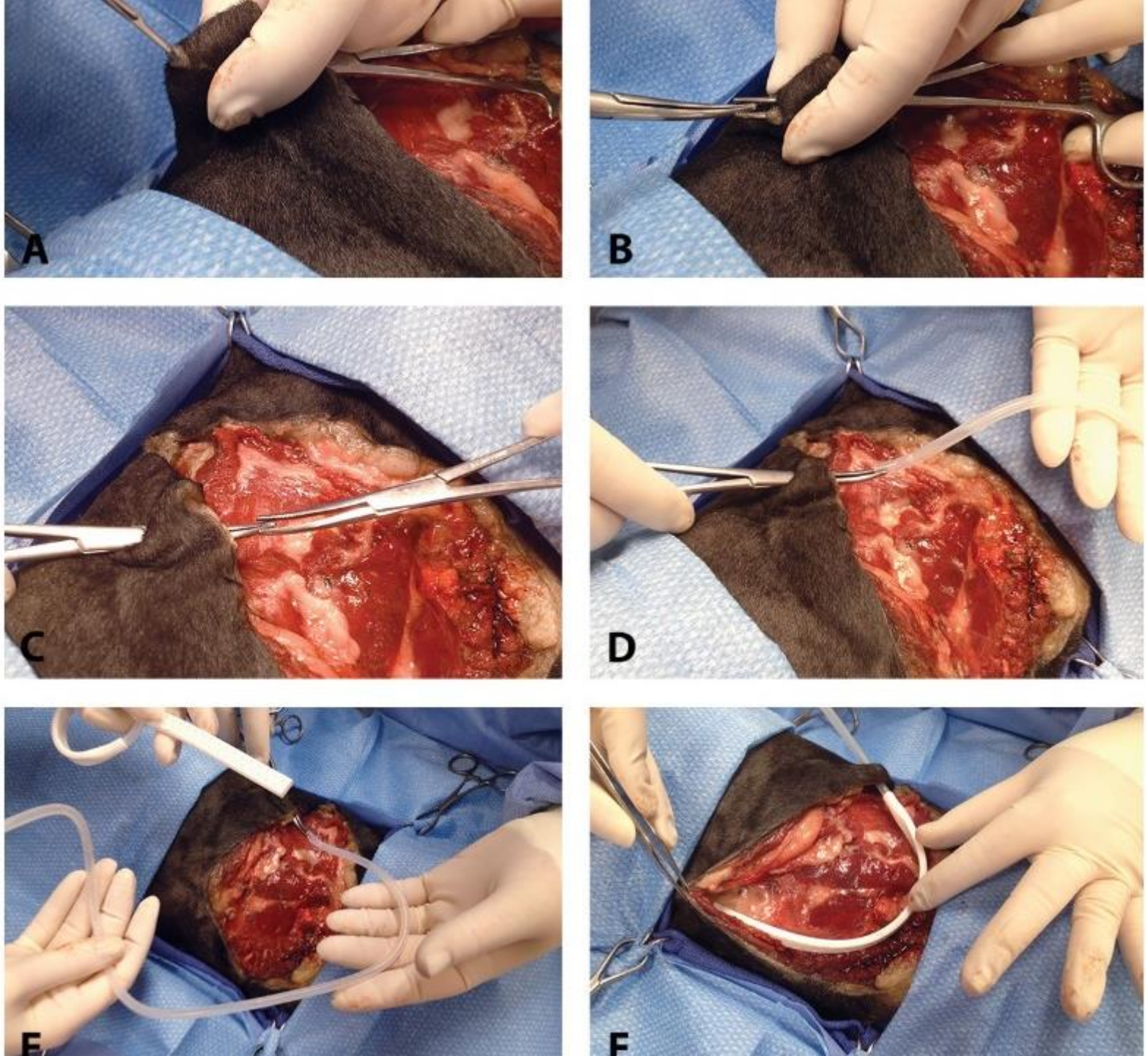
- STEP 4: USE TROCAR TO CREATE EXIT IN SKIN
- STEP 5: SECURE DRAIN TUBING TO SKIN
  - Purse string + finger strap (nonabsorbable monofilament)
- STEP 6: PROCEED WITH PRIMARY WOUND CLOSURE
  - Close in multiple layers, as appropriate
  - Drain held in place by overlying tissues

JP DRAIN PLACEMENT: TECHNIQUE

- STEP 7: DETACH TROCAR & ATTACH RESERVOIR
- STEP 8: CONFIRM NEGATIVE PRESSURE (SUCTION)
  - Open evacuation port
  - Fully depress reservoir
  - Re-cap and release
- STEP 9: BANDAGE & SECURE DRAIN TUBING
  - Cover incision & drain exit for 24-48 hours
  - Minimizes risk of ascending infection







JP DRAIN PLACEMENT: TROCAR-FREE DRAIN

Tunnel a pair of forceps from inside the wound to the planned exit site (**A**).

Push forceps tips against the deep skin surface and incise the skin via scalpel. Open the forceps enough to interlock with a second pair of forceps (**B**) and pull the latter into the wound (**C**).

Grasp the non-fenestrated end the JP drain tubing with the second forceps and pull it from inside to outside the wound (**D**).

Protect the fenestrated drain so it does not contact the skin and collect contaminants (**E**).

Place the fenestrated drain into the most dependent part of the wound where fluid will accumulate (**F**).

JACKSON PRATT DRAIN MANAGEMENT

HOW TO SAFELY EMPTY A JP DRAIN:

- Halsted mosquito forceps gently clamp the drain tubing.
- Clean the secondary port with alcohol.
- Attach syringe & evacuate the reservoir.
- If patient going home with drain:
  - Wear gloves & gently kink drain tubing to prevent backflow.
  - Open evacuation port & empty contents.
  - Reset grenade & confirm negative pressure.
  - Use syringe to measure & record drain output.

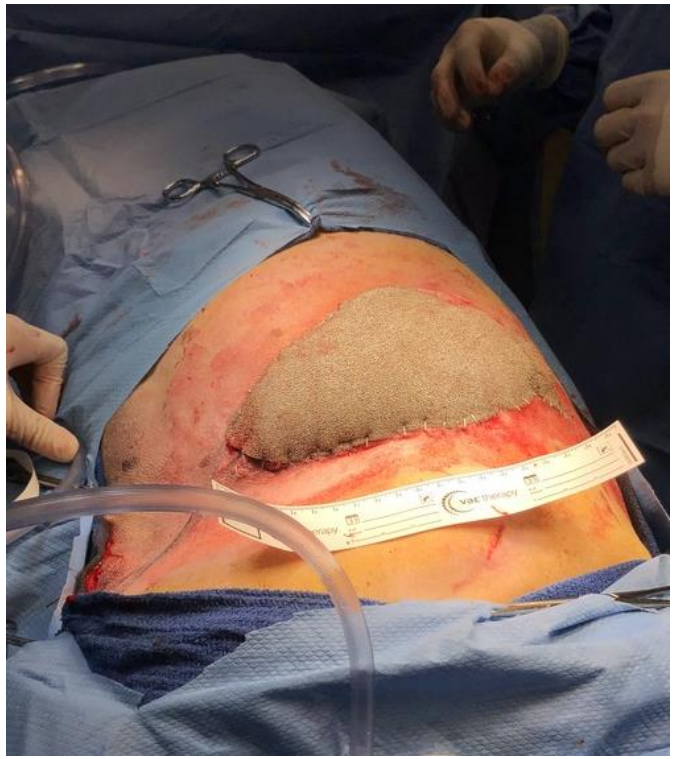
JACKSON PRATT DRAIN REMOVAL

- Timing of removal based on quantity & quality of fluid produced.
  - **QUANTITY**: Less than 1 ml/kg/d.
    - Trends of significantly decreasing fluid production.
  - **QUALITY**: Cytologic appearance of fluid.
    - Wounds: Decreasing cellularity & improved neutrophil appearance → healing.
    - Abdomen: Screen for bacteria & post-op recurrence of sepsis.
- To remove: Cut purse string suture and apply gentle traction.
  - Sedation rarely needed. Exit site left open to heal by second intention.
  - Apply nonadherent bandage (Op-Site, Tegaderm) for 24-48 hr.

ESTABLISH A VIABLE VASCULAR BED

- ASSESSING SKIN VIABILITY
  - Stripped SQ tissues → vascular compromise
  - Large avulsion wounds → risk of terminal flap necrosis
  - Restrained, layered debridement
  - Time to declare (4-5 days)
- HEALTHY GRANULATION TISSUE
  - Key indicator of tissue viability
  - Presence in wound bed → necrotic tissue eliminated
  - Time for closure

WOUND VAC FOR TERMINAL FLAP NECROSIS

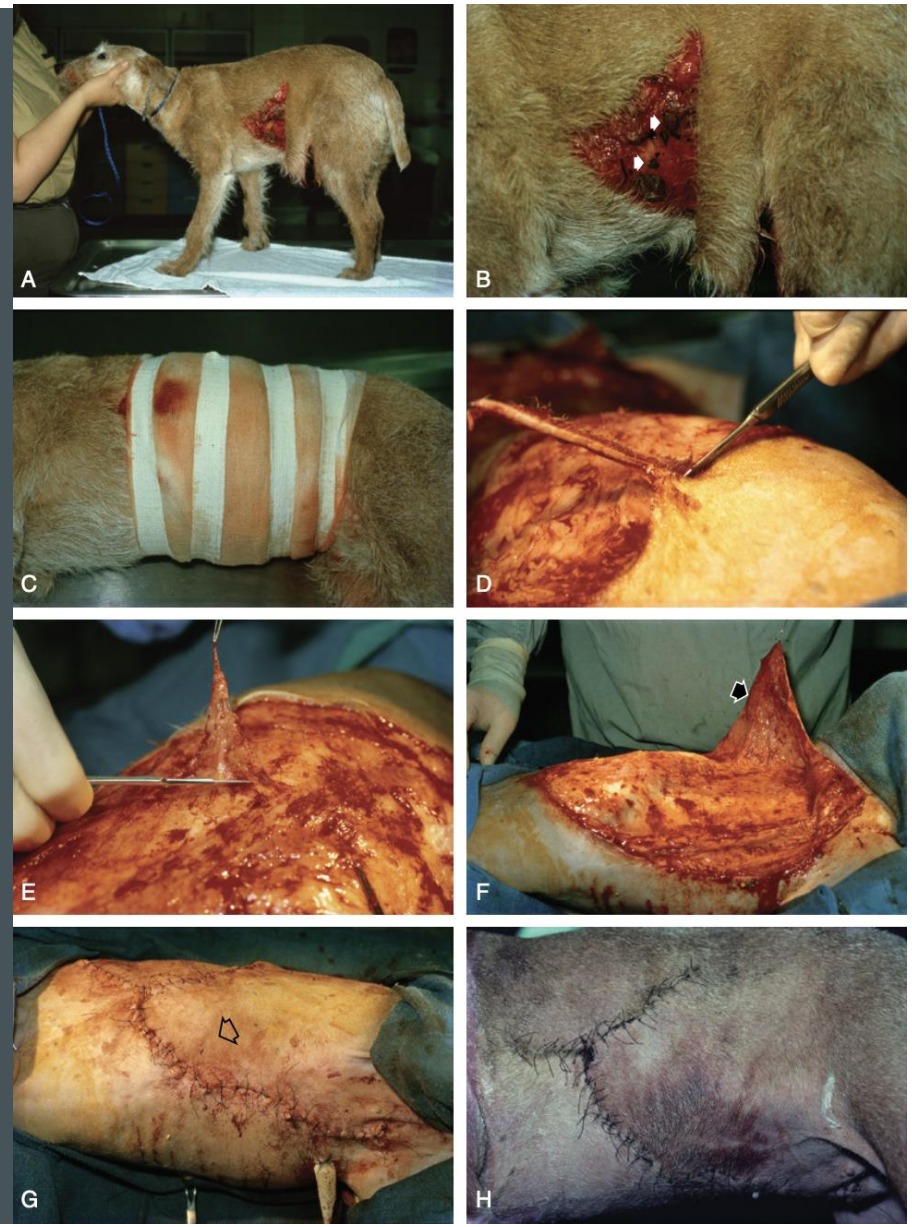


SELECTING THE APPROPRIATE CLOSURE METHOD

- Best determined once:
  - Tissue swelling has subsided
  - Wound is devoid of necrotic tissue
- Distal extremity wounds
  - 25% circumference – Likely to heal by second intention
  - 50% circumference – Second intention unlikely to succeed
    - Skin grafting often necessary to prevent contracture
- Wound contraction typically slows 42 days post-injury
  - Remainder must heal by epithelial migration (or surgery)
  - Fragile epithelialized scars may abrade, split
    - Healing proceeds more slowly in cats

SELECTING THE MOST APPROPRIATE CLOSURE METHOD

- MOST IMPORTANT FACTOR
  - Final assessment after proper exploration, debridement & lavage
- KEY CRITERIA FOR SUCCESS
  - Complete tissue viability
  - Absence of infection
  - Elimination of necrotic tissue
- CHALLENGING CASES
  - Contamination with dirt, grit, organic material
    - Close post-op monitoring required
    - When in doubt, leave it open
  - Questionable tissue survivability
    - Initial open wound management preferred
    - Aggressive debridement of ‘expendable’ tissue

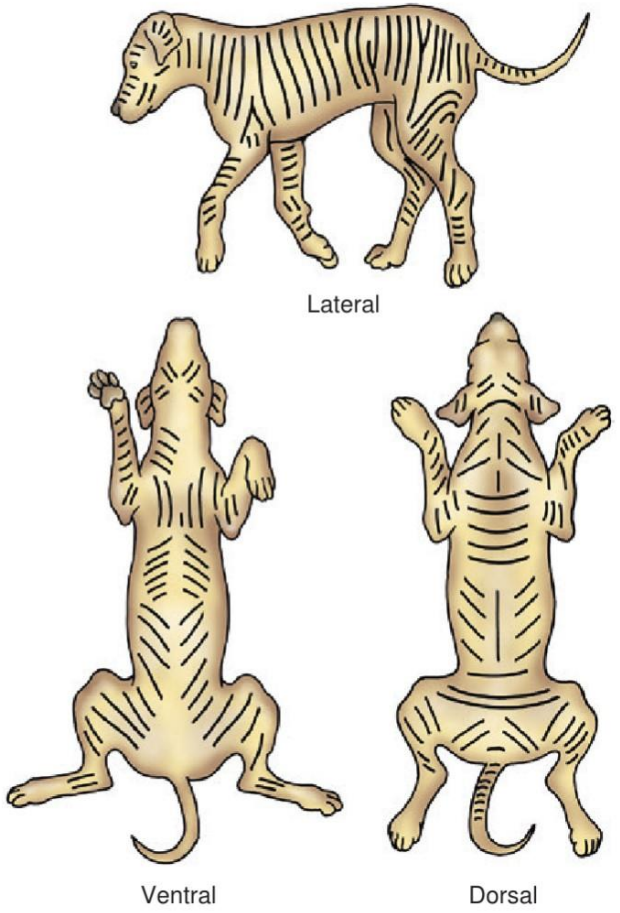


PUTTING IT INTO PRACTICE

PRE-OPERATIVE CONSIDERATIONS

PLAN YOUR PROCEDURE *BEFORE* YOU START

- Lines of Tension
- Skin Tension & Elasticity
- Suture Patterns
- Closure of Irregular Defects
- Drains & Bandages
- Sedation vs General Anesthesia



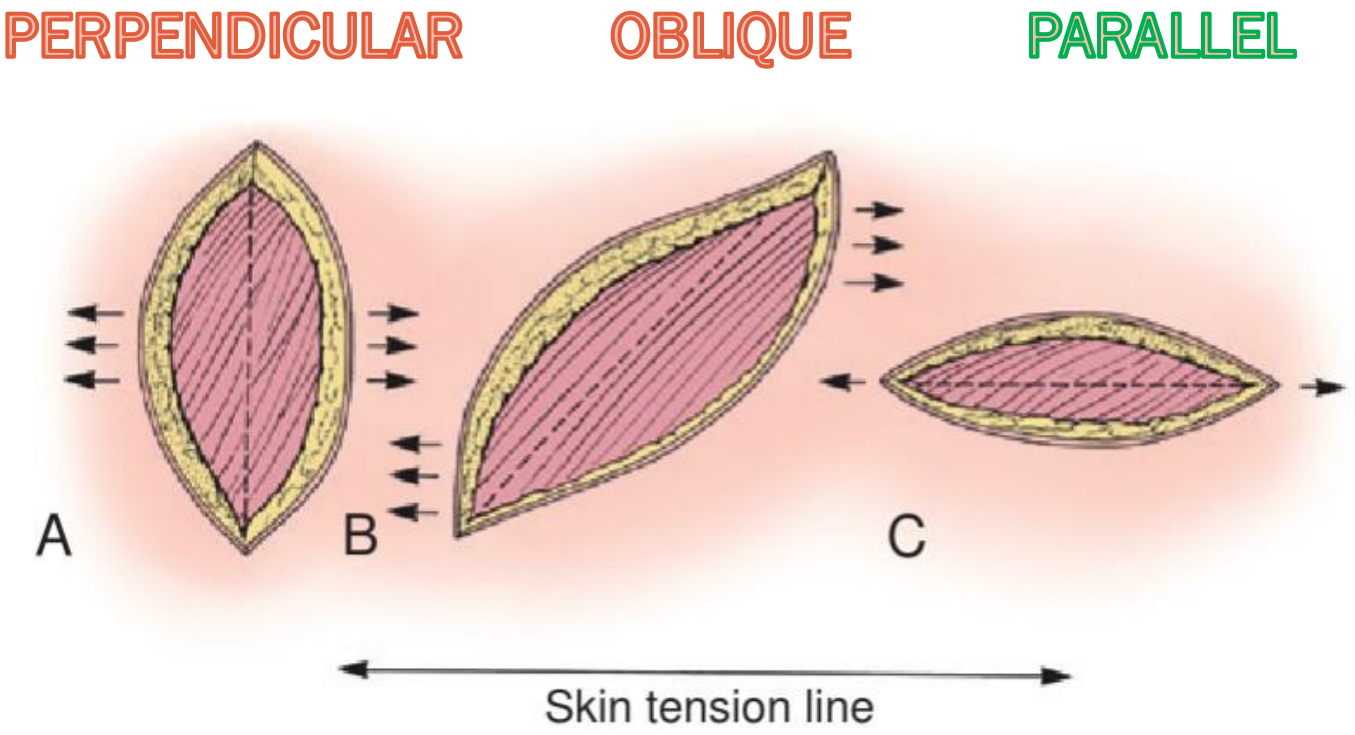
LINES OF TENSION

Wounds PARALLEL to tension lines

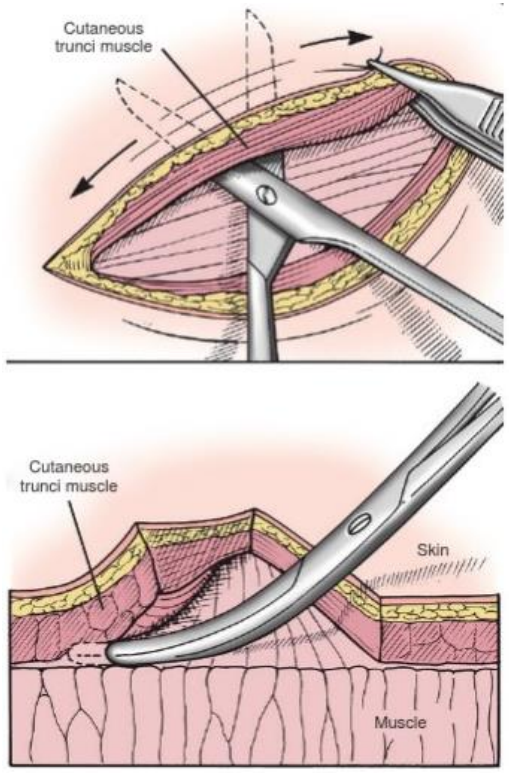
- Decreased tension on closure
- Better, faster healing

Wounds ACROSS tension lines

- Increased dehiscence risk
- Greater incisional discomfort
- More suture required
- Higher risk for pressure necrosis



TENSION MINIMIZING TECHNIQUES



UNDERMINING

- Preserve circulation
- Deep to subdermal plexus & panniculus

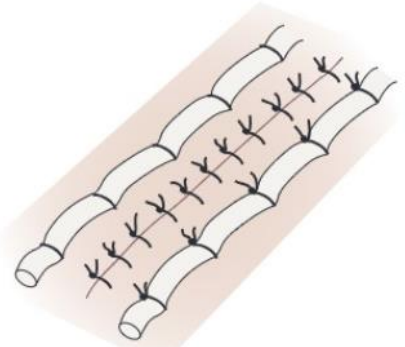
SKIN HOOKS

- 60 s cycles of tension
- 30 s of relaxation
- Repeat over 5 min

SKIN STRETCHING

- Backhaus towel clamps
- Applied after undermining

TENSION MINIMIZING SUTURE PATTERNS



STRONG SUBCUTANEOUS CLOSURE

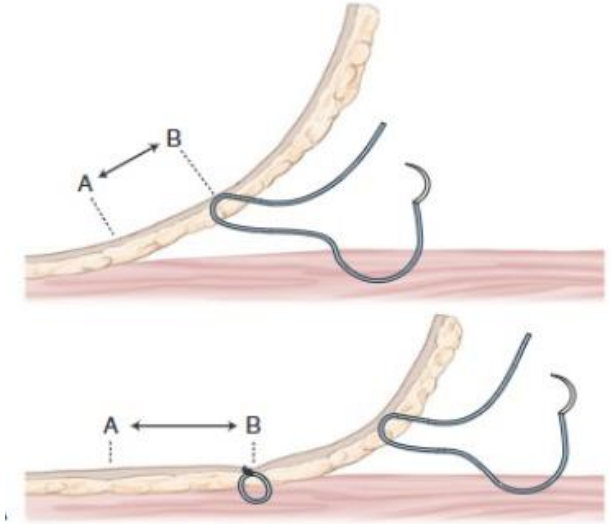
- Incorporate fibrous hypodermis
- Minimize tension on skin
- Interrupted sutures in high-risk areas
  - Far-near near-far
  - Far-far near-near
  - Cruciate

INTRADERMAL WALKING SUTURES

- Use sparingly (vascular compromise)
- 3-0 monofilament absorbable suture

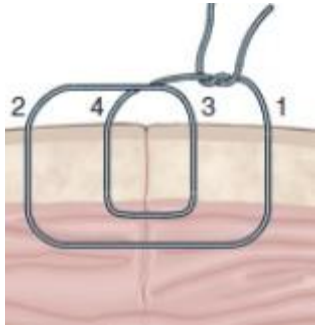
SKIN SUTURES

- Interrupted pattern
- Stent or Tension-Relieving Sutures PRN

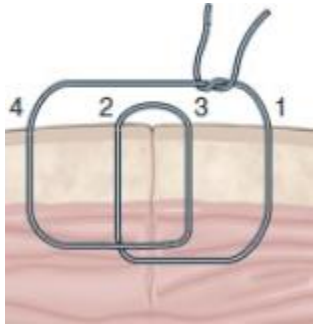


WALKING SUTURE

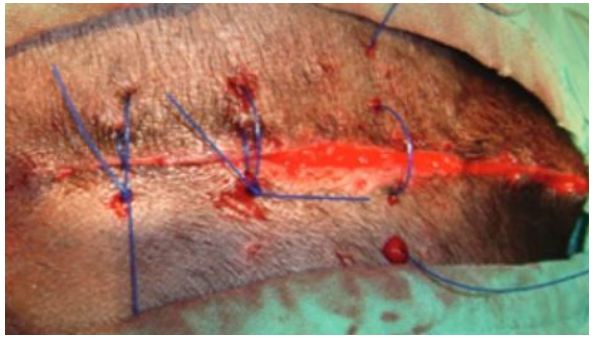
VERTICAL MATTRESS STENT



FAR-FAR
NEAR-NEAR



FAR-NEAR
NEAR-FAR



INTERRUPTED FFNN IN SKIN

ADDITIONAL TENSION-RELIEVING TECHNIQUES: RELAXING INCISIONS

SIMPLE RELAXING INCISION (A)

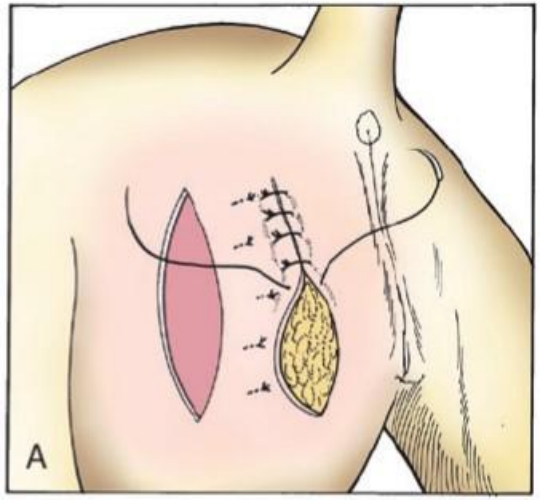
- Made at point of maximum tension
- Unilateral or bilateral
- Heal by second intention

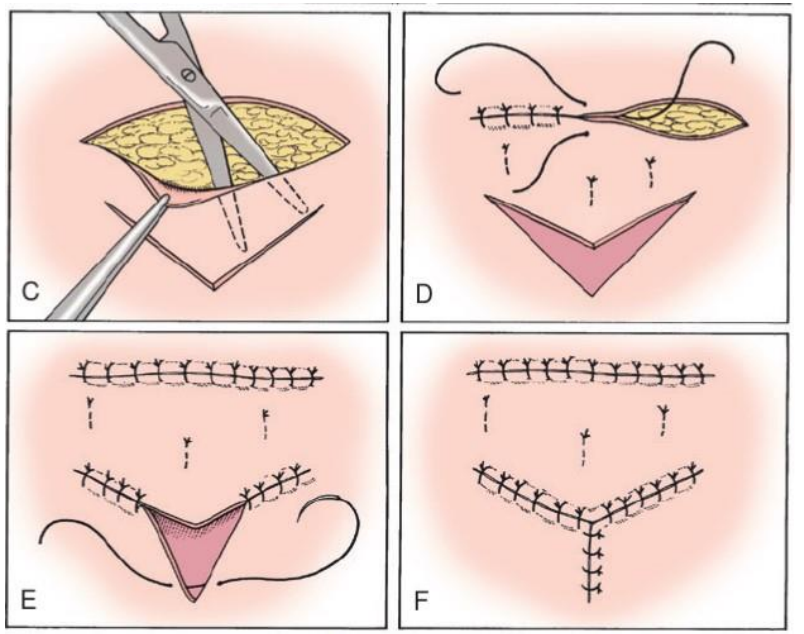
V-to-Y PLASTY (C-F)

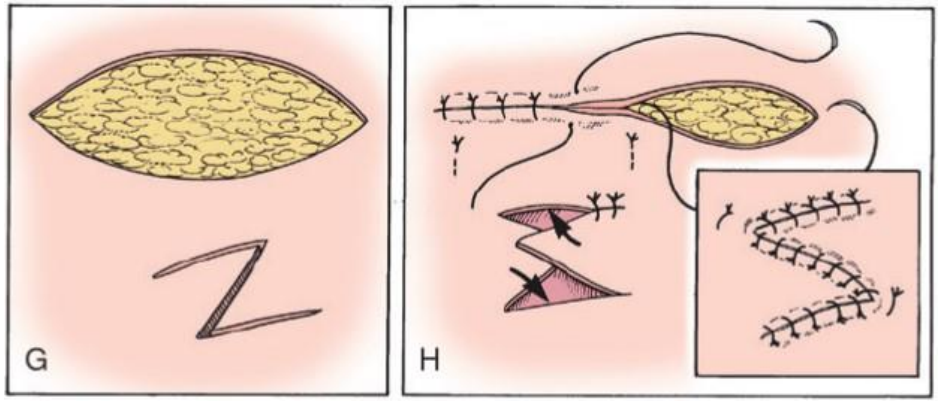
- Provides advancement flap
- Chronic, inelastic wounds
- Eyelid surgery

Z-PLASTY (G-H)

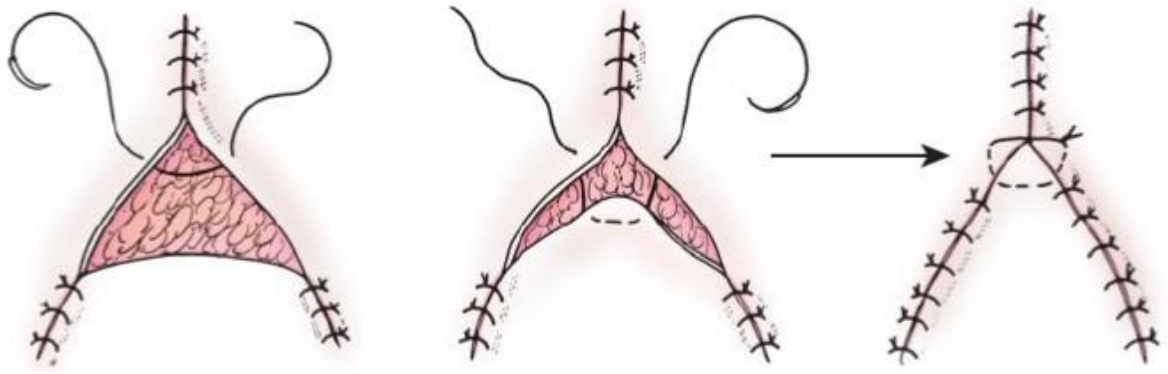
- Lengthens & relaxes incision
- 60-degree angles advised



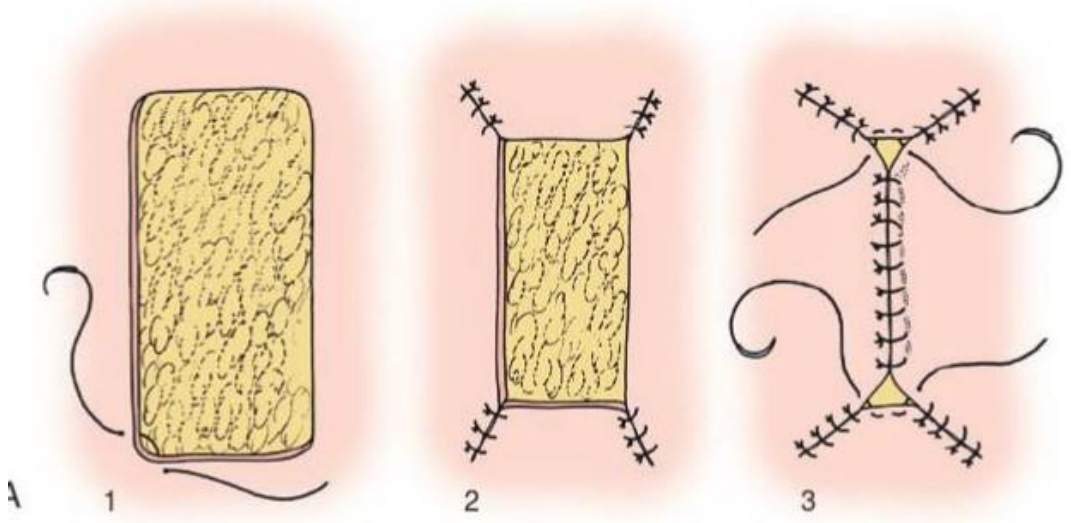




TRIANGLE



RECTANGLE

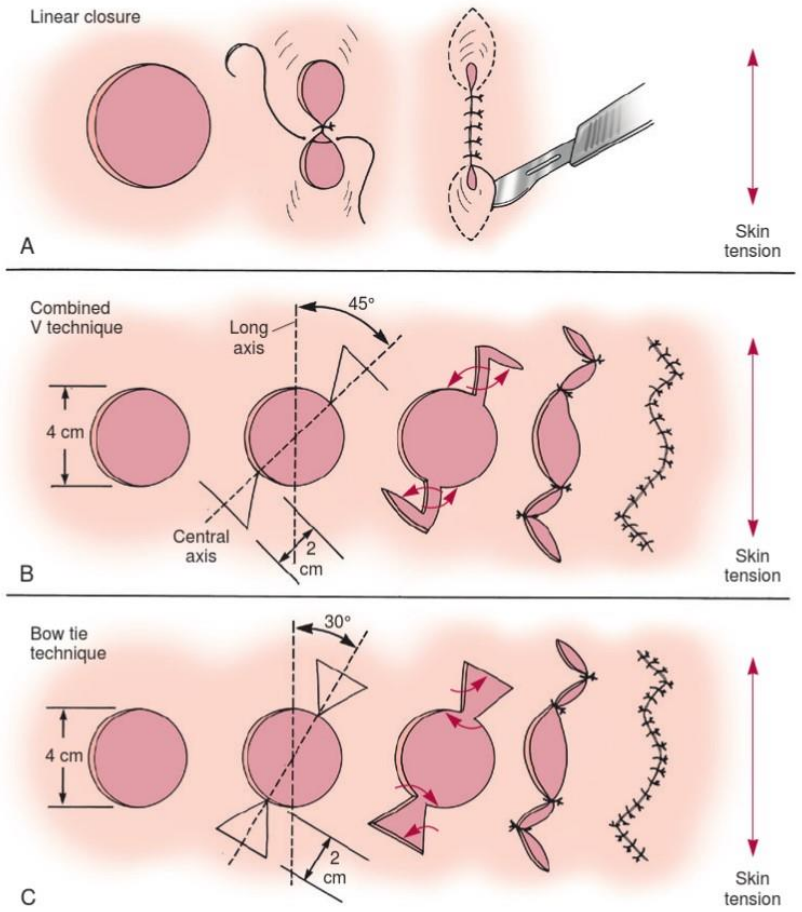


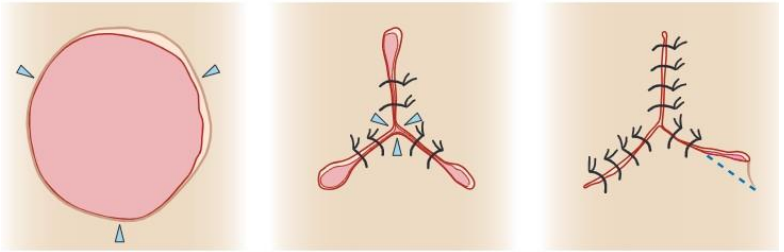
CLOSURE OF IRREGULAR DEFECTS

- Increased difficulty
- Undermine & close from edges inward
- Half-buried mattress suture closes central portion

CLOSURE OF IRREGULAR DEFECTS

- Advanced
- Multiple techniques described
- Combined V technique
  - Limited skin for reconstruction
- Bow-tie technique
  - Abundant skin
- Excise dog-ears PRN



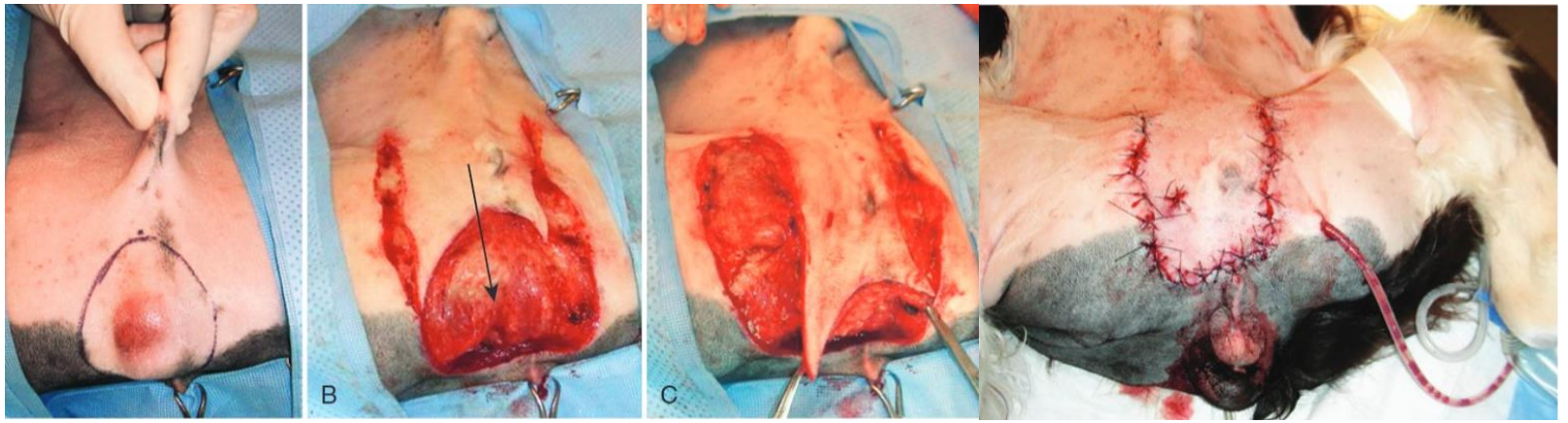


ADVANCED SURGICAL RECONSTRUCTION

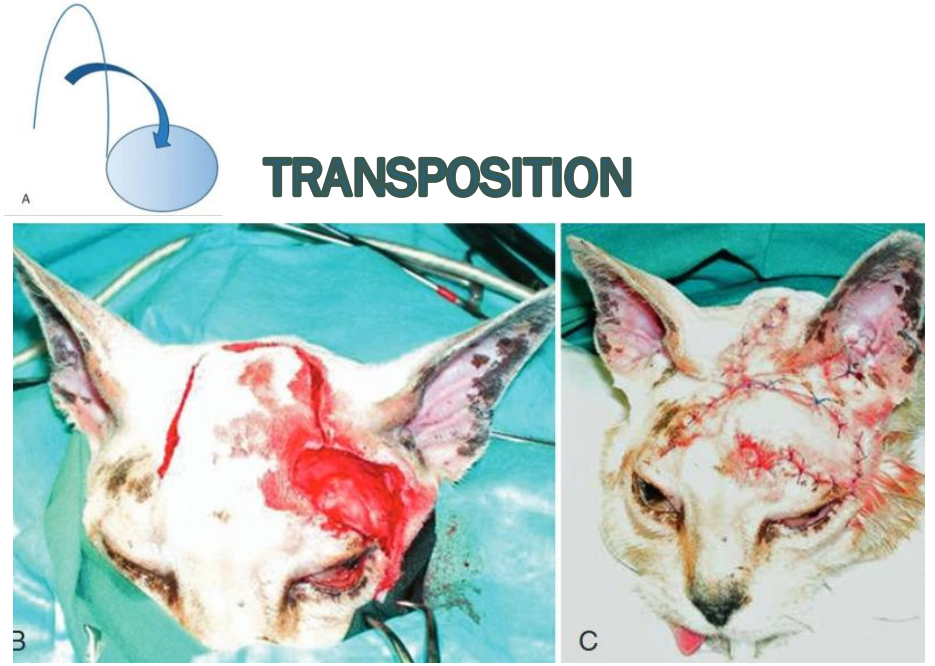
SUBDERMAL PLEXUS FLAPS

- Local vs Distant
- Type of Movement
  - Advancement
  - Rotation
  - Transposition
  - Interpolation

ADVANCEMENT



TRANSPOSITION



ROTATIONAL

ADVANCED SURGICAL RECONSTRUCTION

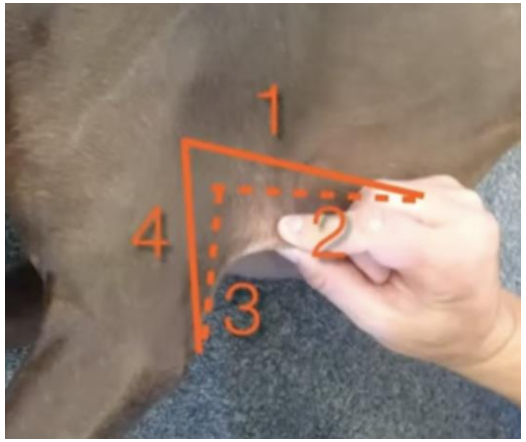
AXIAL PATTERN FLAPS

- Most complex
- Technically challenging
- Mobilize cutaneous artery

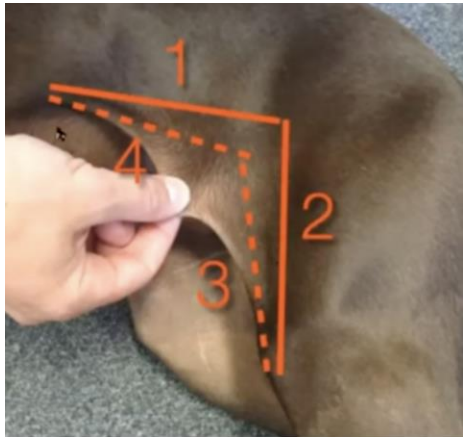
RECOMMENDED RESOURCE

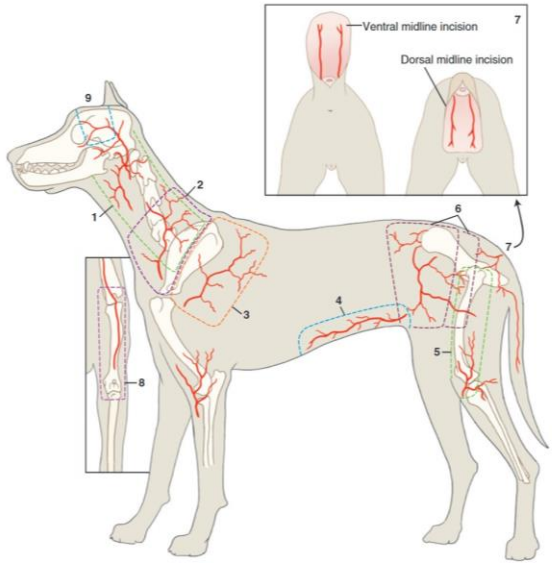
- Dr Charles Kuntz DVM ACVS
- VetDojo video tutorials (youtube)
- “Lecture on Options when referral is not an option” (Minutes 45-75)

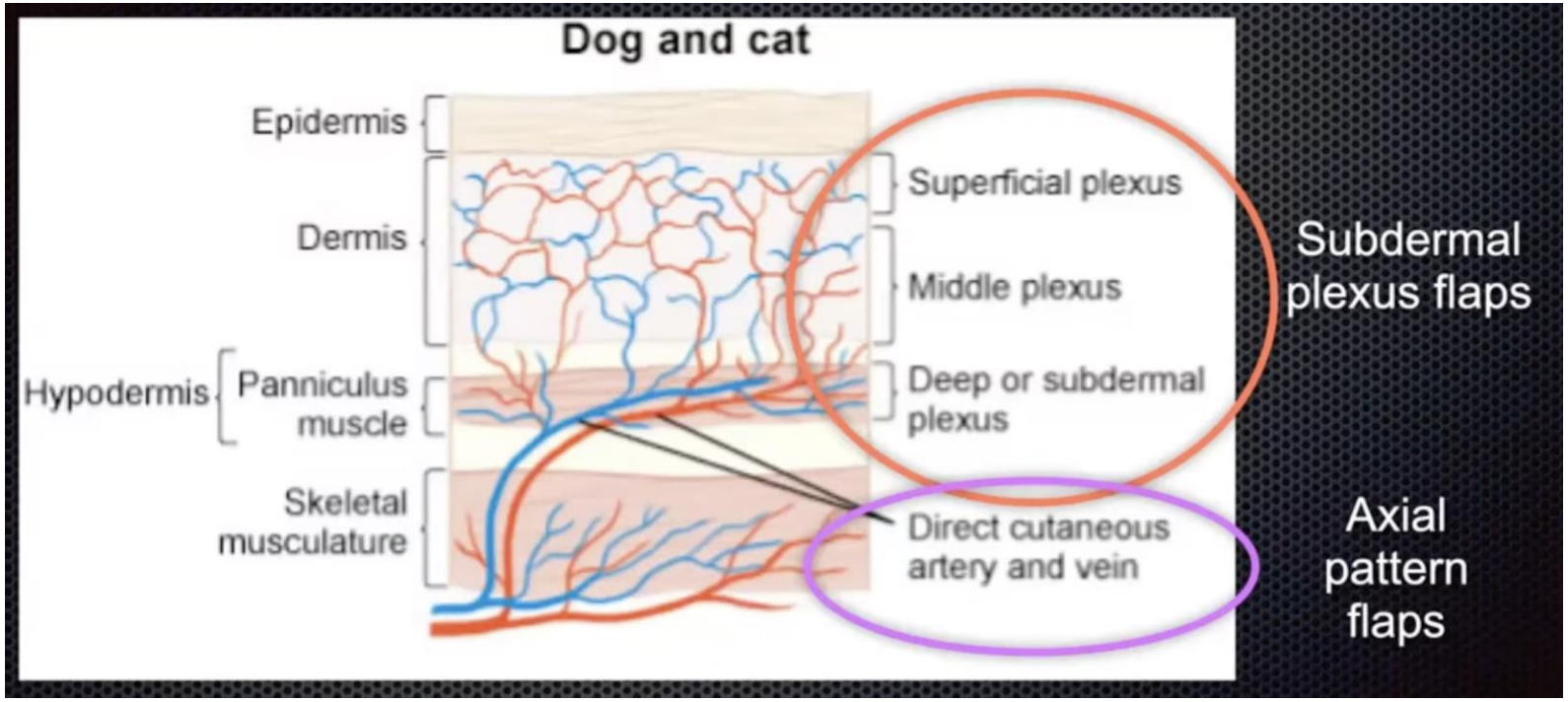
AXILLARY



INGUINAL







SUMMARY

- Wounds are dynamic & require a case-based approach
- When in doubt, open-wound management preferred
- Granulation tissue equals viability
- Appropriate drain usage reduces dead space & speeds healing
- Never be afraid to seek a second (or third) opinion

ANY QUESTIONS?

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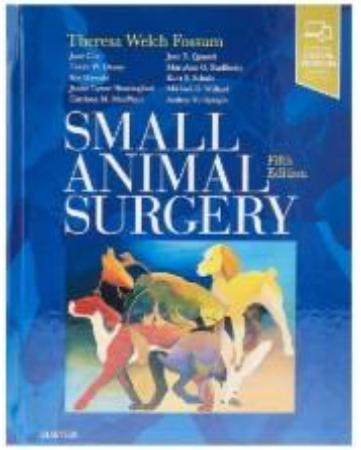
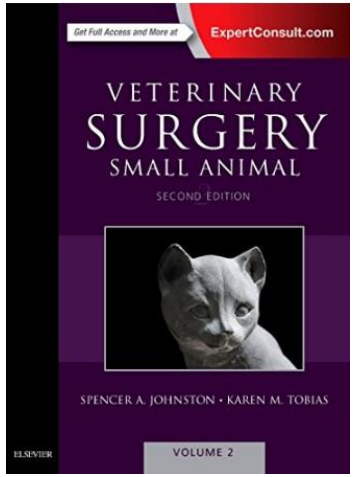


Fossum Ch. 15



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